Fruit & Veg Processing 2011

Catherine M.G.C. Renard

Fruit & Veg Processing

1st Euro-Mediterranean Symposium

18-21 April 2011 · Avignon, France

Organized by INRA Université d'Avignon et des Pays de Vaucluse

In partnership with ctcpa, PEFL, Arvalis

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Why such a specific Symposium?

Meeting the Food Science Community

Fruit and Vegetables are an essential part of the human diet, and they are increasingly consumed as processed products. The aim of this symposium is to identify recent advances and new knowledge on fruit and vegetable processing. It brings together academics, transfer organisations and R&D researchers of the F&V processing industries, around the same research topics.

- Nutritional qualities of processed products
- Consumer's perception & expectations
- Microbial and chemical safety and quality
- Innovative and sustainable processes

Building a new academic network

As the academic community working on these subjects in Europe and in the Mediterranean countries is not strongly structured and coordinated, we wish to take this opportunity to structure a network especially dedicated to scientific partnerships for fruit & vegetable processes. This specific session is held on Tuesday 19th April, 17:20.

Dedicating a special event to the stakeholders of the fruit & vegetable chain

This symposium is followed (21 April) by an event dedicated to R&D and innovation**.** With speakers coming from industries as well as transfer organisations, this is the opportunity to better understand the benefits from integrated partnerships on the way to innovation in fruit and vegetable processing. This session is held in French.

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A word of welcome

Dear Attendees,

On behalf of the members of the scientific and organisation board, it is my great pleasure to welcome you to the First Euro-Mediterranean Symposium for Fruit and Vegetable Processing.

I hope you will all find interesting results and challenging discussions as well as identify people with whom to work in the future.

I wish you all a fruitfull Symposium and a very pleasant stay in Avignon.

Catherine Renard

Deputy Head of the Unit for Safety and
Quality of Plant Products
Convener of the Symposium

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Scientific and Organisation Boards

Joint Research Unit for Safety and Quality of Plant Products, INRA/University of Avignon

INRA - National Institute for Agricultural Research
Centre PACA - Provence-Alpes-Côte d'Azur
Domaine Saint Paul,
Site Agroparc
84914 Avignon Cedex 09 – France
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Dr Catherine Renard is in charge of the scientific organization of the symposium
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More about Dr Catherine Renard:
https://colloque.inra.fr/var/fruitvegprocessing/storage/fckeditor/file/cr.pdf

Scientific Board

- **Catherine Bonazzi,** Joint Research Unit for Engineering and Food Processing, INRA AgroParisTech, Massy (France)
- **Pierre Brat**, Joint Research Unit for Qualisud, CIRAD, SUPAGRO, Universities of Montpellier 1 and 2 (France)
- **Frédéric Carlin,** Joint Research Unit for Safety and Quality of Plant Products, INRA, University of Avignon (France)
- **Olivier Dangles**, Joint Research Unit for Safety and Quality of Plant Products, INRA, University of Avignon (France)
- **Crépin Ella Missang**, Institut National Supérieur d'Agronomie et de Biotechnologies, Masuku Franceville (Gabon)
- **Jean-François Maingonnat**, Joint Research Unit for Safety and Quality of Plant Products, INRA, University of Avignon (France)
- **Martine Padilla**, Joint Research Unit for Markets, Organisations, Institutions & Stakeholders Strategies, INRA-CIRAD/CIHEAM/SupAgro Montpellier (France)
- **Witold Plocharski**, Research Institute of Pomology & Floriculture (RIPF) (Poland)
- **Catherine Renard**, Joint Research Unit for Safety and Quality of Plant Products, INRA, University of Avignon (France)
- **Jean-Paul Vincken**, Wageningen University (The Netherlands)

Organisation team

Catherine Renard, INRA
Jean-Marc Audergon, INRA
Stéphane Georgé, CTCPA
Barbara Gouble, INRA
Barbara Le Boursicaud, INRA
Catherine Lesveque, CRITT PACA
Sylvie Menassieu, INRA
Claire Mermet, PEIFL
Laurence Prévosto, INRA

Contact the organising team: fruit&vegprocessing@avignon.inra.fr

Grants

Organisers wished to promote the participation of young scientists from Mediterranean countries and new members of the UE, in order to support the building of a new academic network on Fruit & Vegetable processing.

The eligibility criteria were :

- **young scientists**, less than 35-years-old at the beginning of the symposium
- and residents in one of these countries:
  - a Mediterranean country, including Portugal but not France
  - new members of the European Union: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Czech Republic, Romania, Slovakia, Slovenia

The Scientific Committee would like to congratulate our grantees from Poland, Slovenia and Tunisia that will present their work (oral communications) :

- **Tina JERMAN, University of Nova Gorica, Slovenia**

The fate of olive fruit phenols during commercial olive oil processing: traditional press versus continuous 2- and 3- phase extraction system.

- **Monika MIESZCZAKOWSKA-FRA, Horticultural Institute, Skierniewice, Poland**

Cloudy or clear juices or nectars from plum, blackcurrant and apple fruits.

- **Nourhène MIHOUBI BOUDHRIOUA, Superior Institute of Biotechnology, Université de la Manouba, Tunisia**

Influence of air drying temperature on kinetics of colour, density, porosity, total phenols and ascorbic acid of pear.

- **Nouha M'HIRI, Institut National Agronomique de Tunis, Bizerte, Tunisia**

Construction of a database on retention factors for polyphenol content in cooked and processed foods based on literature surveys.

Organisers, Partners and Supporters

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Agence Nationale de la Recherche
The ANR is a research funding organization. It aims to bring more flexibility to the French research system, foster new dynamics and devise cutting edge-strategies for acquiring new knowledge. It also aims at enhancing the general level of competitiveness of both the French research system and the French economy.
http://www.agence-nationale-recherche.fr/

Pôle Européen d'Innovation Fruits&Légumes
is a competitiveness cluster. It strategy is to favourably position the fresh and processed fruit and vegetable sector, and to structure innovation by stakeholders across the sector
Cité de l'Alimentation
Technopole Agroparc
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84 916 Avignon Cedex 09, France

http://www.peifl.org/

ACTIA
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Centre Technique AgroAlimentaire
the "technical center for food preservation"
This technical center is one of the biggest french technical centers working with food industries.
It realises research and consulting for food professionals.
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http://www.ctcpa.org/

AgriFood Results FP7 European Project
The objective of AgriFood Results is to improve the communication of food research results.
Coordination: C. Cotillon, Actia
Contact: actia@actia-asso.eu

http://www.agrifoodresults.eu/

DREAM, FP7 European Project
The overall goal of DREAM is to develop realistic, physical and mathematical models to be used as standards that can be exploited across all major food categories to facilitate development of common approaches to risk assessment and nutritional quality for food research and industry.
Coordinator: Monique Axelos, INRA,
Head of the division for science and process engineering of agricultural products (CEPIA)
Contact: ap-cepia@nantes.inra.fr

http://dream.aaeuropae.org/

CRITT Agro-alimentaire PACA
The CRITT is a french Innovation and Technology Transfer Center dedicated to food processing industry.
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Programme

Monday 18th April

11:00 to 13h30 *Registration and Posters installation*

14:00	Welcome	RENARD Catherine	INRA-Université d'Avignon, France	

Nutritional qualities of processed products - DREAM FP7 Project session

Chairman: Peter Raspor, University of Ljubljana, Slovenia

14:10	Nutr-Invited conference	DEKKER Matthijs	WUR, Wageningen, The Netherlands	Modelling the health aspects of processed fruit and vegetables
14:50	Nutr-O01	JERMAN Tina*	University of Nova Gorica, Slovenia	The fate of olive fruit phenols during commercial olive oil processing: traditional press versus continuous 2- and 3- phase extraction system
15:10	Nutr-O02	CHRISTIAENS Stephanie	KU Leuven, Belgium	The impact of food processing on plant cell wall pectin: combining ex situ pectin characterisation methods with in situ pectin visualisation
15:30	Nutr-O03	DUFOUR Claire	INRA-Université d'Avignon, France	Stability of tomato micronutrients in systems modeling the industrial preparation of tomato-based products
15:50	Nutr-O04	OLIVEIRA Ana	Universidade Católica Portuguesa, Porto, Portugal	Phytochemical composition and antioxidant activity of peach as affected by freezing and pasteurization

16:10 *Coffee break*

16:10-17:30 - Posters session
Nutritional qualities of processed products
Consumer's perception and expectations

Innovative and sustainable processes

Chairman: Jarowlaw MARKOWSKI, Institute of Horticulture, Skierniewice, Poland

17:30	Inno-O01	MIESZCZAKOWSKA-FRAC Monika*	Horticultural Inst., Skierniewice, Poland	Cloudy or clear juices or nectars from plum, blackcurrant and apple fruits
17:50	Inno-O02	VINCKEN Jean-Paul	WUR, Wageningen, The Netherlands	Enhancing bioactivity of soy upon simultaneous malting and challenging by fungus
18:10	Inno-O04	TURK Mohammad F.	INRA-Université Technologique de Compiègne, France	Qualitative and sensorial attributes of PEF treated juices on an industrial scale
18:30	Inno-O05	DIETRICH Helmut	Research Center Geisenheim, Germany	Ways to increase the contents of bioactive substances in fruit juices, purees and fruit products: a general survey

18:50-20:00 Cocktail

Tuesday 19th April

Microbial and chemical safety and quality

Chairman: Frédéric Carlin, INRA, Avignon, France

9:00	Mic-Invited conference	NGUYEN-THE Christophe	INRA-Université d'Avignon, France	Biological hazards in processed fruits and vegetables - Risk factors and impact of processing techniques
9:40	Mic-O01	BRAT Pierre	CIRAD, SUPAGRO, Universités 1 et 2 de Montpellier, France	Acrylamide in model system and plantain based food during heating process: effect of pure phenolic compounds, precursors, and water activity
10:00	Mic-O02	PICOUET Pierre	IRTA, Girona, Spain	Cellulose-silver nanocomposites to control spoilage-related microflora in absorbent materials in trays of minimally processed fruit cuts
10:20	Mic-O03	NIEROP GROOT Masja	WUR, Wageningen The Netherlands	Fresh fruit juices: quality, safety and shelf life extension by Pulsed Electric Field treatment

10:40 Coffee break

Nutritional qualities of processed products

Chairman: Matthijs DEKKER, WUR, Wageningen, The Netherlands

11:10	Nutr-O05	M'HIRI Nouha*	INAT, Bizerte, Tunisia	Construction of a database on retention factors for polyphenol content in cooked and processed foods based on literature surveys
11:30	Nutr-O06	CARIS-VEYRAT Catherine	INRA-Université d'Avignon, France	Changes in the contents of carotenoids, phenolic compounds and vitamin C during technical processing and lyophilisation of red and yellow tomatoes
11:50	Nutr-O07	KNOCKAERT Griet	KU Leuven, Belgium	Is high pressure processing beneficial for the structural and health-related properties of carrots?

12:10 Lunch

13:15 – 14:30 – Posters session
Innovative and sustainable processes
Microbial and chemical safety and quality

Consumer's perception and expectations

Chairwoman: Siet SIJTSEMA, WUR, Wageningen, The Netherlands

14:30	Conso-Invited conference	RASPOR Peter	University of Ljubljana, Slovenia	Knowledge and skills dictate food safety behavioirs along food supply chain
15:10	Conso-O01	ESPINOSA MUNOZ Lucia Carolina	INRA-AgroParisTech, France	Rheological, structural and sensory properties of apple puree: Effect of processing.
15:30	Conso-O02	DONADINI Gianluca	Institute of Oenology and Food Engineering, Piacenza, Italy	Raw, boiled or oven baked: does the method of preparation influence the hedonic response of preschoolers to vegetables?

15:50 Coffee break

Chair woman: Elisabeth Guichard, INRA, Dijon, France

16:10	Conso-O03	SIJTSEMA Siet	WUR, Wageningen, The Netherlands	Consumers' perception of fruit and (products with) dried fruit
16:30	Conso-O04	MANDERSCHEID Jean-Claude	Université de Franche Comté, France	Consume five fruits and vegetables a day
16:50	Conso-O05	MORA Cristina	University of Parma, Italy	Attitude and behavior towards fruit consumption among young adults in Italy

17:20 Networking session
or departure to the Popes' Palace or Epicurium

20:15 *Gala dinner - Le Mireio (Meeting at the boat)*

Wednesday 20th April

Innovative and sustainable processes

Chairman: Jean-Paul Vincken, WUR, Wageningen, The Netherlands

9:00	Inno-Invited conference	HENDRICKX Marc	KU Leuven, Belgium	Pectin changes during thermal and high pressure thermal processing of plant based foods
9:40	Inno-O06	MOURET Jean-Roch	INRA, SUPAGRO, Université de Montpellier 2, France	Interest of on-line higher alcohol and ester determinations during winemaking fermentations
10:00	Inno-O07	DEROSSI Antonio	University of Foggia, Italy	The application of vacuum impregnation treatments in canned food and novel ready to eat products
10:20	Inno-O08	RHOMDANA Hedi	INRA-AgroParistech, France	Superheated steam drying of apple cubes in a drying kiln

10:40 *Coffee break*

Microbial and chemical safety and quality

Chairman: Pierre BRAT, CIRAD Montpellier, France

11:00	Mic-O04	BIRLOUEZ Inès	Spectralys, France	Front face fluorescence spectrom-etry a sensitive and rapid tool to assess quality parameters of fresh and processed vegetable: Example of organic carrot baby food
11:20	Mic-O05	LORRAIN Bénédicte	ISVV, Villenave d'Ornon, France	Effect of two vine cryptogamic diseases (*Botrytis cinerea* and Esca) on phenolic and sensory quality of Bordeaux grapes and their derived wines.
11:40	Mic-O06	NARVÁEZ-CUENCA Carlos-Eduardo	WUR, Wageningen, The Netherlands	New insights into the anti-browning effect of and old agent: Formation of SO3-chlorogenic acid and other SO3-flavonoids during potato processing
12:00	Mic-O07	WEGKAMP Arno	NIZO food research, Ede, The Netherlands	Fermentation of fruit and vegetables by lactic acid bacteria as preservation strategy of making functional foods

12:20 *Lunch*

Posters removal

Nutritional qualities of processed products

Chairwoman: Catherine CARIS, INRA, Avignon, France

14:00	Nutr-O08	MIHOUBI BOUDHRIOUA Nourhène*	Université de la Manouba, Tunisie	Influence of air drying temperature on kinetics of colour, density, porosity, total phenols and ascorbic acid of pear
14:20	Nutr-O09	LEMMENS Lien	KU Leuven, Belgique	Understanding the importance of thermal and mechanical processing of carrots for the b-carotene in vitro bioaccessibility
14:40	Nutr-O10	MORALES DE LA PENA Mariana	University of Lleida, Espagna	Phenolic composition of a fruit juice-soymilk beverage as affected by high intensity pulsed eletric fields or thermal treatments during storage
15:00	Nutr-O11	OLIVIERO Teresa	WUR, Wageningen, The Netherlands	Effect of moisture content/water activity on thermal degradation of glucosinolates in broccoli (*Brassica oleracea* var. italica)
15:20	Nutr-O12	SY Charlotte	INRA-Université d'Avignon, Université de la Méditerranée, France	Physico-chemical and nutritional evaluation of novel bacterial carotenoids for their potential as natural additives and functional ingredients in processed food

15:40 *Poster prizes*
Closure and thanks
Coffee and tea

* Recipient of the “Fruit&Veg Processing” travel grant

Thursday 21th April

(Session uniquement en français)

Innover dans les filières de transformation des fruits et légumes

Animation : Jean Harzig, Rédacteur en chef de la revue Vegetable

9h30-10h00 : Ouverture
Mr Gilles Bariteau, Président du Centre INRA d'Avignon
Mr Yves Baron de Noyer, Président du PEIFL
Mr Emmanuel Ethis, Président de l'Université d'Avignon et des Pays de Vaucluse

10h00-10h50 Qualités nutritionnelles des produits transformés

Catherine Renard, Unité Mixte INRA-Université d'Avignon Sécurité et Qualité des Produits d'Origine Végétale
AMITOM : Sophie COLVINE, Secrétaire Générale : La qualité nutritionnelle des dérivés de la tomate - outil de promotion ?
CTCPA : Stéphane GEORGE : Comment prévoir l'impact des procédés sur des produits à base de fruits ?

10h50-11h10 : Pause café

11h10-12h00 : Perceptions et attentes du consommateur

Fatiha Fort, Unité mixte Marchés, organisations, institutions et stratégies d'acteurs, Supagro Montpellier, Inra, CIHEAM, Cirad, IRD
FOULON SOPAGLY: Jean-Louis ESCUDIER, INRA Pech Rouge, Aurélie SIVRY, responsable de projet : Une nouvelle filière « jus de raisin »
BONDUELLE : Laurence DEPEZAY, Service Nutrition : Consommation de légumes par les enfants: les déterminants du choix alimentaire en restauration

12h00-12h50 : Maîtrise de la qualité sanitaire et microbiologique des fruits et légumes frais ou transformés

Frédéric Carlin, Unité Mixte INRA-Université d'Avignon Sécurité et Qualité des Produits d'Origine Végétale
PISANI : Valérie TREPIER, Responsable Qualité : Gestion du risque aflatoxine dans les fruits secs
Agro-Hall : Adrien AGOULON, Directeur : les utilisations potentielles de la lumière pulsée.

12h50-14h15 : Repas

14h15-15h05 : Procédés innovants et durables

Gilles Trystram, Unité mixte AgroParisTech-Cnam-Inra, Ingénierie, Procédés, Aliments
HYPERBARIC : Catherine TONELLO : Hautes-pressions appliquées aux fruits et légumes emballés
FRUTAROM : Alain ETIEVANT, Innovation Food Systems Manager : Pasteurisation douce des Préparations de Fruits

15h05 – 16h15 : Table ronde : Entreprendre et financer une démarche d'innovation

Plate-forme européenne Food for Life : Christophe Cotillon
OSEO : Carole Loget
ANR : Elisabeth Guichard : responsable du programme "Systèmes alimentaires durables" au sein du département Ecosystèmes et Développement Durable.
PEIFL : Yves Bayon de Noyer, Président du PEIFL
Région PACA - Michèle Alcaraz, Valorisation -Transfert de technologie, Sandrine Cosserat, service d'aide aux entreprises

Oral Communications

❖

I/Consumer's perception and expectations

N° Conso-IC - Knowledge and skills dictate food safety behaviors along food supply chain

Peter Raspor

Chair of Biotechnology, Department of Food Science and Technology, Biotechnical Faculty, University of Ljubljana, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia.

Knowledge and skills of food safety among food business operators and among consumers has various dimensions. Due to a number of food-related incidents and reported outbreaks worldwide, consumer confidence has begun to vacillate. The objective of evaluation was to determine food safety knowledge and practices in production but also consumer's attitude to food safety during purchase, transportation and storage of food, as well as food handling practices at home. The studies in last years highlighted gaps in food safety knowledge and some critical safety violations regarding food handling at home. Changing consumer needs as a result of major macro-economic changes occurred in developed countries led to a rapid growth of novel nutritional approaches, i.e. convenience foods. Research and development (R&D) is constantly facing challenges to develop food that would be convenient to serve and eat, easy to prepare and digest, nutritious to general public and to specific groups and safe to enjoy. In food supply chain it is important to build as much as possible expertise to understand foods from various aspects as is treated with different professions. Communicating about risk and hazard should be an interactive exchange of information about risk and non-risk factors pertaining to risk management. We have to address it during production but also during distribution and in household practice. Education programs can enhance knowledge, enabling people to make decisions based upon personal values and a more accurate perception of the technology.

References

Raspor P. Trends food sci. technol. 2008, 19, 405-412
Raspor P., Jevšnik. Crit. rev. food sci. nutr. 2008, 48(3), 276-292
Jevšnik M., Hlebec V., Raspor P., Acta aliment. (Bp.), 2008, 37(4), 437-448
Raspor P., Acta aliment. (Bp.), 2009, 38(1), 2-5
Ambrožič M., Jevšnik M., Raspor P, Inconsistent Terminology in food safety field JNFR, 2010, 49(4), 186-194

Keywords
consumers, food safety, HACCP, good housekeeping practice, good nutritional practice, good life practice

N° Conso-O01 - Rheological, structural and sensory properties of apple puree: Effect of processing

Lucia C. Espinosa Munoz[1], Ronan Symoneaux[2], Catherine M.G.C. Renard[3], Nicolas Biau[4], Gérard Cuvelier[1]

[1]*AgroParisTech, UMR1145 Ingénierie Procédés Aliments, F-91300 Massy.*
INRA, UMR1145 Ingénierie Procédés Aliments, F-91300 Massy.
[2]*Laboratoire GRAPPE- ESA. 55 rue Rabelais, 49007 Angers France.*
[3]*INRA, UMR A 408 Sécurité et Qualité des Produits d'Origine Végétale. Domaine St Paul, 84914 Avignon France.*
[4]*Conserves France. Domaine du Grand Frigolet, 13150 Tarascon France.*

Background and motivations of the work: Fruit purees are considered as concentrated suspensions where solid insoluble particles (pulp) or cell wall clusters are dispersed into an aqueous solution (serum) of sugars, organic acids and pectic substances[1]. Particles are hydrated and are in equilibrium with the continuous medium. The properties of apple puree depends on many factors, particularly those related to the transformation process (heating and mechanical treatments), and the structural origin of these properties remains poorly understood and difficult to master.
The aims of this work are to better understand the relationship between the structural, rheological, and sensory parameters of apple puree, and to study the impact of manufacturing process on these parameters, mainly the texture.
Material and methods: Purées were industrially processed using the same batch and apple variety (Golden Delicious). Fruits were cooked and refined with a sieve opening of 1.2mm.
In order to get purees with different structural properties pulp content, particle size and the viscosity of the serum (with the addition of pectin) were modified. So a separation-reconstitution strategy coupled to a grinding step was established. Two experimental designs were setup in order to study the impact of pulp content, particle size and serum viscosity, which allowed the selection of 18 different products.
The rheological behaviour of purees (steady and dynamic shear) was determined using a rotational viscosimeter at 20°C. Structural properties were characterized by particle size distribution, pulp content and serum viscosity. Purees were also subjected to a sensory assessment, where a panel consisting of 14 people (3 men and 11 woman, aged between 25 and 35 years old) realized the sensory descriptive profile.
Results: The rheological characteristics showed that the fruit purees studied have a non-newtonian behaviour (pseudoplastic) and that the apparent viscosity, G' (elastic modulus), and yield stress are mainly influenced by the pulp content, particle size and serum viscosity. These parameters increase as the pulp content and particle size increase.
A PCA performed from the sensory analysis made it possible to position the different purees and describing them principally by two axes: consistency and granulometry. The thickening of the continuous phase increases the consistency perception and reduces the granular perception.
Conclusion: Particle size, pulp content and serum viscosity are the key structural parameters to control the texture of apple puree. The relation to sensory properties should enable to pilot these properties allowing the creation of products with mastered textures.
This work was supported by the Agence Nationale de la Recherche within Project ANR-07-PNRA-030 TEMPANTIOX "New processes for production of fruit derived products with optimised organoleptic and nutritional qualities".

References
Qiu C.G. and Rao M.A. 1988. Journal of Food Science. 53(4)

Keywords
apple puree, texture, rheology, sensory perception

N° Conso-O02 - Raw, boiled or oven baked: does the method of preparation influence the hedonic response of preschoolers to vegetables?

Gianluca Donadini[1], Maria Daria Fumi[1], Sebastiano Porretta[2]

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[2]*Experimental Station for the Food Preserving Industry, Parma, Italy.*

Aim of this study was to assess how different methods of preparation can influence the hedonic acceptability of preschool children to vegetables. Children tasted and scored for liking on a 5-point non gender facial scale three preparation methods for carrots, tomatoes, zucchinis, spinaches, fennels and Catalogna chicory: raw, boiled and oven baked topped with mozzarella cheese. Factorial Anova revealed that liking of dishes was significantly ($p < 0.05$) influenced by the method of preparation, type of vegetable and children. The effect of the method of preparation was significantly ($p = 0.0001$) modulated by the type of vegetable considered and by a wide heterogeneity in children response to vegetables.
Further, neophobia and familiarity played a significant role on liking for the dishes.
These findings revealed that liking of vegetables was a complex behavioral pattern which depends on a number of interacting factors.

Keywords
vegetable liking, cooking methods, drivers of liking, preschoolers

N° Conso-O03 - Consumers' Perceptions of Fruits and (products with) Dried Fruit: Health and convenience

Siet J. Sijtsema[1], Katarzyna Jesionkowska[2], Ronan Symoneaux[3], Dorota Konopacka[2], Harriëtte Snoek[1]

[1]*LEI Wageningen University and Research centre, Wageningen, The Netherlands*
[2]*Research Institute of Pomology and Floriculture. Skierniewice, Poland*
[3]*Groupe ESA - Labo GRAPPE, Angers, France*

Dried fruit consumption has not received much research attention to date, though the opportunity exists to develop innovations to increase fruit consumption. Especially, with regard to healthiness and convenience, which are important factors influencing food choice of consumers nowadays, dried fruit seems promising. Therefore, the aim of this study is to compare health- and convenience-related issues, as well as consumer feelings, regarding dried fruit (DF), products with dried fruit (PDF) and fresh fruit (FF). In addition comparison is made between segments of consumers with a different orientation about health consciousness and convenience.
An on-line questionnaire was, completed by 1,092 respondents (Polish, French and Dutch), which measured consumers' perceptions of health and convenience as well as feelings about the consumption of FF (apples and, plums), DF (raisins, dates, apricot, etc.) and PDF (cereals, biscuits, etc.).
Generally, fresh fruit was perceived to be healthier and less convenient than dried fruit or products with dried fruit. Consumers also reported more positive feelings about the consumption of fresh fruit compared to dried fruit (products). The more that the respondents were willing to sacrifice for their health the more positive they felt about the health aspects of both fresh and dried fruit (products), as well as most perceptions of convenience regarding both fresh and dried fruits. Health occupation was unrelated to most convenience perceptions and associated with lower scores on several health perceptions. Convenience orientation of consumers was not consistently correlated to health and convenience perception of either fresh or dried fruit (products).
Compared to fresh fruit the health perception of dried fruit is more complicated which has to be taken into consideration when communicating with consumers. It means that although consumers seem to be aware of the convenience of dried fruit the health information commonly used and easily recognized by consumers in reference to fresh fruit (e.g. "fruit is healthy") needs to be adopted to the case of dried fruit (products).
This study clearly shows that consumers, except the ones that score high on health sacrifice, seem to be harder to convince with regard to their perception of health and convenience of fruit and dried fruit. Looking for effective procedures that can influence consumers' positive attitudes towards this kind of products a case specific approach should be considered in which convenience and health issue aspects could strengthen each other in a consumer oriented approach of dried fruit development.

Keywords
consumer, perception, fruit, dried fruit, health, convenience

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N° Conso-O04 - Consume five fruits and vegetables a day

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Context and rationale: We developed, implanted and estimated an intervention aiming at the consumption of at least five portions of fruits and vegetables a day at persons intending to adopt this behavior but not making it.
We realized a systematic review of the literature. This one allowed to show the heterogeneousness of the results of the undertaken actions and their low efficiency generally. It also allowed to identify the determiners of the consumption of fruits and vegetables. The most frequent determiners were the habit, the intention, the feeling of self efficacy and the knowledge. The regulation of the behavior also appeared as a determiner but was tested only in one study.
On the basis of these results and the high degree of motivation of the aimed population, the feeling of self efficacy as well as the action planning and the action management were the main foundations of our intervention.
Materials and Methods: A sample of 319 participants from 20 to 65 years old was randomly distributed in four groups:
1) An intervention based on the action planning and the action management;
2) An intervention based on the development of the feeling self efficacy;
3) An intervention combining these two approaches;
4) A control group.
163 participants sent back questionnaires before, at once after the intervention and in three months of follow-up.
Results : In three months of follow-up, by comparison with the control group, the consumption of fruits and vegetables increased in a significant way in the groups action planning and combined interventions (respectively, 1.5 and 1.9 portion a day). Most of the psychosocial variables significantly increased, with the exception of the feeling of self efficacy associated with the consumption of vegetables. Furthermore, the change of consumption of fruits and vegetables seemed to pass by the change of intention to consume fruits and the change in the action planning to consume vegetables.
Conclusion: The interventions based on the action planning and the action management seemed effective to increase the consumption of fruits and vegetables, that they are associated or not with the feeling of self efficacy. The future interventions should privilege this approach to favor the passage from the intention to the action to consume fruits and vegetables. It brings to light the interest of the psychosocial and psycho-pedagogical approaches. But it seems so indispensable, on one hand, to give actors of ground of the rather simple psycho-pedagogical tools to be accessible, on the other hand to train these actors of ground in the use of these tools. The first stage consists in publishing guides worked out for the dietitians.

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Keywords
consumers, dietitians

N° Conso-O05 - Attitude and behavior towards fruit consumption among young adults in Italy

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This paper analyses young consumers' attitude and behaviour towards fruit consumption. The behavioural determinants of fruit intake, in particular apricot and cherries, has been studied in order to gain better understanding on this trend among young consumers.
The factors affecting young adults' fruit and vegetable consumption have been reviewed through the literature. These include sensory appeal, familiarity and habit, social interactions, costs, availability, time constraints, personal motivation, health, media and advertising.
A survey, preceded by a focus group, has been performed aiming at explaining fruit consumptions using the theory of planned behaviour (TPB) (Ajzen, 1991). This theory suggests that the likelihood of a particular behaviour can be predicted by individual's intention to perform that behaviour, which in turn is determined by personal attitudes, subjective norms and perceptions of control. The relative importance of these factors was evaluated, as well as the habit strength. The habit construct, although not included in the traditional TPB framework, has been investigated in many food choice contexts, including fruit and vegetables purchase (e.g. see de Bruijn, 2010).
A number of 800 University's students (aged between 18 an 25 years) have been interviewed during June and July 2010 in Parma (Northern Italy); the collected data have been analysed with structural equation modelling (SEM) technique (Byrne, 2010). Finally, a critical review of the current market supply allowed to evaluate its consistence with the identified consumers' attitude and preferences.
The results suggest what are the relevant messages to be stressed in health communication programmes aiming to improve fruit consumption; at the same time the multiple-group analysis performed with structural equation modelling helps to target segments of young population (Byrne, 2010). The consistence of the existing market supply and current marketing-mix strategies of the main Italian retailers and fruit producers (cooperatives or producers' association) is critically discussed on the basis of these findings.

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Keywords
fruit consumption, theory of planned behavior, structural equation modeling, attitude, habits

2| Innovative and sustainable processes

N° Inno-IC - Pectin changes during thermal and high pressure thermal processing of plant based foods

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The texture and rheology of plant based food systems is largely influenced by pectin changes taking place during postharvest and processing steps used in the transformation of raw plant based materials into food products. Pectin changes are caused by biochemical (enzyme catalyzed) and chemical reactions influenced by intrinsic food properties and extrinsic processing variables. The major reactions include (i) the demetoxylation of the pectin homogalacturonan part (by pectin methyl esterase or saponification) leading to different degrees and patterns of metoxylation; (ii) the depolymerisation by (depending on the reaction conditions) polygalacturonase or acid hydrolysis of (partially) demetoxylated pectin or by beta-elimination reactions on highly metoxylated pectin at increased temperatures. These reactions and sequences thereof lead to pectin with different molecular structures influencing the textural and rheological properties of tissue based systems and plant derived food products.
This contribution will deliver an in depth discussion on the different reaction steps involved and how they are influenced by conventional thermal processes and emerging high pressure (thermal) based processed. The discussion includes the influence of temperature and/or pressure on (i) enzyme stability and activity (in particular pectin methyl esterases and polygalacturonases) including the inhibition of PME by its proteinaceous inhibitor (PMEI), chemical demetoxylation, depolymerisation and beta-elimination.
The insights in these reactions are subsequently translated in principles that can be used in fruit and vegetable processing to enhance desired texture changes or retentions in unit operations such as freezing, thermal processing and high pressure processing of plant based food systems.
Parts of the data that will be presented have recently been obtained in the context of NovelQ. NovelQ represents an integrated interdisciplinary research, demonstration and dissemination project designed to overcome bottlenecks inhibiting the introduction of novel technologies in the European food industry.

N° Inno-O01 - Cloudy or clear juices or nectars from plum, blackcurrant and apple fruits

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Context and rationale: Fruits contain various bioactive compounds having beneficial properties for human health. To increase consumption of some fruits in off season it is important to produce more attractive than currently available processed products. The promising products are cloudy juices containing more antioxidants and fibre than clear juices. Apple cloudy juices are usually produced without enzymation and clarification stages. This is not possible for berry and stone fruits which contain a large amount of pectic substances. Considering the existing problems technology of cloudy juice from blackcurrant and plum were optimised in respect to enzymes used, their doses and treatment time. Enzymation was also tried in cloudy apple juice production, considering semi-concentrates production.
Materials and methods: The juices or nectars were produced from: blackcurrant – 'Tisel', 'Tiben' and 'Ben Lomond' cvs., plum – 'Promis', 'Najbolia' and 'Dabrowicka' and apple – 'Shampion' and 'Idared'. Preliminary juice production was made on laboratory scale using special attachment to Instron texture press. Different technological parameters were investigated: specific enzymes (pectin lyase, polygalacturonase and macerating mixture), enzyme doses, enzymation times. The best combinations for cloudy and clear juices production were used at the second stage conducted on semi-technological scale using a rack and cloth press. These were: for cloudy juices production macerating mixture (Rohapect PTE and Rohament PL 2:1) at a dose of 200 g/t for 1 hour at 50 ^{o}C; for clear juices polygalacturonase at a dose 200 g/t at 50 ^{o}C for 1 hour (plum) or 2 hours (blackcurrant). In plum juice production ascorbic acid (500 mg/kg) was added.
Results: Macerating combination allowed to obtain cloudy blackcurrant juice with the turbidity of at least 230 NTU and yield 58÷59%. Extension of treatment time did not increase juice yield. Respective values for plum juices were 293 NTU and 95÷96%. Use of polygalacturonase or pectin lyase alone did not give satisfactory turbidity. In production of clear juices increase of enzymation time of blackcurrant pulp increased yield up to 67% after 1 hour and 74% after 4 hours.
Blackcurrant cloudy nectars produced were characterized by turbidity about 93÷113 NTU and stability of turbidity 40÷56%, higher content of phenolic compounds (8÷15%) and higher antioxidant activity (19÷35%) compared to clear nectars.
The highest turbidity had plum juice from 'Promis' – 555 NTU with stability ~70%. The cloudy plum juice contains about 20÷32% more phenolic compounds than clear juice. Addition of ascorbic acid had protective effect on anthocyanins during processing (an increase about 51÷60%), however, negatively influenced the stability of anthocyanins during products storage.
Yield of cloudy apple juice produced using enzyme treatment was higher by 10% and it also contained more phenolics than the control. The turbidities of both kind of cloudy apple juices were similar but the stability of turbidity of juice produced with mash enzymation was lower (only about 17÷20%) compared to 20-46% cloudy juice produced without mash enzymation.
Conclusion: Applying proper technology including enzyme treatment allows production of cloudy plum juice and cloudy blackcurrant nectar characterized by the substantial turbidity and higher antioxidant contents than clear ones. Use of enzyme in cloudy apple juice production is justified considering juice yield and polyphenolics content, however effects were negative in respect to cloudiness stability.

Keywords
cloudy juice, clear juice, apple, plum blackcurrant

N° Inno-O02 - Enhancing bioactivity of soy upon simultaneous malting and challenging by fungus

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Background and motivation: It is well-known that soybeans contain bioactive compounds, which are associated with relieving hormone-related discomforts and diseases. These isoflavones, a sub-class of isoflavonoids, mediate their effect by binding to the human estrogen receptors (ER-a and ER-b). Less known is the possibility of altering the isoflavonoid profile of soybeans by germinating the beans under stress, and therewith enhancing the bioactive potential of the material. In the present study, soybeans were germinated at kilogram-scale, using malting technology commonly employed in the brewing industry. The developing seedlings were stressed by inoculating with a food-grade fungus, *Rhizopus microsporus*. The isoflavonoid composition was quantitatively monitored in time, and correlated to the increase in estrogenicity of the growing seedlings.
Materials and Methods: The combined 'malting / challenging by *Rhizopus* treatment', further referred to as the induction process, was performed in a Joe White micromalting system unit 90-102 (Perth, Australia) [1]. Samples, taken at different time points (0-10 days) in this process, were extracted and analyzed by RP-UHPLC-DAD-ESI-MS^n [2]. The response of ER-a and ER-b towards the various extracts was determined using the yeast-based estrogen receptor bioassay described by Bovee *et al.* [3].
Results and Discussion: During induction, a gradual increase in total isoflavonoid content was observed, with a more than 10-fold higher content after 10 days. This showed that isoflavonoids were *de novo* synthesized during this process. The isoflavonoid composition changed dramatically from mixtures only comprising the common isoflavones (daidzein, genistein, glycitein, their glucosides, and their malonyl-glucosides) to mixtures comprising predominantly pterocarpans (glycinol, two glyceollidins, and various glyceollins) and smaller amounts of coumestans (*e.g.* coumestrol) and isoflavones. Besides the introduction of a D-ring into the molecules (as in pterocarpans and coumestans), also prenylation of all three subclasses of isoflavonoids was a common modification during the induction process. After 10 days, half of the isoflavonoids contained a prenyl group, either as a chain, or a pyran ring, or a furan ring. The changes in isoflavonoid composition resulted in an increased estrogenic activity of the soy seedling extracts, with both ER-a and ER-b. Besides induction of a number of strong ER-a and ER-b agonists, there is evidence that also antagonistic isoflavonoids were formed.
Conclusion: Malting of soybean seeds in the presence of a food-grade fungus yielded a completely different spectrum of isoflavonoids, with a much higher bioactivity towards the estrogen receptor. This, together with the over 10-fold increase in potential bioactives, offers promising perspectives for producing more, new, and higher potency nutraceuticals by malting under stressed conditions.

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Keywords
isoflavonoids, prenylation, Glycine max, Rhizopus microspores, estrogenicity

N° Inno-O04 - Qualitative and sensorial attributes of PEF treated juices on an industrial scale

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Introduction: Recent indicators showed a positive impact toward highly processed products such as fruit juices containing high amounts of compounds with a nutritional added value such as antioxidants. Fruit juices is one of the most consumed beverage in Europe (22,9L/year/habitant). More than 50% of the consumers are attracted by their nutritional values. Pulsed electric field is a low energy technology that improves juice extraction up to 30% on a laboratory scale and increase polyphenols content in juices up to 40% on pilot plant scale. These compounds are responsible of the color, the astringency and contribute to the nutritional value of the juice. However, there are no publications regarding industrial scale PEF for juice processing. Therefore, this study focused on the effects of apple mash treatments with PEF on yield, phenolic composition color and sensorial attributes of juice.
Methodology: A continuous PEF treatment module was placed upriver to a belt press. Apple mash was pumped in the module at 4500 $kg.h^{-1}$ for 2.5 hours. PEF treatment was performed at 650 V/cm and 100 µs of pulse duration at 200 Hz (Energy consumption = 12,1 kJ/kg). A second lot, referred as control, was pressed without electric treatment. Dry matter, polyphenol content, juice color and an expert panel sensory analysis were performed on both control and treated juices.
Results and discussion: Juice yield of control mash was 68.5 % and increased by 5.1 % when mash was treated by PEF. Electric treatment of mash increased the dry matter of pomace from 19.8 ± 0.2 % (control) to 22.5 ± 0.3 %. Total polyphenol concentration in the samples of juice, preserved against oxidation, significantly increased from 288 mg/L to 313 mg/L when mash was treated by PEF. While, unpreserved juices showed insignificant differences of polyphenols concentration: 63 mg/L for untreated *vs.* 65 mg/L for treated samples. Mean while, juice color in the L*a*b* system showed a significant difference in the yellowness axis between control (b*=17,9) and treated (b*=26,8) samples of unpreserved juices. More appreciated than the control, 12 judges of the expert sensory analysis panel have detected significant differences regarding two qualitative attributes of odor (overall intensity odor, typical apple odor) and taste (overall taste intensity and typical taste of apple) for juices from treated mash.
Conclusion: This technology has proved its efficiency on an industrial scale by increasing the quantity of juices and improving its sensorial quality with a low cost of energy. This technology contributes to sustainable development by reducing energy consumption during the drying step of pomace.

Keywords
apple juice, pulsed electric fields, color, sensorial analysis

N° Inno-O05 - Ways to increase the contents of bioactive substances in fruit juices, purees and fruit products: a general survey

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Background: Fruits and vegetables contain a huge number of secondary plant metabolites. It is known that these bioactive substances are significantly influenced by processing and storage conditions resulting in severe losses. In this survey, different technical measures of increasing their concentrations and minimizing their losses are discussed based on processing studies.
Materials and Methods: The right selection of fruit varieties plays a major role in the development of fruit juices and fruit juice-related products. The next step is the evaluation of appropriate and inappropriate techniques of fruit and vegetable processing. Fruit juice and puree processing techniques, mash treatment, new press systems, the influence of clarification and concentration were compared in regard to the preservation of valuable bioactive substances.
Results: The importance of selecting the right varieties is shown for red grapes, anthocyanin-rich berries, apples and red-fleshed apples resulting in red apple juices. A market survey of apple juices from cider apple and table apple varieties reveals that the genetic pool of old apple varieties must be preserved for future breeding programs. A new press system, Vaculiq, is presented which was tested for the production of cloudy apple juices. The apple mash is dejuiced with a spiral coil under vacuum. It is shown that the juice yield is nearly comparable with classical pressing, but the preservation of polyphenols and vitamin C in the juice is significantly better. After addition of 200 mg/kg ascorbic acid into the mash, the cloudy apple juice contained 169 mg/L after Vaculiq dejuicing and 81 mg/L after dejuicing with a horizontal press. This leads also to higher polyphenols and antioxidant capacities by a factor of 2.
The clarification of fruit juices by fining procedures and filtration reduces the concentrations of polyphenols between 10-30%, in some cases also up to >90%. The results with gelatin/silica sol fining, PVPP, adsorber resins and activated charcoal/Bentonite are compared.
Another way to increase the contents of processed fruits is the production of purees which are part of so-called smoothies. A processing study of cloudy juices and corresponding purees made from blackberries and strawberries revealed that also purees can suffer from severe losses of polyphenols, anthocyanins and Vitamin C. Nevertheless, the addition of puree increases the concentrations of polyphenols, of trace elements, and, in particular, of dietary fibers in the smoothies. Based on a survey of commercial products, one portion of smoothies covers the daily consumption of dietary fibers in the range of 10-15%.
Conclusion: New techniques are available for a better preservation of bioactive substances, but some treatments are counterproductive. Unavoidable losses during processing can be partly compensated by intelligent combination of fruits leading a good acceptance by consumers. Special convenience products were also developed for children who do not accomplish the recommended daily intake of fruits and vegetables.

Keywords
varieties, fruit juice technology, puree, processing studies, pressing, product development

N° Inno-O06 - Interest of on-line higher alcohol and ester determinations during winemaking fermentations

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Context and rationale: On-line monitoring is a promising way to improve fermentation control in winemaking. Some actual devices, based on the CO_2 measurement, permit to control the main reaction of the process. The next challenge will be to act directly on wine characteristics. This will necessitate the use of additional sensors to measure 'quality markers'. We developed an on-line gas chromatography device for the frequent measurement (once hourly) of the major aromatic compounds synthesised as secondary products of yeast metabolism: principally higher alcohols and esters. We also studied the partition of the volatiles between the gas and the liquid phases. The high frequency measurement enabled us to access to a very precise description of their synthesis and therefore to a better understanding of the metabolism and to new prospects in modelling and control of fermentation.
Materials and Methods: Fermentations were run in 100 l tanks. The concentration in volatile compounds in the off-gas was monitored using an on-line Gas chromatography. The gas was pumped from the tank headspace through a heated transfer line. Carbon compounds were concentrated in a cold trap, injected into a GC column. 16 volatile carbon compounds (higher alcohols, esters and acetaldehyde) were monitored. The rates of production of volatile compounds in the gas phase were calculated using a sliding window polynomial smoothing. The equations of the mathematical model describing the gas/liquid ratio were implemented in a program written under Matlab. Off-line measurements in the liquid phase were performed by HPLC for the main carbon compounds and the amino acids and by GC for the volatile compounds.
Results: For the first time, the kinetics of synthesis of the main higher alcohols and esters during winemaking fermentations were precisely described and the rates and specific rates of production (proportional to the metabolic fluxes) of the different metabolites were calculated. Constant yields of acetate ester production both from the sugar and the corresponding higher alcohols were observed. The evolution of the specific production rates of the higher alcohols was directly correlated with the nitrogen metabolism. Propanol proved to be a compound of particular interest as metabolic marker of nitrogen assimilation.
A physico-chemical study showed that the ratio between the gas and liquid concentrations of the volatile compounds only depends on the temperature and matrix composition and not on the CO_2 production rate. This was demonstrated using an original approach based on constant rate fermentations. A mathematical model was developed to describe this ratio. Based on this model, it was possible to establish gas/liquid balances throughout fermentation. For isobutanol, the losses in the gas were negligible but for esters, losses represented up to 60% of the total production.
Conclusion: The present work opens the way to innovative approaches to describe, understand and possibly model and control the dynamics of synthesis of the volatile compounds. Furthermore, it points out the necessity of considering the losses of volatiles in the exhaust gas (i) to access to the total production (metabolic interest) and (ii) to define control strategies lowering these losses (technological interest).

Keywords
winemaking fermentation, on-line monitoring, higher alcohols, esters, gas/liquid transfer, dynamic modelling

N° Inno-O07 - The application of vacuum impregnation treatments in canned food and novel ready to eat products

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Background: In the last years the importance of microscopic structure of vegetables as one of the most important variables during food processing has been widely recognized in literature (Aguilera, 2005; Mebatsion, 2005). In this way vacuum osmotic dehydration was proposed as method to improve the dehydration rate taking advantage from the capillaries of vegetable tissues. Starting to this application, a more general series of treatments named as vacuum impregnation (VI) have been proposed (Zhao and Xie, 2004). Nevertheless, few papers on the use of VI in canned food industry or to develop novel fruit products are available. Here, the results of the application of VI to increase the rate of pH reduction during the canned food processing and as method to change the sensorial and functional properties of apples slices were reported.
Material and Methods: Vegetables such as peppers, zucchini, carrots, mushrooms, eggplants and apples were used as raw materials. Vacuum acidification (VA) and pulsed vacuum acidification (PVA) treatments were studied modulating three variables: vacuum pressure (50-400 mbar), vacuum period (t_1) (1-5 minutes) and deformation-relaxation time (t2) (Derossi et al., 2010a). In all cases a lactic acid solution at pH ~ 3.0 was used. After each treatment, physical-chemical analyses such as porosity, total mass variation, pH values, firmness as well as the visual aspect of samples were performed. Also, structure changes were analyzed by modeling the changes of liquid, gas and solid matrix phases (Barat, Fito and Chiralt, 2001). In all cases the kinetic of pH reduction was studied by using a "Peleg type model" (Derossi et al., 2010b). Apples slices were submitted to vacuum impregnation in different operative conditions by using some fruit juices. Color changes were measured by image analysis; antioxidant capacity (TEAC) of fresh and processed samples was also measured.
Results: Pepper samples submitted to VA treatments at pressure of 400 mbar and 200 mbar for a t_1 of 2 min and a t_2 of 30 min showed a RpH respectively of 0.954 and 0.941; instead the sample submitted to a traditional dipping in acid solution showed a RpH value of 0.968. In the same way, mushroom samples submitted to PVA at 400 mbar and 200 mbar for a vacuum period of 2 min and a t_2 of 720 min showed RpH values respectively of 0.818 and 0.756; instead the sample submitted to traditional acidification showed a value of 0.848. The "Peleg type model" was able to fit experimental RpH values and to obtain the description of the kinetic of PVA. The vacuum impregnation of apple slices at 200 and 400 mbar for a t_1 and t_2 of 1 minute into a pineapple juice increased the antioxidant capacity from 3.69 (mg trolox/g d.b.) to respectively 4.41 (mg trolox/g d.b.) and 4.46 (mg trolox/g d.b.).
Conclusion: Vacuum acidification (VA) and pulsed vacuum acidification (PVA) treatments were shown to be useful techniques to improve the rate of acidification during canned food processing. Also, the VI could be used to obtain innovative fruit products with different sensorial properties and increased antioxidant capability.

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Keywords
vacuum impregnation, pH reduction, canned food, antioxidant capacity, novel products

N° Inno-O08 - Superheated steam drying of apple cubes in a drying kiln

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Context and rationale: The apple is one of the most important fruit in France. According to French overnment statistics [1], apple production was estimated at about 1,675,000 tons on 1st November 2010. Around the world, the apple has also a significant share in fruit production. Word-wide production was 71,736,938 tons in 2009 [2]. The apples are consumed fresh or processed such as juice, jam or dried. Drying is the most common process of food preservation, since the microbiological activity and physical and chemical changes are considerably reduced during storage. Superheated steam drying (SHS) is an innovative technology with great benefits compared to conventional air drying in term of energy consumption [3]. It also allows to get new products with revised quality specifications. Moreover, in the case of products sensitive to oxidation, the surface of the product remains in contact with pure steam, in an O_2 free atmosphere. Literature available on SHS drying shows that this process is becoming more popular especially in foodstuff drying. But despite the success of the process at laboratory scale, industrial SHS drying is still limited or even non-existent. Moreover there is a lack of data on the impact of SHS drying on some specific properties such as colour, nutrient value, texture, etc. The list and citation of specific literature on fruit drying with SHS is scares and can be limited to a few products such as banana [4] or longan [5]. According to Mujumdar [6], such an emerging technology must be supported by academic and research organizations, to provide adequate justification for such expenditures or investments in industries.
Currently no research has been found on the drying of apple with SHS. The goal of this study was therefore to illustrate the interest to dry apples with SHS. We tested the feasibility of SHS drying on apple cubes at 120, 150 and 170 °C, recording shrinkage, colour, and drying kinetics.
Materials and Methods: The dryer consists of a stainless steel drying chamber. Saturated steam was enerated at 3 bars (30 kg/h), and then was reduced to 1 bar prior to enter the heater tube with passage of current. A batch of 5 apple cubes of about 10 g was used in each drying experiment. Moisture loss was determined as mass loss weighing (± 0.1 mg) after drying, for each drying duration. Colour was determined using a Minolta CR-200 colorimeter that enabled the computerized acquisition of Hunter *L, a, b* colour scale values. The shrinkage due to drying was calculated from pictures of the surface of the same 5 apple cubes taken before and after drying.
Results: The repeatability was checked at different temperatures between 120 and 170°C. Results of drying kinetics show a very good superimposition of the experimental curves. The repeatability was a little less good for colour, because of the heterogeneity of the coloration of the samples surface, but same trend on the samples versus processing time was observed on the samples versus processing time indicating a slight change of the colour with drying time. The repeatability of shrinkage with drying time was very good. SHS drying appeared as an interesting technology for a rapid elimination of more than 50% of the initial water content in less than 10 minutes at 150 or 170 °C.
Conclusion: Drying behaviour apple cubes was experimentally tested at the pilot scale showing very short drying times. This technology can be used in combination with hot air drying at lower temperature in order to obtain stable products at low A_w, or as it for obtaining intermediate moisture fruit for specific applications (addition of non impregnated fruit pieces in apple puree for example). In these conditions, it is possible to obtain fruit pieces with relatively unchanged shape and colour, but with a nice _'cooked apple_' smell.
Acknowledgment to the European Commission for part-funding this study under the ISAFRUIT Integrated Project (FP6-FOOD 016279-2).

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Keywords: apple, fruit, drying, superheated steam, colour, shrinkage

3| Microbial and chemical safety and quality

N° Mic-IC - Biological hazards in processed fruits and vegetables - Risk factors and impact of processing techniques

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Fruits and vegetables have increasingly been linked to foodborne diseases in the US (Lynch et al. 2009), and to a lesser extent in Europe. For instance, from 1995 through 2005, 21 fruit juice-associated outbreaks were reported in the US, causing 1,366 illnesses (Vojdani et al. 2008). Most of these juice-associated outbreaks were caused by *Salmonella* and *E. coli,* and were linked to apple and orange juices, showing that bacteria with animal reservoirs can contaminate fruits and survive in the juice in spite of the acid conditions. More generally, foodborne outbreaks linked to fruits and vegetables have been caused by a wide range of pathogenic agents (bacteria, viruses and parasites). Both raw and processed fruits or vegetables have been implicated, with however an important contribution from minimally processed products.
Good hygienic practices and implementation of HACCP can efficiently reduce the incidence of foodborne outbreaks linked to fruit and vegetables (Vojdani et al. 2008). However, identification of the routes leading to contamination of fruits and vegetables with human pathogens can be complex (Cooley et al. 2007), making difficult prevention of such contamination.
Inactivation of foodborne pathogens to acceptable residual levels during food processing usually rely on heat. However such treatments are reduced or omitted in minimally processed foods, usually to improve sensory quality of the final product. Reduced heat treatments may be sufficient to inactivate the most heat sensitive pathogens, but may permit survival of some more heat resistant ones (*e.g.* spore forming bacteria or relatively heat resistant viruses). The use of alternative, non-thermal treatments have been investigated, to obtain an equivalent safety level without the sensory modification imparted by heat. For instance, irradiation, high pressure, pulse electric fields can inactivate pathogenic agents. However, quantitatively predicting the efficacy of these alternative methods is still difficult. Their efficacy may vary with the nature of the pathogen, the chemical and physical composition of the processed food. In addition some of these non thermal methods may also have detrimental impact on some aspect of fruits and vegetable quality.

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Keywords
fruits, vegetables, foodborne pathogens, *Salmonella*, *Escherichia coli*, viruses, minimal processing

N° Mic-O01 - Acrylamide in model system and plantain based food during heating process: effect of pure phenolic compounds, precursors, and water activity

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Acrylamide, ranked by the World Health Organisation as a Group 2A carcinogen or 'probable' cause of cancer. It is present in starchy product thermally processed such as French fries and crisps and plantain-based products. Almost two thirds of plantain world production is processed by means of deep frying which place it in the same occurrence as potatoes-based food.
In this context, the aim of this presentation was:
i) to investigate and discuss the correlation of the antioxidant activity of the system (different phenolic compounds added in a closed asparagine-glucose model, Andueza et al., 2009; Bassama et al., 2010a) on the acrylamide formation kinetics during the heat treatment
ii) to give an original dataset on asparagine content in ten different plantain varieties and follows asparagine content through plantain ripening, highlighting a possible reduction of acrylamide content in this products (Rydberg et al., 2003; Bassama et al., 2010b).
iii) to uncouple (with the use of kinetic modelling) the effect of water activity from that of temperature in a plantain-based model system (Bassama et al., 2010b). Indeed, if the effect on temperature is well-known, the effect of water activity remains controversial: most of studies showing no significant effect of water activity on acrylamide kinetic (in equimolar model system). Although, our study as Hedegaard et al., (2007) show a synergetic effect of decreasing water activity and increasing temperature on acrylamide net amount.

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Keywords
acrylamide, plaintain based food, heating, phenolic compounds, asparagine, water activity

N° Mic-O02 - Cellulose-silver nanocomposites to control spoilage-related microflora in absorbent materials in trays of minimally processed fruit cuts

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Cellulose based absorbent materials are extensively used in retail food packaging and liners. They help food products to keep fresh, protect packaging from unsanitary meat juices, and create an aesthetically attractive product. However, immobilised fluids are a potential source of undesirable spoilage-related microflora or even food-borne pathogens. In this work, the suitability of cellulose-silver nanocomposites to decrease the microbial loads in absorbent materials was studied during the shelf-life of minimally processed fruit cuts. For this, cellulose-silver nanoparticle hybrid materials were developed after *in-situ* reduction by UV/heat of 1% silver nitrate adsorbed on cellulose fibres. Silver nanoparticles (AgNPs) accounted between 5 and 35 nm diameter, and were not aggregated.
Fresh-cuts of kiwi (pH 4.5; ºBrix 15.0) and "Piel de Sapo" melon (pH 5.8; ºBrix 10.6) were packaged in trays with commercial pads or cellulose-AgNPs pads during 10 days at 4ºC. The cellulose-AgNPs nanocomposites released silver ions after the juices impregnated the pad, which were particularly useful to control the population of spoilage-related microorganisms. Thus, total viable counts in the pads were 3 $\log_{10}$ and 3.7 $\log_{10}$ CFU/g below the control for kiwi and melon, respectively, after 10 days storage in the presence of the silver containing nanocomposites. Consequently, silver based absorbent materials could be especially designed to preserve aseptic conditions during the manipulation and storage of minimally processed fruit cuts, leading therefore to a feasible application of a silver based nanotechnology in food technology.

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Keywords
fresh cut, kiwis, melon, nanoparticles, silver

N° Mic-O03 - Fresh fruit juices: quality, safety and shelf life extension by Pulsed Electric Field treatment

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Background: Unpasteurized fruit juices derived directly from fresh fruits with a high pulp and a bioactive content of native enzymes are considered as a true alternative to boost the consumption of fresh fruits. The preference of the consumer towards these juices is largely driven by convenience and quality [1]. A major drawback is the limited shelf life of 5-7 days due to microbial spoilage. Previously, microbial safety issues have been risen [2] in the US and a recently described outbreak in the Netherlands that was associated with the consumption of unpasteurized fruit juice [3] has again led to question the safety of unpasteurized juices. Food safety authorities have suggested the use of Pulsed Electric Field (PEF) technology [4] to guarantee the microbial safety of unpasteurized fruit juices. We present the results of a study on the quality, enzymatic stability and food safety of fruit juices that are processed by pulsed electric field to obtain a shelf life in excess of two weeks.
Materials and Methods: Shelf life studies
Orange juice was used to assess the effectiveness of PEF treatment on shelf life extension and its impact in particular on pectinmethylesterase (PME) as an indicator of biochemical activity of native compounds. Juice samples with high pulp content were treated in a pilot plant scale PEF system at a throughput of 120 L/hr using 2 microseconds pulses at an electric field strength of 22 ± 2 kV/cm. Samples were analysed for total aerobic count, enterobacteria, yeast and fungal counts, PME activity and cloud loss under refrigerated storage at 4°C for a period of 3 weeks.
Challenge studies
Sacharomyces cerevisiae was cultivated in juice at 20°C before treatment. The outbreak isolate of *Salmonella Panama,* was cultivated at a suboptimal temperature of 20°C in TSB broth to mimic exposure to reduced temperature realistic for fruit processing. From this culture, apple juice was inoculated and control studies confirmed the *S.* Panama strain remained viable in apple juice up to several days. The juices in the pathogen studies were treated using a downscaled copy of the pilot plant at a throughput of 2 L/hr under identical conditions that were validated.
Results: The shelf life of PEF treated orange juice was extended in excess of two weeks at an outlet temperature not exceeding 56°C. These conditions resulted in an observed level of inactivation in excess of 5 log units for both *Salmonella* Panama and *S. cerevisiae*. Under these treatment conditions the PME activity remained 76 ± 3 % when compared to untreated control (100%) whereas after heat pasteurisation at 80°C for 10 minutes only 4% residual activity was left.
Conclusion: Shelf life extension of fresh fruit juice in excess of two weeks is feasible when treated by PEF at an outlet temperature of 56°C. This temperature lies well below the critical denaturation temperatures of enzymes and retention of a high level of bioactivity of native enzymes was demonstrated. Inactivation of relevant a model spoilage and pathogenic micro-organism by PEF treatment was shown effective at mild temperatures.

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Keywords
juice, safety, quality, PEF

N° Mic-O04 - Front face fluorescence spectrometry a sensitive and rapid tool to assess quality parameters of fresh and processed vegetable: Example of organic carrot baby food

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Background: In the frame of the QACCP (Quality Assessment of Critical Control Points) project of the Core Organic platform, the potential of front face fluorescence for assessment of carrot quality and critical points in processing was demonstrated. Influence of the raw fresh material regarding the agricultural practices of the variety and harvest year was studied. The impact of processing for baby food puree manufacturing was also analyzed, including the different steps of the process such as freezing, mixing, cooking, in bottle sterilization. All quality dimensions were considered, including sensorial, nutritional and healthy aspects.
Material and Methods: Three carrot varieties were studied (Bolero, Excelsior and Maestro), two geographical zones (Denmark and Italy) and two farming practices (organic and conventional). Three independent manufacturing processes were carried out, two in an industrial plant (P1 and P2) and one at a pilot plant (P3). Biophenols distribution and concentration were studied in particular detail because of their high sensitivity to each variability parameter. In addition many other quality indicators were also assessed, including sensorial, nutritional and neoformed compounds.
Fluorescence fingerprints were recorded on a Jobin Yvon fluorimeter and analyzed by a multiway model after convenient pre-treatment. Shortly, 3D excitation-emission matrices were preprocessed to eliminate undesirable signals, and decomposed in individual fluorescence profiles using PARAFAC modeling. Multivariate analysis, such as PCA, was applied to the PARAFAC loadings to discriminate the impact of production factors.
Results: Fluorescence fingerprints made it possible to distinguish the different carrot varieties and the agricultural practice. However, once the data of two consecutive years were treated together, almost no difference in the farming process remained, while the variety and especially the harvest year appeared most discriminant. Similar observations were obtained when individual phenols were considered.
The samples taken according the different steps of the process showed that any process applied to raw carrots, including freezing or storage, induced global physicochemical changes that induced modification of the fluorescence fingerprint. But heat treatment processes were those affecting maximally the fluorescence, with the most severe (highest time-temperature couple) inducing the deeper changes. So, pasteurization, or cooking operations had less impact than more severe in-bottle sterilization of carrot purees. At the same time, carrot heat-processing induced phenols degradation and accumulation of neoformed compounds, such as the volatile carcinogenic contaminant, furan, as well as change in many other product quality parameters. High correlation levels were found between most quality parameters and fluorescence scores and good calibration models were obtained for some of them.
Conclusion: We demonstrate that fluorescence is able to extract the specific information associated to processing of the carrot, independently of the many other variability factors including variety or process plant. Using prediction models over product quality indicators makes it possible to predict the impact of process on food quality by simply and rapidly getting a fluorescence image from the product.
In conclusion, non destructive fluorescence spectrometry appears a very potent analytical tool to assess at low cost the nutritional quality and safety of raw as well as processed vegetables, such as carrot puree baby food.

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Keywords: fluorescence, PARAFAC, prediction models, quality, carrot, organic farming, processing, baby food

N° Mic-O05 - Effect of two vine cryptogamic diseases (*Botrytis cinerea* and Esca) on phenolic and sensory quality of Bordeaux grapes and their derived wines

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Introduction: Vineyards in Aquitaine region are affected by several diseases in particular those due to fungal pathogens such as *Botrytis cinerea* which causes important losses in yield or esca, a grapevine trunk disease. The French "Grenelle de l'Environnement" policy in 2007 has advised to reduce the use of chemical inputs in viticulture. Vine-growers begin to worry about the implementation of this measure. The aim of this study was to determine the percentage of either botrytised grapes or grapes from vine stock affected by esca which can be tolerated during the wine-making process without modifying wine phenolic composition and sensory properties.
Materials and Methods: Two different batches of microvinification were carried out in duplicate. For the Botrytis-batch, 5%, 10% and 15% of botrytised grapes (Merlot cultivar) were added to healthy grapes to attend 10 kg per tank. For the Esca-batch, the same procedure was applied with 5%, 15% and 25% of Cabernet-sauvignon grapes from esca-diseased vines. Total polyphenols, tannins and anthocyanins contents were determined from skin and seed extracts, in must and in wine. The proanthocyanidin monomers and oligomers were identified and quantified by HPLC-UV-Fluo (Chira *et al*. 2009). Percentages of galloylation (%G), of prodelphinidins (%P) and mean degree of polymerization (mDP) of tannins oligomers were determined by HPLC-UV-MS (Drinkine *et al*. 2007). The anthocyanic composition of skins extracts and wines were analysed by HPLC-MS. Furthermore, sensory analyses were conducted and correlations between sensory analysis data and phenolic compounds composition were established. These experiments were conducted on two vintages in 2009 and 2010.
Results: Results showed that *Botrytis cinerea* was able to degrade the phenolic compounds enzymatically. This led to a loss of grapes proanthocyanidins of 12% in seeds and 70% in skins and to a degradation of skins anthocyanins from 70% to 82%. Consequently, the anthocyanins concentrations of derived wines were reduced of 15% for the wine modality "15%-Botrytised garpes". Only 5% of botrytised grapes were necessary to affect negatively both the phenolic composition and the organoleptic properties of corresponding wines. Furthermore, this work confirmed that esca caused a delay on ripening and led to modifications on grapes: decrease in the level of reducing sugar, anthocyanins, mDP, proanthocyanins, acidity and consecutive repercussion in wines (Calzarano *et al*., 2004). The tasting showed significant differences in both astringency and bitterness which decrease with the percentage of affected grapes.
Conclusion: Esca and Botrytis induces some important modifications in grape phenolic composition. After wine making process included some affected grapes, these modifications were also noticeable in chemical composition and sensory profiles of the derived wines.

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Keywords
Botrytis cinerea, esca, grapes, wine making process, phenolic compounds

N° Mic-O06 - New insights into the anti-browning effect of and old agent: Formation of SO3-chlorogenic acid and other SO3-flavonoids during potato processing

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Background and Motivation: Enzymatic browning of fruits, vegetables and their products is a major problem in food industry. Several techniques are used to avoid this phenomenon, among which the use of anti-browning agents. Compounds such as $NaHSO_3$ (*S*) and ascorbic acid (*A*) are commonly used during e.g. starch production from potato. The anti-browning effect of *A* has been attributed to its ability of reducing quinones to their precursor phenolic compounds. *S* appears to inhibit browning by inactivation of polyphenol oxidase (PPO) and by forming adducts with quinones.[1] In vitro models have shown that adducts between phenolics (e.g. chlorogenic acid, catechin) and sulfhydryl compounds (e.g. cysteine) can be produced via PPO catalysis.[2] Nevertheless, there are no studies regarding the possible adduct reaction between *S* and phenolics, neither in a more complex system. The aim of this work was to study the effect of *S* and *A* on the phenolic composition of potato under laboratory-scale conditions.
Materials and Methods: To evaluate the effect *S* or *A* during potato processing, samples of the tuber were blended with aqueous solutions of *S* or *A*. Starch was decanted and the supernatants were centrifuged and ultrafiltrated. Both extracts (*S* and *A*) were analysed by RP-UHPLC-DAD-ESI-MS^n. Identification of compounds was done based on the screening of ions and neutral losses after MS fragmentation, their molecular mass, and UV-Vis spectra data as we have described before.[3] Two major compounds that were obtained in the extract *S* were purified by semiprep-RP-HPLC, and analyzed by NMR.
Results and Discussion: After using either *A* or *S* yellowish extracts were obtained, and no browning was observed. In the presence of *A*, two major compounds were obtained: 5-caffeoylquinic acid followed by 4-caffeoyl quinic acid. Other less abundant compounds were 3-caffeoyl quinic acid, caffeoyl putrescine, caffeic acid, and two quercetin glycosides. Interestingly, in the presence of *S*, a different chromatographic profile was obtained. The isomers 3-, 4- and 5-caffeoylquinic acids and caffeoyl putrescine completely disappeared, whereas caffeic acid and quercetin glycosides were present at a lower concentration than those observed in the presence of *A*. Furthermore, in the presence of *S* two major new peaks were observed which were identified as 2'-SO_3-5-caffeoyl quinic acid and 2'-SO_3-4-caffeoyl quinic acid, based on NMR and MS analysis. Several other minor peaks were tentatively assigned as positional isomers of SO_3-caffeoyl quinic acid. Moreover, sulfited adducts of caffeoyl putrescine, caffeic acid and quercetin glycosides were observed.
We hypothesize that during potato processing in presence of $NaHSO_3$ PPO remains (partially) active and produces quinones from their precursor phenolics. Once the quinones are produced an addition reaction with $NaHSO_3$ is induced. The sulfited compounds are stable and do not polymerize, browning does not occur. When ascorbic acid was used the phenolic compounds were found as such, confirming the hypothesis of its anti-browning effect via reduction of quinones to the former phenolics.
Conclusion: Besides direct inhibition of polyphenoloxidase by $NaHSO_3$ it has been proposed that HSO_3^- can react with quinones to yield stable sulfoquinones. We provide molecular evidence for first time on the production of SO_3-phenolics by using potato as a model.

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Keywords
sulfite, chlorogenic acid, Solanum tuberosum, browning, polyphenoloxidase, adducts

N° Mic-O07 - Fermentation of fruit and vegetables by lactic acid bacteria as preservation strategy of making functional foods

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Background and motivation of the work: Lactic acid bacteria (LAB) and their ability to preserve food products is a not a novel feature; fermented food products have been consumed for thousands of years. In these products LAB convert the carbon sources into lactic acid; the production of lactic acid is accompanied by a drop in pH, hereby preservation is established in a natural way. Traditionally LAB are used for the manufacturing of yoghurt, cheese, olives, sausages, wine and sauerkraut, however, currently new substrates are being explored as well. Besides the benefit of food preservation other functionalities can also be exploited; e.g. increased vitamins levels, natural preservatives (such as bacteriocines), novel flavors or reduced off-flavors. Strains displaying the optimal (combination of) functionalities can be selected by screening the large biodiversity within the LAB population.
Material and methods: The NIZO food research culture collection of LAB, isolated from a wide range of different food related niches, forms the basis for the strain selection. This culture collection has been used for a fast number of purposes: e.g. growth behavior (acidification rate), increased vitamin production, production of natural preservatives, genomics, metabolic modeling, mixed cultures, Bioinformatics and off-flavor reduction on food substrates, such as fruits and vegetables.
Results: We have investigated the ability of a wide range of LAB's to acidify eleven different fruit purees. This ability appears to very species specific; *Lactobacillus plantarum* was able to grow very good on all eleven fruits whereas *Lactobacillus bulgaricus* displayed growth on five of the eleven fruit purees. Aside from the growth potential on these fruit purees, we have tested whether we could increase the nutritional value of fruit juices by fermentation. *Lb. plantarum* has been found to increase the nutritional value of fermented melon-juice by producing high folate levels on melon juice; *Lactobacillus reuteri* was found to produce vitamin B_{12} in combination with folate [1]. Consumption of these fermented products might be useful for vegetarians, since this product would serve as an excellent substitute for meat as source for vitamin B_{12}. In another experiment, *Lactococcus lactis* was used as cell factory for the production of plant-bioactive compounds, e.g. strawberry flavors compounds [2]. Currently, soy products become increasingly popular; however beany off-notes can have an effect on the overall liking. The key-compound for this flavor defect is hexanal. We screened the ability of LAB for reducing the beanie-flavor of soy products; again this ability was found to be very strain specific. Some LAB were found to reduce hexanal levels more than 99% while other strains show lower activities.
Conclusion: Screening on the natural biodiversity of LAB on the ability to ferment fruits and vegetables is a very useful method for preserving food products, but at the same time the nutritional beneficial components can be increased and off flavors can be reduced

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Keywords
lactic acid bacteria, fruit, vegetables, fermentation and functional foods

4| Nutritional qualities of processed products

N° Nutr-IC - Modelling the health aspects of processed fruit and vegetables

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Dealing with the health aspects of processed fruit and vegetables is a complex task. Epidemiological studies relating intake of fruit and vegetables with human health are positive but not always consistent in their results. Fruit and vegetables contain a huge number of components that can contribute to their potential health benefits.
The level and bioavailability of these components is strongly affected by processes in the supply chain. To use the various sources information for design of healthier processes and products various challenges remain to be solved, like:

- How to deal with uncertainty and variability in the results of epidemiological studies?
- How to estimate the health impact of individual components?
- How to optimize processes and preparation methods for health?

In this presentation the use of mathematical modeling for these issues will be shown by various examples. Different modeling approaches are needed for specific areas :

- Mechanistic Kinetic Models for process simulation,
- Monte Carlo Simulations for modeling epidemiological results,
- Bayesian Belief Networks for linking consumer aspects to product and processing variables.

By these examples it will be shown that modeling can be used to use experimental data more efficiently and to improve the decision making process by combining expert knowledge and data.

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Keywords
modelling, health, processing, supply chain, glucosinolates, metabolites, phytochemicals

N° Nutr-O01 - The fate of olive fruit phenols during commercial olive oil processing: traditional press versus continuous 2- and 3- phase extraction system

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Context and rationale: For past few decades olive oil consumption has been linked with prevention of many oxidative-stress related diseases, attributed to its high content of phenol antioxidants responsible for beneficial effects of Mediterranean diet. However, although olives are recognized as valuable source of different phenol antioxidants, unfortunately most of them are lost during oil processing, ending up in wastes (olive pomace and wastewater) instead of oil. Thus, three commercially available olive oil extraction systems; traditional press, continuous 2- and 3- phase mills were compared in terms of phenols fate assessment from fruits to end products – oil and waste, providing important information of the quality and quantity of natural antioxidants expected in our food, *i.e*. olive oil, as well as in its processing wastes.
Materials and Methods: olive samples from three commercial olive mills were investigated in this study; fruits, paste, pomace and oil from continuous 2- phase extraction system and fruits, paste, pomace, wastewater and oil from (a) traditional pressing and (b) continuous 3- phase extraction system. All samples were immediately freezed with liq. N_2, freeze-dried (except olive oil) and phenols were extracted using high intensity probe ultrasonication [1], further analysed by HPLC-DAD-MS and Folin-Ciocalteu method, in addition to antioxidant activity assessment using DPPH assay.
Results: While the fruits, paste and olive wastes presented similar phenol composition, their phenol profiles differed significantly from that of oil, suggesting that phenols are not only transfered but also transformed during oil processing, forming several derivatives in degradation and/or hydrolysis reactions. However, our results revealed that only 50-60% of total phenols are transfered from fruits to paste, suggesting that majority of antioxidants are already lost during crushing, most likely due to activity of several endogenous enzymes. Suprisingly, only 1-1.5% of available phenols were found in olive oil, while the rests ended up in wastes (> 40%) depending on the extraction system used. As seen from results, a continuous 2-phase extraction system provided highest oil phenol content (1.5%), followed by traditional 3-phase pressing system (1.4%) and a continuous 3-phase system (0.5%), respectively. Moreover, the use of 2-phase system has not only influenced its total phenol content, but has also resulted in an increased concentration of hydroxytyrosol and tyrosol, associated with highest antioxidant activities. This suggests that water addition during oil processing influences phenols partition during oil processing, as particular evident in both 3-phase systems (continuous and traditional) resulting in great losses of hydrophilic phenols flushed away with wastewater (> 30%), respectively.
Conclusion: among the existing olive oil technologies available, a continuous 2-phase extraction system seems to provide the highest phenols transfer from fruits to oil, resulting in richest antioxidant content.

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Keywords
olive fruit, olive oil processing, phenols

N° Nutr-O02 - The impact of food processing on plant cell wall pectin: combining ex situ pectin characterisation methods with in situ pectin visualisation

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Pectin has been identified as a critical structure component of plant cell walls contributing to tissue integrity and rigidity and, hence, textural quality of fruit- and vegetable-based products. The functional properties of pectin depend on its molecular fine structure, which can be altered chemically and/or enzymatically. Several structural modifications of pectin occur during food processing, rendering pectin a major point of interest for food technologists seeking to tailor the textural properties of plant-based food products. Assessing the influence of processing on pectin in food matrices has, so far, predominantly been performed using *ex situ* analysis techniques. However, several recent advances in pectin analysis enable to complement these findings with precise information obtained by *in situ* visualisation of pectin (*1-2*).
The current study is one of the very first studies in the context of food processing that actually complements the *ex situ* pectin characterisation methods with *in situ* pectin localisation in order to obtain in-depth insight into the structure-function relationship of pectin in plant-based foods. In this respect, a case study on broccoli (*Brassica oleracea* L. cv italica) was performed. More specifically, the influence of thermal and high-pressure pretreatment, whether or not in combination with Ca^{2+} impregnation, on the textural quality of thermally processed broccoli was explored. The macroscopic attributes of broccoli (i.e., hardness) were linked to the chemical fine structure of broccoli pectin. In addition, anti-pectin antibodies were used to perform *in situ* (microscopy) and *ex situ* (immuno-dot assays) analyses on broccoli pectin which resulted in accurate information concerning the locations of defined pectic domains in broccoli cell walls and the fine structure of pectin. For instance, the effect of pressurisation on pectic components in the cell wall was visualised *in situ* for the first time.
This integrated study clearly demonstrates the high potential of combining macroscopic, microscopic and molecular analyses in elucidating the pectin structure-function relation, not in the least in a food-processing context. The results form a sound basis to control the textural properties of plant-based food products and to identify targets for food-texture engineering.

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Keywords
pectin, processing, high pressure, texture, anti-pectin antibodies (JIM5, JIM7, LM18, LM19, LM20, PAM1, 2F4), microscopy, broccoli

N° Nutr-O03 - Stability of tomato micronutrients in systems modeling the industrial preparation of tomato-based products

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Background: Tomato is a fruit widely consumed either fresh or processed possessing recognized nutritional qualities. Rich in carotenoids (such as lycopene), phenolic compounds and vitamin C, its regular consumption could reduce risks of developing cardio-vascular diseases and cancers. However, thermal treatments applied during industrial preparation of tomato products may involve various (photo) chemical reactions leading to the degradation of these antioxidants [1-2]. Besides, addition of vegetable oil for the preparation of tomato sauce may lead to lipid oxidation contributing to the micronutrient instability.
The main goals of this work are the evaluation of the stability of tomato antioxidants during the heat treatment step, in the presence or not of vegetable oil, as well as the development of a stoichio-kinetic model applied to the preservation of tomato micronutrients.
Material and Methods: Based on their presence in tomato products, markers of the nutritional quality were identified as three phenolic compounds (chlorogenic acid, prunin, rutin), two carotenoids ((all-*E*)-lycopene and (all-*E*)-β-carotene) and two vitamins (ascorbic acid and α-tocopherol). Their stability was studied at hot (95°C) and cold break (50°C) temperatures in model systems mimicking tomato sauce: an aqueous model containing starch, a lipidic model consisting of vegetable oil and phospholipids and an oil-in-water emulsion as a combination of both aqueous and lipidic phases.
Consumption of markers was followed by HPLC-DAD-MS and lipid oxidation in emulsions was assessed by the spectroscopic measurement of dienylhydroperoxides as well as the analysis of native and oxidized triglycerides (HPLC-DAD-MS).
Validation of oil-in-water emulsions as model systems for tomato sauce was tested at the laboratory scale. Tomato paste was diluted to 1/4th and added with starch (1%) and sunflower oil (2%). This basic tomato sauce was heated to 95°C and the marker stability was followed.
Results: Among all the antioxidants, ascorbic acid proved to be the least stable in both the emulsion and aqueous models. Its oxidation rate was found to be oxygen dependent. Phenolic compounds were little affected even at high temperature although chlorogenic acid disappeared faster than rutin and prunin. In the lipidic model, α-tocopherol proved to be a better inhibitor of lipid oxidation compared to carotenoids which were found to rapidly isomerize. In the emulsion model, lipid oxidation was clearly accelerated when the temperature increased and all markers were more rapidly degraded than in the aqueous and lipidic models. Finally, the validation step with real tomato ingredients demonstrated that emulsions are convenient model systems for studying micronutrient and lipid stabilities.
Conclusion: Rate constants were tentatively determined, either individually for each kinetics or using global approaches (stoichio-kinetic model). This last model aims at giving process conditions limiting lipid oxidation and preserving tomato nutritional quality.

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Keywords
tomato, carotenoid, phenolic compound, vitamin C, vitamin E, lipid oxidation, processing, mathematical modeling

N° Nutr-O04 - Phytochemical composition and antioxidant activity of peach as affected by freezing and pasteurization

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Context and rational: Fruit are an essential part of a healthy diet and vehicle of a number of unique health-promoting phytochemicals. Being very perishable, fruit require preservation, either as fresh or processed foods. It is important to understand the effect of processing and storage conditions on the nutritional and functional composition of fruit to preserve the health benefits Jiménez *et al.* (2008). The effect of freezing and pasteurization on relevant markers of functional and nutritional properties of peaches was determined after processing and during subsequent storage.
Materials and Methods: The effects of processing on antioxidant activity, phenolics and particular carotenoids were evaluated. Peach fruits were peeled, pit removed and cut into small pieces and homogenized to perform extractions. Freezing was performed at -20ºC during 4 days. Fruit homogenates were pasteurized in water-bath at 90 ºC for 5 minutes. Hydrophilic extracts were obtained with 80% methanol and carotenoids extracted by the method described by Lavelli *et al.* (2009). Total antioxidant activity was assessed by the ABTS method, total phenolics by Folin Ciocalteu's method, and total carotenoids by spectofotometer determination. All phenolic and carotenoids compounds were analysed by high performance liquid chromatography (HPLC-DAD).
Results: Significant reductions in antioxidant activity (0.64 to 0.46 mg of ascorbic acid equivalents/g fw) and total carotenoids (6.76 to 4.82 mg of β-carotene/g fw) were observed when fresh peach were frozen at -20 ºC and maintained for 4 days. HPLC analysis revealed that procyanidin B1, (+)-catechin, (-)-epicatechin, chlorogenic acid, dihidroxybenzoic acid, lutein and zeaxanthine increased significantly in frozen peach. When fresh fruit was pasteurized after and before freezing (-20 ºC during 4 days), there was a significant reduction in their antioxidant activity, as well as in the concentration of total phenolics and carotenoids. Direct pasteurization of fresh fruit caused reductions larger than 30% in protocatechuic acid, zeaxanthine, β-carotene and β-cryptoxanthine.
(-)-Epicatechin increased from 6.95 to 13.13 µg/g fw in pasteurized peach. When pasteurization was applied to frozen fruit all the identified phenolics and carotenoids decreased by more than 30% in relation to their levels in fresh peach. Pasteurized fruit stored at 25 ºC for 90 days showed a significant decrease in antioxidant activity (0.52 ascorbic acid equivalents/g fw at day zero to 0.25 mg of ascorbic acid equivalents/g fw at day 90). Total phenolics decreased from an initial concentration of 0.57 to 0.34 of gallic acid equivalents/g fw and total carotenoids decreased in the same period from 2.43 to 0.78 mg β-carotene/g fw. Procyanidin B1 increased from 15.77 to 28.03 µg/g fw and (-)-Epicatechin decreased from 13.13 to 4.02 µg/g fw.
Conclusion: Processing conditions and subsequent storage time strongly affect the concentration of phenolics and carotenoid phytochemicals. Identification of markers sensitive to the processing conditions can serve as a basis for the development of an efficient audit system for the preservation of health-promoting phytochemicals during processing.

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Keywords
peach processing, antioxidant activity, phenolics, carotenoids, nutritional audit

N° Nutr-O05 - Construction of a database on retention factors for polyphenol content in cooked and processed foods based on literature surveys

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Background/aims: Polyphenols are natural antioxidants present in plant foods which may contribute to the prevention of several major chronic diseases. However, processing operations such as cooking, storage and industrial treatment cause important changes in polyphenol content. For this reason, epidemiologists must use polyphenol retention factor tables in order to calculate the polyphenols content of prepared dishes. Until now, no such table of retention factors in processed and cooked foods has been available.
Our objective was to create a comprehensive database on polyphenol retention factors compiled from all the information available in the scientific literature on the effects of food processing on the content of various polyphenols.
Methods: A systematic literature search was performed using Food Science and Technology Abstracts and review articles. The relevant articles containing analytical data were analysed. Each content value was inserted in a Microsoft Access® database, together with the publication reference, a description of the food, the compound, the analytical method used for quantification, the polyphenol content value of the raw and cooked foods, the process description and classification, the yield factors and the calculated retention factors. Data were firstly evaluated for quality according to sample description, analytical methods, food transformation process, expression of results, and disclosure of experimental details. Only those data meeting specified minimum requirements were selected for the creation of the retention factor table and aggregation (mean values).
Results: Polyphenols content values in raw and cooked food from 250 publications were entered into the Access database to provide average retention factors values for several phenolic compounds in foods belonging to the following groups: vegetables, cereals, pulses, fruits and nuts.
A freely available and user-friendly interface will be developed to allow any user to make various queries in the database and retrieve retention factors values for the different processes applied to foods. It will also allow users to easily trace the original polyphenol content values for the raw and cooked foods used to determine the overall retention factors. This information should help epidemiologists and nutritionists to evaluate more accurately the polyphenol content of prepared dishes and diets.
Conclusion: This polyphenol retention factors database is the first of its kind developed for polyphenols in foods and should significantly contribute to improving our knowledge of the effect of food processing on the content of various polyphenols. It will be useful for nutritionists, dietary planners and researchers in many research applications.

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Keywords
polyphenols, cooking, processing, retention factors, losses, gains, database, transformation

N° Nutr-O06 - Changes in the contents of carotenoids, phenolic compounds and vitamin C during technical processing and lyophilisation of red and yellow tomatoes

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Background: Tomato is the second most consumed vegetable in the world, after potato, and approximately 30% is consumed as transformed products. Tomato, as a fresh or transformed product, possesses an interesting nutritional value due to its content in different types of micronutrients: vitamins (C and E), folates, carotenoids (lycopene and beta--carotene) and phenolic compounds. Whereas numerous studies on the micronutrient content of fresh tomato have been conducted, very little is known about the effects of processing on its nutritional quality, and controversial results can be found in the literature.
In this paper we describe the effect of a classical thermal process to produce tomato purée and a freeze-drying treatment on the three main families of bioactive components of tomato: carotenoids, phenolic compounds and vitamin C. Two varieties of tomatoes were chosen for their different carotenoid content: a red cultivar and a yellow one. Their content of targeted micronutrients in the fresh state was compared to those after processing and lyophilisation.
Material and Methods: Two genotypes of tomato plants, one producing red fruits (*Solanum lycopersicum* L. cv. Cheers, De Ruiter) and the other producing yellow fruits (*Solanum lycopersicum* L. cv. 6205, Séminis) were selected. Aliquots of tomato powder, prepared by grinding tomato in liquid nitrogen, were submitted to a one-week lyophilisation (freezing at -20°C, followed by two successive drying steps at 0.5 mbar and 0.1 mbar, respectively, at 10°C). Tomato purée was produced from fresh tomatoes according to the following procedure: heating for 10 min at 92°C in a tubular heat exchanger, removal of the seeds and residual skins, concentration under reduced pressure at 65°C until it reached 14 degrees Brix. After canning, the purée was pasteurised. After extraction using organic solvents, quantitative analysis of carotenoids was performed by spectrophotometry, total polyphenol content was performed using the modified Folin Ciocalteu test [1], vitamin C was analysed by HPLC with a fluorimetric detection.
Results: Yellow tomatoes (YT) contained no lycopene, lower beta-carotene, similar vitamin C and higher total polyphenol contents than red tomatoes (RT). Processing did not affect the carotenoid content in RT, but significantly lowered beta-carotene in YT and also the contents of the total polyphenol and vitamin C in both cultivars. Lyophilisation lowered the carotenoid content in RT but not in YT; in contrast, the total polyphenol content was preserved in RT but lowered in YT, and the vitamin C content was not affected in both cultivars.
Conclusion: For the first time, we compared the micronutrient content of red and yellow tomatoes by analysing three different families of phytonutrients (carotenoids, polyphenols and vitamin C) [2]. We identified which micronutrient was more affected by classical thermal processing and a freeze-drying process. These results could be significant in terms of human nutrition and could serve as the basis for suggesting changes in the industrial processing of tomatoes.

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Keywords
tomato, processing, lyophilisation, lycopene, beta-carotene, vitamin C, polyphenols

N° Nutr-O07 - Is high pressure processing beneficial for the structural and health-related properties of carrots?

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Today, consumers are demanding foods with a high nutritional value and a good eating quality. β-carotene is an important nutrient in the human diet because of its antioxidant property and its provitamin A activity and it can be found in high concentrations in carrots. However, not only the concentration of a nutrient is important. A nutrient has to be released from its food matrix during digestion and made accessible for absorption into mucosa (= bio-accessibility). Since nutrients are often located in cellular compartments or attached to cellular components, the microstructure of foods can influence the bio-accessibility of nutrients. As processing can modify the microstructure, it can also alter the bio-accessibility.
Nowadays, high pressure (HP) processing is gaining interest as a new preservation technique. It has been shown that conventional thermal processing can influence the bio-accessibility of nutrients in a positive way[1] but it has often a detrimental effect on the sensorial quality of foods[2]. However, little is known about the effect of HP processing on the bio-accessibility of nutrients.
In this case study on carrots[3], the impact of equivalent thermal and HP processes on structural and health-related properties of carrot pieces was compared. Both a mild and strong pasteurization process and a sterilization process were considered. As structural properties, the texture and structure were determined respectively by force-deformation measurement and by light microscopy. The bio-accessibility of β-carotene was examined as a health-related property. The bio-accessibility was determined using a static *in vitro* digestion, followed by β-carotene quantification using spectrophotometry.
Both for pasteurization and sterilization, the HP process resulted in a similar or improved (2.6 – 4.5 times higher) hardness of the carrots compared to the equivalent thermal process. Under HP, the β-eliminative depolymerisation of pectin, which is the main cause for thermal softening of carrots, is retarded which can explain the improved hardness of the HP treated carrots. These findings were also confirmed by the microstructure analysis of the carrots. Less cell wall separation was observed in the HP pasteurized carrots compared to the thermally pasteurized carrots. In the thermally sterilized carrots, as a result of the higher solubility of the pectin, more pectin had leached out to the brine compared to the HP sterilized carrots.
The effect of HP on β-carotene bio-accessibility was dependent on the intensity of the process. Going from mild pasteurization, over strong pasteurization to sterilization, the β-carotene bio-accessibility of the HP treated samples changed from 1.2 times higher, over 1.2 times lower to 2.5 times lower than that of the thermally treated samples.
In conclusion, this study suggests that HP processing can be used as a good alternative to thermal processing when it comes to improve the structural properties of carrots. However, this also induces that HP processing has a negative effect on bio-accessibility compared to thermal processing. Further research to find a good balance between the nutritional and structural quality of processed food products remains important.

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Keywords
β-carotene, carrot, in vitro bio-accessibility, structure, thermal processing, high pressure processing

N° Nutr-O08 - Influence of air drying temperature on kinetics of colour, density, porosity, total phenols and ascorbic acid of pear

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Context and rationale: Dehydration is one of the most widely used methods for fruits and vegetables preservation. Its main objective is the removal of water to the level at which microbial spoilage and deterioration reactions are minimised. However, it is well known that during air drying, vegetables undergo physical, structural, chemical and nutritional changes that can affect quality attributes. The aim of this work is to evaluate the quality and structural changes (ascorbic acid and total phenolic contents, colour, volume change, porosity and density) in pear slices during convective drying at different air temperatures.
Materials and Methods: Drying experiments were performed at 30, 40, 50, 60 and 70°C (air velocity = 1.5 m/s and ambient relative humidity) by using a convective pilot air dryer (Djendoubi et al., 2009). Color, total phenolic and ascorbic acid contents, solid and bulk densities and porosity of fresh and dehydrated pear slices were measured at different drying times.
Results: Ascorbic acid deterioration demonstrated first-order kinetic behavior and was found to depend on air temperature and pear moisture content ($p< 0.05$). The loss of vitamin C increases with increasing air temperature and reaches a maximum of 70% in pears dried at 70°C. Thus could be explained by the irreversible oxidative reaction occurring during drying. Phenol content degradation fitted a pseudo first-order reaction and is significantly influenced by air temperature ($p< 0.05$). The variations of the bulk density, shrinkage and porosity depend essentially on pear moisture content. The Lozano et al. (1980) modelgave the best fit of bulk density. The porosity of pear exhibits a nonlinear variation with respect to moisture content and was adequately fitted by a quadratic function. The experimental data show a linear behavior between volume change and pear moisture content, which suggests that the volume change, is predominantly due to the volume of water removed. Drying temperature significantly ($p< 0.05$) affects a* and b* colorimetric parameters but not the lightness (L*) of pear.
Conclusion: The experimental data show the dominating influence of the moisture content on the volume change of dehydrated pear. The rather good prediction of pear density, depending on its moisture content, by the model of Lozano et al. (1983) may improve the determination of the various characteristics of pears depending on its density. Furthermore, pears slices developed relatively high porosities during drying (ranging from 2 to 40%), as a consequence of the rapid drying rates. Drying temperatures had significant effects on the quality attributes (color, total phenolic content and ascorbic acid content) of dried pear slices. The higher drying temperature resulted in greater total color change. Ascorbic acid degradation followed an exponential decay curve during drying. The rate of ascorbic acid decay was found to increase with temperature.

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Keywords
pear, air drying, total phenol, ascorbic acid, porosity, density, shrinkage, color

N° Nutr-O09 - Understanding the importance of thermal and mechanical processing of carrots for the β-carotene in vitro bioaccessibility

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The importance of carotenoid intake for human health and vitality has been shown in several epidemiological studies. Fruit and vegetable based food products, which are a good source of carotenoids, are often characterized in terms of their nutritional content. However, Fernández-García et al. (2009) emphasized the relevance of investigating nutrient bioaccessibility (and bioavailability) as a better indicator for the nutritional value of the food products. Nutrient bioaccessibility is defined as the fraction of the ingested nutrients that is released during digestion and that is available for intestinal absorption (Parada and Aguilera, 2007).
The present investigation describes a case study on carrots mainly focusing on the effect of mechanical and thermal processing on the β-carotene bioaccessibility. Gaining a better insight in how thermal and mechanical processing plays a role in determining the β-carotene bioaccessibility was the major purpose of this study. In the first part, carrots were mechanically processed in order to obtain various sized carrot particles of which the β-carotene bioaccessibility was determined using an in vitro digestion protocol. In order to estimate the influence of thermal processing, this experiment was repeated for different thermally processed carrot samples. In the second part, a small scale human study was performed in order to identify a technique that can mimic the mastication step (which can be seen as a step where particle size reduction occurs) during the in vitro digestion procedure in a standardized and validated way.
The results of the first part clearly showed that the carrot particle size is linked to the β-carotene bioaccessibility. This dependency was influenced by the extent to which the carrot samples were thermally processed prior to mechanical processing. Structural changes due to thermal and subsequent mechanical processing could be used to explain processing induced β-carotene bioaccessibility changes. This insight was used as a starting point to fine-tune the in vitro digestion procedure to determine the β-carotene bioaccessibility in the second part. A mixing technique, adequately imitating the particle size reduction of carrots during human mastication, could be identified and integrated in the currently used in vitro digestion protocol (Lemmens et al., 2009). The developed procedure provides a closer relation between the in vitro digestion protocol and human digestion, resulting in a more reliable interpretation of in vitro bioaccessibility data.
In conclusion, it can be stated that the effect of thermal and mechanical processing of carrots on the β-carotene bioaccessibility is complex. It was demonstrated that even from a methodological point of view, attention should be given to this issue. A good characterization of the carrot samples, more specifically, the structural characteristics (as a result of mechanical processing), is important to estimate or predict the influence of thermal processing on the β-carotene bioaccessibility.

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Keywords
β-carotene, carrots, in vitro bioaccessibility, mastication, mechanical processing, thermal processing

N° Nutr-O10 - Phenolic composition of a fruit juice-soymilk beverage as affected by high intensity pulsed electric fields or thermal treatments during storage

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Background and Motivation: During the last decade, consumption of mixed beverages containing fruit juices and soymilk has gradually growing. The potential health benefits of these products have been attributed to their high content of bioactive compounds such as phenolic acids and flavonoids, which have antioxidant properties.
Usually, these beverages are well preserved by thermal treatments. However, the high temperature achieved during the processing adversely affects the beverage nutritional properties. Hence, non-thermal technologies such as high intensity pulsed electric fields (HIPEF) represent an interesting alternative for preserving liquid foods, since microbial and enzymatic inactivation achieved can be as high as those reached by heat pasteurization. Moreover, it is believed that HIPEF processing could allow great retention of bioactive compounds in liquid foods. Hence, the aim of this work was to evaluate and compare the effects of HIPEF (35 kV/cm, 4 μs-bipolar pulses at 200 Hz during 800 or 1400 μs) or thermal (90 ºC, 60 s) treatments on the phenolic composition of a fruit juice-soymilk (FJ-SM) beverage stored during 56 days at 4 ºC.
Materials and Methods: A FJ-SM beverage was prepared according to Morales-de la Peña et al. (2010). Phenolic compounds were extracted and quantified by HPLC, following a procedure validated by Hertog et al. (1992) and Odriozola-Serrano et al. (2009). HPLC system was equipped with a 600 Controller, a 486 Absorbance Detector, a thermostatic column compartment, and a 717 Plus Auto Sampler with cooling system (Waters, Milford, MA). A reverse-phase C18 Spherisorb ODS2 (5 μm) stainless steel column (4.6 mm x 250 mm) was used to separate the phenolic compounds.
Results: Irrespectively of the treatment applied, FJ-SM beverage had coumaric as the most abundant phenolic acid (32 - 46%), followed by sinapic, caffeic, ferulic and chlorongenic. Initial concentration of most individual phenolic compounds of untreated and HIPEF or thermally treated FJ-SM beverages increased just after treatments; except for chlorongenic, coumaric and sinapic acids, which significantly decreased in heat treated beverage. Otherwise, narirutin was identified as one of the main flavonoids present in the beverages before treatment (19.5 - 27%). Nonetheless, immediately after processing, hesperidin content showed a huge rise from 4 to 24%, irrespectively of the treatment applied, reaching similar concentrations than narirutin. As a result, total phenolic initial concentration was enhanced in processed beverages. Regardless of treatment applied, storage time did not affect total phenolic content of the FJ-SM beverage; nevertheless, the concentration of some individual phenols was slightly affected throughout the time. Chlorogenic and sinapic acids tended to decrease, while ferulic, narirutin and apigenin content augmented as storage time increased.
Conclusions: FJ-SM beverage is a good source of phenolic compounds. Both HIPEF and thermal treatments significantly enhanced the beverage phenolic composition, being HIPEF processed beverage that with the highest concentration of phenolic compounds. Concentration of most phenolic compounds of untreated and treated beverage remained stable throughout the storage time. Thus, HIPEF process could be a good alternative to thermal pasteurization in order to obtain FJ-SM beverages with a similar phenolic profile than fresh beverages.

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Keywords
High Intensity Pulsed Electric Fields, fruit juice-soymilk beverage, phenolic compounds

N° Nutr-O11 - Effect of moisture content/water activity on thermal degradation of glucosinolates in broccoli (*Brassica oleracea* var. *italica*)

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Consumption of Broccoli (*Brassica Oleracea* var. *italica*) is known to be associated with health benefits. The compounds responsible for this health effect are called isothiocyanates which form by the reaction between glucosinolates and the myrosinase enzyme during the destruction of broccoli tissues (chewing, chopping etc.). Isothiocyanates make Broccoli one of the most promising vegetable in cancer prevention.
Drying technologies can have a strong impact on processed foods quality i.e. decreasing the content of naturally occurring health promoting compounds.
During drying of broccoli, glucosinolates can be broken down, the enzyme myrosinase can be inactivated and cellular structures can be altered. All these modifications might reduce the formation of bioactive isothiocyanates from glucosinolates, compromising the health-protective effects of broccoli.
Absorption drying is a novel technology which uses low or moderate temperatures preserving the target compounds of broccoli with a limited ecological impact deriving from low energy consumption and CO_2 exhaust.
The aim of this study is to set up the most suitable drying conditions that preserve the health protective effect of broccoli by using the adsorption drying technology.
For this purpose, a batch of broccoli was freeze dried in order to obtain five batches with different moisture content/water activity: 13%/ 0.32 a_w, 34%/0.83 a_w, 56%/0.94 a_w, 68.4% /0.96 a_w and 82.4/0.99 a_w. The samples have been thermally treated in order to investigate the influence of the water content/activity and temperature on glucosinolates content.
Kinetic parameters were estimated for the degradation that could be described by first-order kinetics irrespective of the glucosinolate investigated and the moisture content/ a_w of the sample. No significant difference was observed between the degradation rate of aliphatic and indolic glucosinolates. At low temperature (60 and 80°C) the sample with 13% moisture content showed the lowest thermal degradation rate, whereas a decreasing in stability is observed as moisture content increases in the samples with 34, 56, 68 and 82% moisture content. At 120°C the sample with 13% moisture content showed the highest thermal degradation rate and this behavior was reflected by its highest value of E_a. This change in thermostability is discussed in terms of activity and molecular mobility of the reactants.
Based on this research the conditions during the drying process can be optimized to increase the health promoting potential of the dried product.

Keywords
moisture content, water activity, temperature, glucosinolates, kinetic modeling

N° Nutr-O12 - Physico-chemical and nutritional evaluation of novel bacterial carotenoids for their potential as natural additives and functional ingredients in processed food

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Background: Carotenoids provide both technological and nutritional properties in processed food. Protective actions of the carotenoids are due to a number of mechanisms. However, when absorbed with food, they are clearly submitted to the same reactive conditions and are susceptible to oxidative degradation. In the stomach, conditions are very reactive and dietary iron, highly present in food, is one of the major sources of oxidative stress. Thus, carotenoid stability and antioxidant studies are very relevant prior to intestinal absorption, when they accumulate in large concentrations in the gastro-intestinal tract. When considering the potential beneficial effects of carotenoids on body tissues, bioavailability is also a crucial criterion. Novel spore-forming pigmented marine bacteria, *Bacillus* HU36 and GB1 were isolated. They are sources of mixtures of several carotenoids with glycosyl moieties, prone to be more gastric-stable than others commonly present in the food industry.
Material and Methods: To study the cocktails of bacterial pigments, other carotenoids naturally present in fruits and vegetable (β-carotene, lycopene or lutein) or used as additives (astaxanthin) were chosen as reference molecules. Comparative kinetic studies were conducted in aqueous systems mimicking the gastric medium. The oxidation of the carotenoids was initiated by Fe^{II} or Fe^{III} ions or by hematin (cofactor of metmyoglobin). Titration methods set up to follow changes in the iron redox state, measurements of dioxygen and ultra fast HPLC-MS analysis of carotenoid-derived products were combined to understand the chemical mechanisms involved. The antioxidant activity of the carotenoids was then evaluated by testing their ability to inhibit the iron-induced peroxidation of linoleic acid. Finally, the bioavailability of the carotenoids was compared by measuring both their bioaccessibility (*in vitro* digestion model involving carotenoid-rich canned vegetables and HU36 or GB1 carotenoid-enriched processed food) and their intestinal absorption (model system with Caco-2 cells). An *in vivo* animal study on rats fed with a carotenoid-enriched diet is currently being conducted to complete the previous experiments.
Results: The stability of the carotenoids varies with the induction time and the speed of oxidation. They can be classified as follows in terms of increasing stability towards iron: beta-carotene < lycopene < astaxanthin < carotenoids from HU36 and GB1. Bacterial carotenoids are significantly more antioxidant against heminic iron but not against free iron, possibly because of their higher stability to iron-induced oxidation and/or their specific location in lipid droplets of the emulsion model. The solubility of the carotenoids in micelles (physiologic transport form to enterocytes) is very uneven, the order is: carotenoids from HU36 and GB1 = lutein > beta-carotene > astaxanthin > lycopene. First results of intestinal absorption showed lower differences: astaxanthin = lutein > lycopene > carotenoids from HU36 > beta-carotene (tests with GB1 carotenoids are planned).
Conclusion: HU36 and GB1 carotenoids are very stable and have high antioxidant activity in chemical models of the gastric compartment. They were found bioavailable. Their structures favour a better solubility in aqueous systems, allowing a good bioaccessibility. *In vitro* intestinal absorption is moderate and the analysis of biological tissues from *in vivo* experiments will be determinant to evaluate their potential as functional additives.

Keywords
carotenoids, stability towards iron, chemical model system, antioxidant activity, bioaccessibility, in vitro digestion, Caco-2, bioavailability

Posters

Consumer's perception and expectations

Conso-P03	Evaluation of essential oils in selected allium vegetables and evaluation of the use of these vegetables as a spices	Monika Michalak-Majewska, Aneta Sławińska, Janusz Kalbarczyk	University of Life Sciences in Lublin	Poland
Conso-P04	Dehydration of Morocco tomato: effect on composition and organoleptic properties	Elisabeth Guichard, C. Salles, C. Septier, A. Raffak, A. Djerrari	INRA UMR CSGA Dijon	France
Conso-P06	Exploration of consumption of fruit and fruit products in Western Balkan Countries	S.J. Sijtsema, K. Zimmermann, I. Spiroski, M. Svetkovic, Z. Stojanovic, R. Butigan, B. Bajic, J. Milosevic, M. Esteve, C. Mora, X. Zhang, M. Klopcics	LEI Wageningen University and Research centre	Netherlands
Conso-P07	Cider production in Norway based on traditions and modern methods	Eivind Vangdal	Bioforsk Ullensvang, Lofthus	Norway

Innovative and sustainable processes

Inno-P01	Analytical study of phenolic compounds in the stones from three Moroccan olive varieties: test their effect on wood	Mustapha Elbir, A. Moubarik, E.Rakib, A. Amhoud, M.Mbarki	Faculty of Science and Technology, University Sultan Moulay Slimane	Morocco
Inno-P03	Fortification of yogurts with grape (*Vitis vinifera*) stem polyphenols	Vagia Chouchouli, Nick Kalogeropoulos, Spyros J. Konteles, Evangelia Karvela, Vaios T. Karathanos	Dpt Science of Dietetics and Nutrition Harokopio University Athens	Greece
Inno-P04	Use of a centrifuge decanter as an alternative to pneumatic pressing on red thermo-treated grape musts	L. Eudier, A. Samson, S. Caille, E. Aguera, M. Bes, G. Dangleville, L. De Vlieger, Jean-Michel Salmon	INRA, UE Pech Rouge, Montpellier	France
Inno-P06	Peeled fresh apple for distribution through vending machines	Elena Venir, Enrico Maltini	Department of Food Science University of Udine	Italy
Inno-P08	Tailorpack: Active tailor made and eco-friendly packaging for fresh fruits and vegetables preservation	Carole Guillaume, Barbara Gouble, Sébastien Lurol, Gero Decher, Nathalie Gontard	INRA-Université d'Avignon	France
Inno-P09	Ultrasound assisted maceration: an original procedure for direct enrichment of olive oil	Sabiha Achat, Valérie Tomao, Khodir Madani, Mohamed Chibane, Olivier Dangles, Farid Chemat	INRA-Université d'Avignon	France
Inno-P10	Effect of high-pressure/high-temperature processing on vegetable based ready meals	Romuald Chéret, François Zuber, Stéphane André	CTCPA Nantes	France
Inno-P11	New processes for production of fruit-derived products with optimised organoleptic and nutritional qualities: the ANR project TEMPANTIOX	C.M.G.C. Renard, A. Baron, C. Billaud, N. Biau, F. Chemat, G. Cuvelier, F. Courtois, L. Espinosa, F. Fort, S. Georgé, C. Le Bourvellec, L. Louarme, P. Sanoner, R. Symoneaux, M. Turk, E. Vorobiev	INRA-Université d'Avignon	France

Inno-P12	Optimization of enzymatic liquefaction of jicama (*Pachyrhizus erosus*) by Pectinex Ultra SP L	A.M. Ramos-de-la-Peña, C.M.G.C. Renard, L. Wicker, J.C. Montañez, M. de la Luz Reyes-Vega, J.C. Contreras-Esquivel	University of Coahuila	Mexico
Inno-P13	Physicochemical composition of the papaya powder by foam-mat drying process	Juliana ET Oikawa, Viviane Farago, Suélyn B. Nigelski, Maria H.G. Canteri, José LF Trindade	UTFPR- Campus Ponta Grossa	Brazil
Inno-P14	Formulation of thermosensitive bilberry anthocyanins in High-Temperature Short-Time extrusion process	Mario Hirth, Julie Le Grandois, D. Werner, E. Marchioni, H.P. Schuchmann	Karlsruhe Institute of Technology	Germany
Inno-P15	Design and development of REAlistic food Models with wellcharacterised micro- and macro-structure and composition (DREAM)	Peter Raspor, Lidija Baša, Monique A.V. Axelos	Biotehnical Faculty, University of Ljubljana	Slovenia
Inno-P16	Microwave hydrodiffusion, an innovative process for extraction of juice	Aurélie Cendres, Mélanie Hoerlé, Farid Chemat, Catherine M.G.C. Renard	INRA-Université d'Avignon	France
Inno-P17	Study of the effects of Pulsed Electrics Fields as an extraction process in red winemaking, on the Cabernet Sauvignon grapes and on the wine	Cristèle Delsart, C. Cholet, N. Grimi, M.A. Silva, R. Ghidossi, E. Vorobiev, M. Mietton Peuchot	Université de Bordeaux, ISVV	France
Inno-P18	Influence of spatial distribution and use of filters on the color of Golden delicious apples processed by pulsed light	Ingrid Aguiló-Aguayo, Olga Martín-Belloso, Robert Soliva-Fortuny	University of Lleida	Spain
Inno-P19	Preservation of antioxidant capacity of wild berry fruits during the concentration of fruit juices by mild membrane processes	András Boór, Katalin Bélafi-Bakó	University of Pannonia	Hungary
Inno-P20	Agro-Environmed project: eco-innovation in food industry	Yvan Deloche	Critt IAA PACA	France
Inno-P21	DIC swell-drying: an innovative and sustainable technology for fruits and vegetables processing	Ismaïl Mih, Tamara Allaf	ABCAR DIC Process, La Rochelle	France
Inno-P22	Effects of high hydrostatic pressure, heat treatment and acidification on carrot juice	Silvia Cofan-Carbo, Laia Carboné-Ballbè, Heloise Villaseca, Pierre A. Picouet	IRTA-Monells Food Processing Department, Girona	Spain
Inno-P23	Power density control in microwave assisted air drying to improve quality of food	Kisselmina Kone, Cyril Druon, Michel Delmotte, Albert Duquenoy, Jean-Claude Laguerre	Institut Polytechnique LaSalle, Beauvais	France
Inno-P24	Microbiological stability of Melon spherics processed by high pressure (HPP)	Silvia Cofan-Carbo, Laia Carboné-Ballbè, Pierre A. Picouet, Pere Castells, Héloïse Vilaseca	Fundació Alícia, Alimentació i Ciencià	Spain
Inno-P25	NMR Determination of a model of solute released from plant tissues in an aqueous environment	Audrey Tardieu, Marcia France, Hervé This	INRA Agroparistech	France
Inno-P26	Effect of High Intensity Pulsed Electric Fields on water-soluble vitamins of fruit juice-milk beverages	Laura Salvia-Trujillo, Mariana Morales-de la Peña, M. Alejandra Rojas-Graü, Olga Martín-Belloso	University of Lleida	Spain
Inno-P28	The effects of sample size and temperature on the diffusion of water soluble compounds from onions into aqueous solutions	Marcia France, Audrey Tardieu, Hervé This	Department of Chemistry, Washington and Lee University	USA

Inno-P29	Effect of high-intensity pulsed electric fields on vitamin c content in broccoli juice	Rogelio Sánchez-Vega, Pedro Elez-Martínez, Olga Martín-Belloso	University of Lleida	Spain
Inno-P32	Influence of sucrose composition on water sorption isotherms and on glass transition in apricots	Nadia Djendoubi Mrad, Catherine Bonazzi, Nourhène Mihoubi Boudhrioua, Nabil Kechaou, Francis Courtois	Superior Institute of Biotechnology, Université de la Manouba	Tunisia
Inno-P33	Optimized ultrasound-assisted water extraction of polyphenols from apple pomace	Daniella Pingret, Anne-Sylvie Tixier, Carine Le Bourvellec, Catherine M.G.C. Renard, Farid Chemat	Université d'Avignon	France
Inno-P34	Study of polyphenols adsorption on resin - kinetic models and coadsorption	Stéphane Bostyn, Henri Fauduet	Université d'Orléans	France
Inno-P36	Enzymatic degradation of apple tissue measured by micromechanics: preliminary results	Jean-François Maingonnat, Alain Baron, Catherine M.G.C. Renard	INRA-Université d'Avignon	France
Inno-P38	Potato starch biofilm with propolis extract and potassium permanganate: active packaging in quality maintaining of grape cv. Italy (*Vitis vinifera* L.)	Maira AR Taques, Denise Milleo de Almeida, Maria HG Canteri, Adenise L. Woiciechowski, Gilvan Wosiacki	UTFPR- Campus Ponta Grossa	Brazil
Inno-P40	Isothermal calorimetry approach for the study of fresh-cut fruit stability	Pietro Rocculi, V. Panarese, U. Tylewicz, P. Santagapita, E. Cocci, F. Gomez Galindo, S. Romani, M. Dalla Rosa	Bologna University	Italy
Inno-P41	Study of the rheological behavior of combined juices of red fruits	Charles WI Haminiuk, Maria-Rita Sierakowski, M SV Plata-Oviedo, Ivanise G Branco, Maria HG Canteri, Maria L Masson	Federal University of Technology, Paraná, Campus Ponta Grossa	Brasil
Inno-P44	New processes for improving appeal and nutritional value of processed fruit taking into consideration driving forces of the market: isafruit contribution	Witold Plocharski, Catherine Bonazzi, Nigel Brunton, T. Ronan Gormley, Catherine M.G.C. Renard	RIPF, 96-100 Skierniewice	Poland
Inno-P45	Grape seed oil obtained by supercritical fluid extraction: an oil rich in polyphenol compounds	Natacha Rombaut, Raphaëlle Savoire, Elisabeth Van Hecke, Jérémie Castello, Brigitte Thomasset, Jean-Louis Lanoisellé	Université de Technologie de Compiègne	France

Microbial and chemical safety and quality

Mic-P01	Physiological response of *Bacillus cereus* during conservation in anaerobic and cold conditions	Benoît de Sarrau, Thierry Clavel, Christophe Nguyen-thé	INRA-Université d'Avignon	France
Mic-P02	Thermophilic spore forming bacteria isolated from spoiled low-acid canned food: a nine-years survey.	Stéphane André, François Zuber, Fabienne Remize	CTCPA, Avignon	France
Mic-P03	Effect of lactobacillus fermentation on gallic acid and iron-gallic acid complexes	Dries Knockaert, Katleen Raes, Christophe Wille, John Van Camp	Department of Food Safety and Food Quality, Ghent University	Belgium

Mic-P04	Effects of ultraviolet radiation against Fusarium palidoroseum in 'Galia' and 'Yellow' melons and viability of pathogenic bacteria	Nedio Jair Wurlitzer, Paulo Roberto Gagliardi, Andréia Hansen Oster, Maria de Fátima Borges, Ebenézer de Oliveira Silva	Embrapa Agroindustria Tropical, Fortaleza	Brasil
Mic-P06	Modeling risk-benefit in a food chain: nutritional benefit versus microbial spoilage risk in canned green beans	Clémence Rigaux, Catherine M.G.C. Renard, Christophe Nguyen-thé, Frédéric Carlin, Isabelle Albert	INRA-Université d'Avignon	France
Mic-P07	Yeast microbiota of natural green table olives from Portugal.	Neusa Rodrigues, Célia Quintas	Universidade do Algarve	Portugal
Mic-P08	The effect of pre-treatment and modified atmosphere on quality of minimally processed coleslaw mix	Elżbieta Radziejewska-Kubzdela, Katarzyna Czaczyk, Róża Biegańska-Marecik	Poznań University of Life Sciences	Poland
Mic-P09	The Properties of Pickles Fermented with LAB Isolated From Traditional Pickles in Ankara-Cubuk Region	Mehmet Tokatli, Nurdan Arslankoz, Simel Bagder, Filiz Ozcelik	Ankara university, department of food engineering	Turkey
Mic-P10	Decontamination of fresh produce by sequential wash in weak organic acid solutins	Sami Bulut	Trakya University	Turkey
Mic-P11	The survey of the incidence and level of patulin contamination in baby food on the Serbian retail market	Gorica Vuković, Marinela Tadić, Marija Stanković, Sanja Lazić, Vojislava Bursić	Institute of Public Health, Belgrade	Serbia
Mic-P12	Evaluation of analytical methods for determining pesticides in baby food	Deyana Shtereva, Rositsa Mladenova, Gorica Vuković, Sanja Lazić, Vojislava Bursić	Institute of Public Health, Belgrade	Serbia
Mic-P13	Assessment of inhibition assays in microarrays platforms to measure individual allergenic components in foods.	Idoia Postigo, Jorge Guisantes, Ester Suñén, Maialen Ceballos, Dana Gabrovská, Jorge Martinez	Faculty of Pharmacy. University of the Basque Country	Spain
Mic-P14	Solid particles from flash-release treatment of grapes: homogenous physical structure, but yeast nutritional heterogeneity	Corinne Trarieux, Evelyne Aguera, Alain Samson, Aude Vernhet, Jean-Michel Salmon	INRA, UE Pech Rouge, Montpellier	France
Mic-P15	Oxygen consumption by the must of cider apple at the beginning of fermentation	Jean-Michel Le Quéré, Rémi Bauduin, Sylvain Guyot, Alain Baron	INRA Recherches Cidricoles, Rennes	France
Mic-P16	The mixed yeast flora in cider fermentation	Rémi Bauduin, Céline Langlais, Jean-Michel Salmon, Jean-Michel Le Quéré, Alain Baron	INRA Recherches Cidricoles, Rennes	France
Mic-P17	Antimicrobial activity and composition of the essential oils of origanum spp. cultivated under the good agricultural practics in Turkey	Yüksel Kan, Murat Kartal, Zeki Aras, Ayşe Çelik	Selçuk University, Agricultural Faculty	Turkey
Mic-P18	Quality of kale (*Brassica oleracea* var. *acephala*) at the application of minimal processing and modified atmosphere packaging with microperforation of packaging material	Róża Biegańska-Marecik, Elżbieta Radziejewska Kubzdela, Katarzyna Czaczyk	Poznań University of Life Sciences	Poland
Mic-P19	Comparison of volatile compounds of fresh and fermented aplle juice from different apple varieties	Zanda Kruma, R.Riekstina-Dolge, D.Karklina, D. Seglina	Latvia University of Agriculture	Latvia
Mic-P20	Enzymatic processing of the aleurone cereal fraction increases its antioxidant capacity	Natalia Rosa, Michèle Loonis, Claire Dufour, Valérie Micard	Supagro Montpellier, France	France

Mic-P21	Effects of ethyl formate on dates (deglet nour) quality and carob moth pest mortality	Haithem Bessi, Sihem Bellagha, Kaouther Grissa, Veronique Bikoba, Elizabeth J.Mitcham	National Institue agronomic of Tunisia	Tunisia
Mic-P22	Effect of cultivar and fruit storage on composition of clear and cloudy pear juices	Jarosław Markowski, Monika Zbrzeźniak, Monika Mieszczakowska-Frąc, Krzysztof Rutkowski, Wioletta Popińska	Instytut Ogrodnictwa, Skierniewice	Poland
Mic-P23	Multi-scale measurements of porosity in fruits by Magnetic Resonance Imaging	Maja Musse, François Mariette	Cemagref, Food Process Engineering Research Unit, Rennes	France
Mic-P24	Effects of percolation and water content in the NIR spectrum of acai pulp	Sandra Leandro Koizimi, Valquiria Garcia Lopes, José Dalton Cruz Pessoa, Gustavo Henrique de Almeida Teixeira, Luis Carlos Trevelin	Dpt of Biotechnology, Federal University of São Carlos	Brasil
Mic-P25	Segregation analysis of mandarin and clementine volatile compounds during fruit ripening and evaluation of peel impact on aromatic property during juice processing	Toussaint Barboni, Nicolas Venturini, Julien Paolini, Pierre Tomi, François Luro, Alain Muselli, Jean Costa	Université de Corte, UFR Sciences	France
Mic-P26	Relationship between browning and related enzymes (PAL, PPO and POD) during storage of different carrots varieties	Elodie Sarron, Sophie Lecomte, Nelly Cochet, Pascale Gadonna Widehem	Institut Polytechnique LaSalle, Beauvais	France
Mic-P27	Useful and rapid tools for fruit quality determination before processing	Sylvie Bureau, Maryse Reich, Catherine M.G.C. Renard	INRA-Université d'Avignon	France
Mic-P28	Intra-fruit texture variation in apricot fruits and relation with the texture after cooking	Crépin Ella Missang, Jean-François Maingonnat, Catherine M.G.C. Renard, Jean-Marc Audergon	Université des Sciences et Techniques de Masuku	Gabon

Nutritional qualities of processed products

Nutr-P01	Evolution of allicin contents on minimally processed garlic (*Allium sativum* L.) cloves	Telma Veríssimo, Ivone M. C. Almeida, Luís M. Cunha, M. Beatriz P.P. Oliveira	Faculdade de Ciências da Universidade do Porto	Portugal
Nutr-P02	Espresso coffee composition: influence of technological parameters	Rita C. Alves, Susana Casal, M. José Núñez, M. Beatriz P.P. Oliveira	Faculty of Pharmacy/University of Porto	Portugal
Nutr-P03	Modulation of bitterness and astringency of French ciders by the choice of treatments from pressing to bottling	Jean-Michel Le Quéré, Rémi Bauduin, Alain Baron	INRA Recherches Cidricoles, Rennes	France
Nutr-P04	Lycopene oxidation and isomerization kinetics depend on the food matrix	I. Colle, Lien Lemmens, Sandy Van Buggenhout, K. De Vleeschouwer, Ann Van Loey, Marc Hendrickx	KU Leuven	Belgium
Nutr-P05	Evaluation of ascorbic acid degradation during fruit dessert processing under conventional or ohmic heating treatment	Loïc Louarme, Catherine Billaud	CNAM, Paris	France

Nutr-P06	Biochemical and nutritional characterization of baobabs pulp of Madagascar and continental Africa	Renaud Boulanger, I. Cissé, D. Montet, M. Reynes, N. Durand, J. Grabulos, P. Danthu, B. Yao	UMR QualiSud, Cirad Montpellier	France
Nutr-P07	Influence of ultrasound treatment on the stability of all-E-béta, béta-carotene	Michel Carail, Anne-Sylvie Fabiano-Tixier, Karim Daflaoui, Farid Chemat, Catherine Caris-Veyrat	INRA-Université d'Avignon	France
Nutr-P08	Impact analysis of season and process on in vitro biological activities of spinach extracts	S. Léger-Clavel, Laurence Depezay, A. Coussaert, E. Chappuis, C. Ripoll	Bonduelle	France
Nutr-P09	Native fructose extracted from apple improves glucose tolerance in mice	Aurélie David, Pierre Lapoujade, Philippe Valet, Cédric Dray, Françoise Ouarne, Alain Guibert	Nutritis, Montauban,	France
Nutr-P10	An in vitro model to quantify the lycopene diffusion from processed tomato to a lipid phase as occurrs in the stomach bolus	Antoine Degrou, David Page, Stephane Georgé, Maryse Reich, Catherine M.G.C.Renard	CTCPA Avignon	France
Nutr-P11	What happens to folate when green beans and spinach are cooked in home conditions?	Nicolas Delchier, Maryse Reich, Catherine M.G.C. Renard.	INRA-Université d'Avignon	France
Nutr-P12	Impact of local cooking on b-carotene bioaccessibility from orange fleshed sweet potato derived products made in Uganda	Claudie Dhuique-Mayer, Marie Poulaert, Keith Tomlins, Andrew Westby, Aurélie Bechoff	UMR QualiSud, Cirad, Montpellier	France
Nutr-P13	Assessment of antioxidant effects of some cereal grains using in vitro test systems	Fatma Sezer Senol, Asuman Kan, Ilkay Erdogan-Orhan, Gulay Coksari	Gazi University, Faculty of Pharmacy, Ankara	Turkey
Nutr-P14	Comparative studies on neuroprotective potentials of different terebinth coffee commercial brands and the unprocessed fruits of *Pistacia terebinthus* L. and their phytochemical analyses	Ilkay Erdogan-Orhan, Fatma Sezer Senol, Ali Rifat Gulpinar, Nazim Sekeroglu, Murat Kartal, Bilge Sener	Gazi University, Faculty of Pharmacy, Ankara	Turkey
Nutr-P15	Evaluation of neuroprotective effects of the Maydis stigma extracts from four corn varieties using in vitro experimental models	Asuman Kan, Ilkay Erdogan-Orhan, Gulay Coksari, Bilge Sener	Vocational School of Technical Sciences, Selçuk University, Konya	Turkey
Nutr-P16	HPLC and LC-MS analysis of ferutinin in Ferula eleaochytris root: A natural aphrodisiac growing wild in Hatay province (Turkey)	Ilkay Erdogan-Orhan, Ali Rifat Gulpinar, Murat Kartal	Faculty of Pharmacy, Ankara University	Turkey
Nutr-P18	Assessment of cholinesterase inhibitory and antioxidant properties and quantification of rutin and fatty acids in buckwheat (*Fagopyrum esculentum* Moench)	Ali Rifat Gulpinar, Ilkay Erdogan-Orhan, Asuman Kan, Fatma Sezer Senol, Sadiye Ayse Celik, Murat Kartal	Faculty of Pharmacy, Ankara University	Turkey
Nutr-P19	Changes in the antioxidant properties of dried fruit during storage	Piotr Gębczyński, Radosława Skoczeń-Słupska, Anna Korus and Jacek Słupski	Agricultural University of Krakow,	Poland
Nutr-P20	Changes in vitamin C content in selected cabbage vegetables depending on the drying method and storage conditions of dried products	Piotr Gębczyński, Katarzyna Kur, Jacek Słupski and Zofia Lisiewska	Agricultural University of Krakow	Poland

Nutr-P21	Effect of dietary fat on sweet corn carotenoid bioavailability	Béatrice Gleize, Franck Tourniaire, Laurence Depezay, Romain Bott, Marion Nowicki, Lionel Albino, Denis Lairon, Marie Josèphe Amiot, Patrick Borel	Université de la Méditerranée, Marseille	France
Nutr-P22	Effect of Thermal Treatment on Bioactive Compounds and Antioxidant Activity of Some Garlic Verities (*Allium sativa*)	Abderrahmane Mokrani, Hayette Louaileche, Lynda Arkoub-Djermoune	Université de Béjaia	Algeria
Nutr-P23	Dietary supplements and teas: comparison of phenolics content and antiradical activity	Mariana R. Carvalho, Ivone M.C. Almeida, Rita C. Alves, M. Fátima Barroso, M. Beatriz P.P. Oliveira, Anabela S.G. Costa	REQUIMTE/ Dep. Ciências Químicas, Fac. de Farmácia, Universidade do Porto	Portugal
Nutr-P24	Improving quality and health-related properties of grape juice	Giuseppe Genova, Pietro Tonutti	Scuola Superiore Sant'Anna, Pisa	Italy
Nutr-P25	Structure activity relationship of apo-lycopenoids in the inhibition of metmyoglobin-induced lipid peroxidation	Pascale Goupy, Eric Reynaud, Olivier Dangles, Catherine Caris-Veyrat	INRA-Université d'Avignon	France
Nutr-P26	LC-MS quantification of caffeicin-like phenolic compounds in apple juices and ciders	N. Marnet, D. Parrot, S. Bernillon, Alain Baron, Sylvain Guyot	INRA, URC Le Rheu	France
Nutr-P27	Identification of phenolic compounds from pomegranate (*Punica granatum* L.) juice of Moroccan cultivars	Ilham Hmid, Driss Elothmani, Hafida Hanine, Ahmed Oukabli, Abdelmajid Haddioui, Emira Mehinagic, Omar Khatabi	Ecole Supérieure d'Agriculture d'Angers	France
Nutr-P30	Berry seeds: a source of speciality oils with high nutritional value	Roland Verhé, V. Van Hoed, C. Stevens, H. Grisart, C. Schatteman	Ghent University, Faculty Bioscience Engineering	Belgium
Nutr-P31	The quality evaluation of marmelade candies during the storage	Solvita Kampuse, Sandra Muizniece-Brasava, Zanda Kruma, Eva Ungure	Latvia University of Agriculture	Latvia
Nutr-P32	Antioxidant properties and phenolic composition of juice from cladodes of Prickly Pear (*Opuntia ficus indica*) of Moroccan origin.	Khatabi Omar, Elothmani Driss, Hanine Hafida, Emira Mehinagic, Hmid Ilham	ESA Angers	France
Nutr-P33	A comparison of anthocyanins, phenolic compounds, and antioxidant activity in different species of berry fruit grown in Poland and in their juice	Marcin Kidoń, Janusz Czapski	Poznań University of Life Sciences	Poland
Nutr-P34	Influence of harvest season in anthocyanin content of açaí pulp (*Euterpe oleracea* Mart.)	Sandra Leandro Koizimi, Valquiria Garcia Lopes, José Dalton Cruz Pessoa, Gustavo Henrique de Almeida Teixeira, Luis Carlos Trevelin	Departament of Biotechnology, Federal University of São Carlos	Brasil
Nutr-P35	Valorization of mediterrenean wines by-products : phenolic caracterization and antioxidant activity	Isabelle Ky, Natallia Kolbas, Jean-Michel Merillon, Pierre –Louis Teissedre	Faculté d'Œnologie, Bordeaux	France
Nutr-P36	Identification and characterization of phenolic compounds extracts from olive by-products	Inass Leouifoudi, M. Mbarki, E. Rakib, J.A. Zyad	Faculty of Science and Technology University of Sultan Moulay Slimane	Morocco

Nutr-P37	Bioactive phytochemicals in byproducts of industrial tomato processing	Nick Kalogeropoulos, Antonia Chiou, Vassiliki Pyriochou, Anna Peristeraki, Margarita Christea, Vaios T. Karathanos	Department of the Science of Dietetics and Nutrition Harokopio University Athens	Greece
Nutr-P39	New approaches for microbial risk - nutritional benefits assessment in the case of heat processed vegetables	Christophe Nguyen-thé, C. Renard, F. Courtois, D. Aoude-Werner, S. Georgé, M. El-Jabri, I. Albert, O. Couvert, V. Lepape, L. Albino	INRA-Université d'Avignon	France
Nutr-P40	Determination of antioxidants contents from some dried fruits and evaluation of their antioxidant activities	Salim Ouchemoukh, Said Hachoud, Hamou Boudrahem, Abderrahmane Mokrani, Hayette Louaileche	Faculté de Béjaia	Algeria
Nutr-P43	Polyphenol oxidase activity in fresh-cut sweet peppers of cultivars 'California wonder' and 'Quadrato d'Asti'	Riccardo N. Barbagallo, Cristina Patanè	DISPA, University of Catania	Italy
Nutr-P44	Fermentation of a commercial fiber product to release phenolic compounds	Dries Knockaert, Katleen Raes, Christophe Wille, Karin Struijs, John Van Camp	Department of Food Safety and Food Quality, Ghent University	Belgium
Nutr-P45	Proximate composition of raw and cooked sicilian chickpea seeds	Giovanni Avola, Cristina Patanè, Riccardo N. Barbagallo	CNR-ISAFOM, Catania	Italy
Nutr-P46	Fruit Carotenoids affect the bioaccessibility and intestinal cell uptake of β-carotene from orange fleshed sweet potato	Marie Poulaert, Patrick Borel, Ziya Gunata, Claudie Dhuique-Mayer	UMR QualiSud, Cirad, Montpellier	France
Nutr-P47	In vitro bioavailability of isoflavones in a fruit juice - soymilk beverage	Maria Janeth Rodríguez-Roque, Maria Alejandra Rojas-Grau, Pedro Elez-Martínez, Olga Martín-Belloso	University of Lleida. Department of Food Technology	Spain
Nutr-P48	A systematic survey of polyphenol losses during food processing based on the analysis of the scientific literature	Nouha M'Hiri, J. Perez-Jimenez, P. Garcia Lobato, A. Scalbert	Inat, Bizerte	Tunisia
Nutr-P49	Phenolic contents and quality changes of different sweet cherry cultivars from Norway stored in modified atmosphere packing (MAP) bags	Branka Mozetič Vodopivec, Alena Gibalova, Rajko Vidrih, Eivind Vangdal	University of Nova Gorica	Slovenia
Nutr-P50	Labels of commercial juices: are they really informative?	M. Antónia Nunes, Anabela S.G. Costa, Rita C. Alves, M Beatriz P.P. Oliveira	Faculty of Pharmacy, University of Porto	Portugal
Nutr-P51	Monitoring Quality of Fresh-Cut Baby Leaf Vegetables used for salads	Joana e Oliveira Santos	Dep. Ciências Químicas, Faculdade de Farmácia	Portugal
Nutr-P52	Effect of probiotic cultures on the anthocyanins stability in blueberry yoghurts	Iwona Ścibisz, Małgorzata Ziarno, Marta Mitek, Dorota Zaręba	Department of Food Technology, Warsaw University of Life Sciences	Poland
Nutr-P53	Antioxidant activity and total phenolics of commonly consumed edible mushroom in poland	Aneta Sławińska, Monika Michalak-Majewska, Janusz Kalbarczyk	University of Life Sciences in Lublin,	Poland

Nutr-P54	Comparison of the nutritional quality of sous vide and conventionally processed carrot and Brussels sprouts	Nicoletta Pellegrini, Teresa Mazzeo, Emma Chiavaro, Chiara Manzi, Vincenzo Fogliano	University of Parma	Italy
Nutr-P55	Antioxidant and anti-inflammatory activities of Ribes nigrum extracts	Jessica Tabart, T. Franck, C. Kevers, Joël Pincemail, J. Dommes	University of Liège	Belgium
Nutr-P56	Composition and nutritional aspects of the military diet in Slovenia	Ksenija Podgrajšek, Anja Janeš, Tamara Puš, Janez Hribar, Marjan Simčič	University of Ljubljana, Biotechnical faculty	Slovenia
Nutr-P58	Composition of oil extracts obtained of seeds separated from industrial black currant pomaces or freeze-dried fruits grown in Poland	Michał Sójka, Edward Rój	Technical University of Lodz	Poland
Nutr-P59	Evolution of flavonoids composition during fruit ripening of *Citrus medica* L. var. corsican	Nicolas Venturini, Franck Curk, Julien Paolini, Jean-Marie Desjobert, Jean Costa	Université de Corte, UFR Sciences Laboratoire Chimie des Produits Naturels	France
Nutr-P60	Vitamin C retention in different plant foods after cooking in an electric fryer	Frédéric J Tessier, Céline Niquet-Léridon, Philippe Jacolot, Céline Sobole	Institut Polytechnique LaSalle, Beauvais	France
Nutr-P61	Fatty acid composition of alternative sources: case of small fruits and sweet cherries	Rajko Vidrih	University of Ljubljana, Biotechnical faculty	Slovenia
Nutr-P62	Interactions between pectins and procyanidins: consequences of heat treatment	Aude Watrelot, Carine Le Bourvellec, Catherine M.G.C. Renard	INRA-Université d'Avignon	France
Nutr-P63	Study on the profile of volatile compounds of deep fried iodine-enriched and non-enriched potatoes	Valeria Zanirato, Raffaella Inchingolo, Maria Teresa Rodriguez-Estrada, Stefano Savioli, Giovanni Lercker	Department of Food Science, University of Bologna	Italy
Nutr-P64	Antioxidant activity, phenolic content and physicochemical composition of tropical fruits cultivated in Costa Rica	María Laura Montero Díaz, Ana Mercedes Pérez, Carolina Rojas Garbanzo, Óscar Acosta-Montoya, Jessie Usaga Barrientos	Centro Nacional de Ciencia y Tecnología de Alimentos - CITA	Costa-Rica
Nutr-P65	Evidence of health benefits of polyphenolsenrichedfoods: from in vitro studies to clinical trials performed at University–CHU of Liège, Belgium	Joël Pincemail, C. Kevers, Jessica Tabart, A. Sipel, JA Michiels, A. Albert, J. Dommes, JO Defraigne.	University of Liège–CHU	Belgium
Nutr-P66	Kinetics of thermal degradation of vitamin C in marula fruit (*Sclerocarya birrea* subsp. caffra) as compared to other selected tropical fruits	Penny Hiwilepo, Charlotte Bosschaart, Charlotte van Twisk, Ruud Verkerk, Matthijs Dekker	Product Design and Quality Management Group, Wageningen University	Netherlands
Nutr-P67	Nutritionnal properties of seaweeds	Hélène Marfaing	CEVA, Presqu'Ile de Pen Lan, Pleubian	France
Nutr-P68	Carbohydrates and total phenolic contents of domestic cooked artichoke	Gaëlle Leroy, Céline Baty-Julien, Serge Mabeau, Jean-François Grongnet	Vegenov-BBV, Penn-ar-Prat, Saint Pol de Léon	France

I/ Consumer's perception and expectations

N° Conso-P03 - Evaluation of essential oils in selected allium vegetables and evaluation of the use of these vegetables as a spices

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Allium vegetables are used as spices in a wide range. Their sensory characteristics are associated with the presence of volatile essential oils, which content in fresh plants normally not exceed a few percent [Brewster, 2008].
In the technological process, vegetables used for seasoning are subjected to drying. The method of carrying out this process, its parameters and conditions for the harvesting of raw materials have a decisive impact on the quality and characteristics of the products offered to the consumer. During the curing of raw materials, their active ingredients, including essence components, are undergo many changes, which reducing their concentration in the material. Consequently, it differentiates the quality of flavor dried vegetables, which are used by manufacturers of convenience foods and food concentrates, and individual consumers.
The dynamic development of the food industry in Poland, especially dinner concentrates and low-salt, low-fat foods, stimulates the growth of consumption of spices, improving their quality and production of new forms, adapted to the requirements of modern technological processes [Kowrygo and Rowińska, 2009]. Seasonal availability of spices vegetables and economic aspects, related to the costs of distribution (reduction of volume, reduce storage costs) create the need for preservation of these products.
The objectives of the present study were to determine the effect of freeze-drying and air-drying on aroma volatiles of onion and garlic, compared to those of fresh vegetables, and to evaluate the impact of processing on odor characteristics - intensity and typicality.
Research material consisted of fresh vegetables - onions and garlic, which were purchased through retail trade. The total content of essential oils was determined using a Deryng apparatus (method II), and their composition was identified by GC-MS. In the fresh and preservation (frozen-dried and air-dried) samples estimated odor intensity and odor typicality by applying them to model vegetable-meat bouillons.
To evaluate the characteristics of each sample was used sensory evaluation of the quality: ranking test, scaling test and quantitative descriptive analysis (QDA) [ISO, 2003]. To estimate the differences in sensory quality one-way analysis of variance were used. Testing was conducted at the significance level of 0.05.
Based on the survey it was found, that analysed varieties of fresh allium vegetables characterized a quite high level of essential oils, which could affect the intensity of the odor perceived by consumers.
There were significant differences between the dried vegetables of onions and garlic, depending on the method of preservation (frozen-dried and air-dried). The intensity and typicality air-dried samples were evaluated statistically lower in comparison with the other. However, the form - the raw fresh material and lyophilized samples, despite differentiating the samples, was not statistically significant for the tested parameters.
The results suggest that the quality of food products obtained from the air-dried and frozen-dried material was different. The intensity of aroma and taste and odor typicality was evaluated higher in the samples where raw or frozen-dried material was used, rather than air-dried. This is due to losses in aromatic compounds resulting in a change in the odor profile of seasoning vegetables, which happened during the process of air-drying. This was confirmed in the scaling test and QDA method.

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ISO 13299:2003. Sensory analysis. Methodology. General guidance for establishing a sensory profile

Keywords
essential oils, air-dried, frozen-dried seasoning vegetables, sensory quality

N° Conso-P04 - Dehydration of Morocco tomato: effect on composition and organoleptic properties

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Context and rationale: Tomato is one of the main vegetable of the Mediterranean diet. It is a basic food in the Morocco cookery. Drying of tomato is an important way of valorisation. However, the drying process can lead to important changes compared to the initial flavour compound content of fresh tomato (1-3). The aim of this work is to study the drying parameters of Jana, a typical Morocco variety in order to optimize drying duration with a final product of good quality.
Material and methods: Humidity, minerals, carotenoid, sugar, acid and aroma composition were measured to characterize the fresh Jana tomato, in comparison with a more common variety: Gabriella. Both the effect of temperature and slice thickness were evaluated on the drying kinetic of Jana tomato. *Results*: The consequences of the drying process on water activity, glucose, fructose, organic acids and sensory characteristics are different according to the conditions. For fixed slide thickness and temperature, a model allowing an estimation of the drying time was established.
For both fructose and glucose, their concentration reported to dry matter were higher than in fresh tomato for drying at 60 and 75°C. At 90°C, their concentration decreased drastically. Low slice thickness preserved better the reducing sugar content whatever the drying temperature. These data were corroborated with sensory analysis. Increasing the drying temperature led to a decrease of sweetness intensity while sourness remained unchanged. During dry tomatoes storage, potassium, citric, malic and lactic acids contents increased during the 2 first months and were then stable. That can influence taste properties of dry tomato.
The analysis of the volatile fraction showed an important increase of furanic compounds and decrease of the most volatile compounds during storage. These changes in composition induced a drastic loss of aromatic sensory characteristics measured by GC-olfactometry experiment.
Conclusion: The main drying parameters for tomato can be predicted from modelling study. However, this process leads to considerable changes in composition of both non volatile and volatile components leading to changes in sensory qualities of the dehydrated product, in particular, an important decrease of sweetness and aroma intensity.

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Keywords
tomato, drying process, flavour, composition

N° Conso-P06 - Exploration of consumption of fruit and fruit products in Western Balkan Countries; perceptions, motives and barriers of consumers

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Perception and consumption of fruit is often studied from a western European perspective. The aim of this study is to explore motivations and barriers of fruit and fruit products consumption from Western Balkan perspective. Six different countries are covered in the Western Balkan Region; Bosnia-Herzegovina, Croatia, FYRoM, Montenegro, Serbia and Slovenia.
By means of in total 180 in-depth face to face interviews in those countries a qualitative understanding is gained of consumption of fruit and fruit products such as jam, juice and dried fruit, motivations and barriers, position of home grown fruit, and preferred place to buy fruit.
Fresh fruit consumption of participants is rather high, 82% of the participants consume a portion of fruit at least once a day. Also consumption of fruit juice seems rather high. At least half of the participants say that one third of the fruit they consume is home grown or from orchards from family and friends. This is a specific characteristic of fruit consumption in the Western Balkan Countries (WBC), about which is not much known yet. This tradition of home grown fruit might influence how consumers perceive fruit, due to seasonality, harvesting and preparing their own preservatives or getting it from people you know. The latter is also an issue when buying fruit, WBC like to buy fruit from people they know, thus they prefer to buy directly from a farmer or at the green market, because they consider this fruits to be more safe. However, in everyday life the participants actually mainly buy their fruit from the green market or supermarket.
In accordance with literature taste and health are mentioned as the most important motivations to eat fruit. Compared to west EU, it is striking that convenience aspects and appearance seem not to be motives which are taken into consideration in this region. The most often mentioned barriers related to fruit consumption are price, availability and lack of habit.
When discussing processed fruits the participants thought in particular of home grown products, which you do not buy. The motivations for consumption of processed fruits are taste, health, availability and substitute for fresh fruit. Food products are less common than fresh fruits and consumed more in seasons when fresh fruit is less available. For those fruit products eating habits, availability and product safety are experienced obstacles. For example, dried fruit they like for its taste, health, better digestion and you can eat them when no fresh fruit is available, but they are not appreciated because of the price and unpleasant taste.
Generally spoken the participants of all six countries show the same picture which is quite specific for this region due to the tradition of home grown fruits and homemade processed fruits, but in line with the transition of those countries a difference is seen between urban and rural areas.
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Keywords
consumers, expectations, Western Balkan Countries, fruit products

N° Conso-P07 - Cider production in Norway based on traditions and modern methods

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In the fruit growing area Hardanger, in the fjord districts of Western Norway, a cider based on the local apples was been produced for centuries. Strict regulations on production and marketing of alcoholic brews, stopped the commercial production 70 years ago.

Around 1990 the interest for local foods and drinks opened the way again for a commercial production of apple cider from Hardanger. The cider producers (organized in a cider producers' association), in cooperation with Bioforsk Ullensvang Horticultural Research Centre (a local division of The Norwegian Institute for Agricultural and Environmental Research) started the work to

- improve the quality of cider from Hardanger
- implement a quality control system
- get a AOC-like geographical protected brand (Sider fraa Hardanger = Cider from Hardanger) (accepted by KSL Matmerk - The Norwegian Agricultural Quality System and Food Branding Foundation)

The traditional cider from Hardanger is different from ciders elsewhere in Western Europe:

- the production is based on apples primarily grown for fresh consumption
- juice is produced when the apples are still firm and crisp
- sugar is added to make a stronger cider (often around 10% ethanol) with 20-30 g/liter sugar for sweetness in the final products

Knowledge in modern cider production has been sought in the cider producing areas in Western Europe (France, SW England, North of Spain). Advicer Herve Duclos from Normandy has visited Hardanger almost every year since 2003, and the cider producers have visited colleagues in several European countries.

In the poster the R&D-work on cider production based on old traditions and modern methods, will be described more closely. Future R&D-challenges will be discussed.

2| Innovative and sustainable processes

N° Inno-P01 - Analytical study of phenolic compounds in the stones from three Moroccan olive varieties: test their effect on wood

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The phenolic extracts are compounds derived from agricultural food products. Among these products there under the olive stones, which are not sufficiently valued, particularly in a country with an olive oil industry such as Morocco. It was, also, demonstrated that the presence of these phenolic compounds is positively correlated with the durability of wood. This property is very interesting for outdoor uses of by-products of olive tree, with a limited treatment. In this context, the main objective of this work was to find new ways to valorisation of olive stones through chemical and biological analysis, in a first step. The phenolic compounds may be used for the synthesis of natural wood adhesive. In order to improve knowledge on olive stones, we studied the polyphenols concentration of stones from three Moroccan olive varieties; Picholine, Menara and Haouzia. The solid-liquid extraction of polyphenols was performed by Soxhlet method. The chemical identification of olive stones compounds was performed using Fourier Transform Meadle Infrared Spectroscopy (FT-MIR). The determination of phenolic compounds is made according to the Folin Ciocalteau method. Biodegradation studies show that wood bended with a new, environment-friendly adhesive derived from Stones tannin improves the total resistance of the wood composite against both *Coriolus versicolor* and *Coniophora puteana* rot fungi.

Keywords
olive stone, Picholine, Menara, Haouzia, phenolic compounds, FT-MIR, Folin Ciocalteau method, decay resistance

N° Inno-P03 - Fortification of yogurts with grape (*Vitis vinifera*) stem polyphenols

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Introduction and scope: The winemaking industry in Europe results in an annual production of 14.5 million tones of grape byproducts -skins, seeds and stems- (Pinelo et al. 2006), known to be rich in polyphenolic phytochemicals, which exert a wide spectrum of bioactivities. Grape stems, have been given relatively little attention although they contain substances not encountered in other by-products, e.g. flavonols, stilbenes, monomeric and oligomeric flavanols. In the present study we evaluated stems extracts as source of bioactive polyphenols for the production of polyphenol fortified yogurts.
Methodology: Ethanolic extracts of stems from two wine grape varieties, widely cultivated in Greece, one red used for white wine production (Moschofilero) and one red used for red wine production (Agiorgitiko) were added in full-fat and low-fat yogurts at 650mg/kg. Stems were obtained from wineries of Attica immediately after destemming of grapes and were extracted with ethanol-water under conditions optimized by factorial design and response surface methodology (Karvela et al., 2009).
Control and fortified yogurt samples were refrigerated and at days, 0, 7, 14, 21, 32 the total phenolic content, DPPH$^{\bullet}$ radical scavenging capacity and ferric ion reducing antioxidant power (FRAP) were assayed. Additionally, simple polyphenols were quantitated by GC/MS.
Results: The results, presented in Table 1, indicate that fortified yogurts contained polyphenols, which were present even after 32 days of storage. They also exhibited antiradical and antioxidant properties compared to control samples. Low-fat samples contained less polyphenols probably due to their higher protein content and the known ability of proteins to bind with polyphenols.

Table 1. Total phenolic content, DPPH$^{\bullet}$ scavenging capacity, FRAP, and simple polyphenols, per 100 g fresh weight of fortified and control yogurts at days 0 and 32.

	Time days	Total phenols (mg GAE)	DPPH scavenging capacity (mmol TE)	FRAP (mmol AAE)	Catechin (μg)	Epicatechin (μg)	Gallic acid (μg)
			Full-fat yogurts				
Moschofilero	0	42.06	6.99	1.02	32.20	1.93	25.76
	32	14.76	0.88	0.73	26.10	0.94	24.32
Agiorgitiko	0	44.21	6.15	1.26	17.74	2.18	27.93
	32	15.53	1.04	0.63	13.79	1.28	24.66
Control	0	22.50	2.08	0.55	n.d.	n.d.	n.d.
	32	14.25	0.79	0.60	n.d.	n.d.	n.d.
			Low-fat yogurts				
Moschofilero	0	18.31	4.35	0.88	29.84	0.96	25.69
	32	7.73	1.34	0.72	22.02	0.31	24.81
Agiorgitiko	0	17.49	4.87	1.16	26.21	1.95	27.26
	32	8.25	1.44	0.74	17.70	0.95	24.59
Control	0	11.91	2.50	0.61	n.d.	n.d.	n.d.
	32	7.18	1.32	0.64	n.d.	n.d.	n.d.

GAE stands for gallic acid equivalents; TE stands for Trolox equivalents; AAE stands for ascorbic acid equivalents.

Implications: Stems by-products can be successfully employed for the production of polyphenol- fortified yogurts.

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Keywords
yogurt, vinification by-products, stems, polyphenols

N°Inno-P04 - Use of a centrifuge decanter as an alternative to pneumatic pressing on red thermo-treated grape musts

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An Alfa Laval FOODEC 200 decanter centrifuge was tested during 2007-2009 vintages for the clarification of thermo-treated or flash-released pressed grape musts, but also directly on the same thermo-treated grapes after an enzymatic treatment in replacement of the traditional pneumatic pressing step. In this last condition, the utilization of a decanter centrifuge allows to obtain very similar turbidity levels, and very similar final wines with identical sensory attributes (empyreumatic, animals and fruity notes). However, the final turbidity level reached in the treated musts remains insufficient to meet the expectations of wines with amylic or pastry sensory attributes after fermentation. For such an objective, it is therefore necessary to couple the decanter centrifuge technology with other clarification techniques.

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Keywords
decanter centrifuge, flash release, thermo-treatment, turbidity, sensory analysis

N° Inno-P06 - Peeled fresh apple for distribution through vending machines

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Context and rationale: promoting fruit and vegetable consumption is recognized as an important tool toward health education and good dietary habits. Children, teenagers and young people are the main targets of this strategy, even if adult people can also be involved. Typical distribution channels highly appreciated by these social segments are snack cabinets and vending machines, usually located in schools, youth centers, educational and public institutions and others private and public meeting places.
Distribution by vending machines can make easier and pleasant the consumption of ready to eat fruits at all times and in a number of different occasions.
In the present work a process preparation able to provide fresh, peeled, packaged whole apples, suitable for distribution through vending machines, is proposed. The prepared apple should be eaten as it is, after removal of the package. An apple product prepared on the basis of the present study is now undergoing selected market tests in Italy.
Materials and methods: the process flow sheet was as follows:
Raw apples- the cv. Golden delicious was preferred due to its availability all over the year and to its low natural browning tendency.
Washing – in cold clorinated water (average active Cl ~ 5%).
Rinsing – in cold running water and draining.
Peeling – mechanical peeling by automatic apple peeler. Apples were not cored.
Dipping in stabilizing solution – seven combinations of citric and ascorbic acid, calcium and sodium chloride were tested.
Packaging – single apples were packaged in vacuum heat shrink film. Shrinkage in water at 85 °C for 2-4 sec.
Refrigerated storage at 7 °C
Apples were evaluated for color (browning), taste and crunchiness by panel tests, before and during storage at 7° C. Microbiological control for mesophylic and psychrotrophic bacteria, lactic bacteria and yeasts was performed on apples before and during storage.
Results: the dipping solution with 1% ascorbic acid, 0.05% NaCl and 0.5% $CaCl_2$ gave the best protecting effect. Apple should preferably not be cored, to avoid unprotected skin exposition to residual oxygen in packaged apples.
Taste, color and crunchiness were comparable with fresh peeled apples up to 8-10 days at 7° C. Flavor change and "sparkling" taste were the most prominent defects affecting high quality storage life.
The initial microbial count was reduced by the thermal effect of the packaging step and remained constant during storage. Possibly, the thermo shrinkage step can provide a surface pasteurizing effect, improving shelf life.
Conclusion: a process flow sheet suitable for the preparation of fresh apples to be distributed via vending machines has proven to be feasible, provided that suitable cultivars are chosen and particular care is devoted to the dipping and packaging steps, which have been revealed as the most critical ones. Minimum high quality storage life up to 8 days at 7 °C was achieved.

Keywords
apple, vending machine, healthy food

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N° Inno-P08 - Tailorpack: Active tailor made and eco-friendly packaging for fresh fruits and vegetables preservation

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Despite governmental efforts to promote health benefits of fresh fruits and vegetables, their short shelf-life still remains a brake to their consumption. Beyond respect of the chill chain, modified atmosphere is an efficient way to delay senescence and spoilage. The Tailorpack project aims to develop innovative and tailor-made packaging made from renewable resources that is an ecological alternative to synthetic materials, and moreover better adapted to sufficient gases and vapour exchanges required. Simultaneously, active systems can bring further functionalities such as controlled absorption of active compounds. Through a global and trans-disciplinary approach based on modelling tools, the project aims to design and dimension multilayered composite materials at a nanometric scale constituted by a fibres based support, protein and nanoparticles based layers for controlling mass transfer: gaz, water vapour, and active compounds.

Keywords
biofilm, modified atmosphere, postharvest quality

N° Inno-P09 - Ultrasound assisted maceration: an original procedure for direct enrichment of olive oil

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The Mediterranean diet involves the intake of moderate amounts of olive oil. It is widely appreciated throughout the world by consumers more attentive to both health and nutritional aspect of food. The increasing popularity of olive oil has mainly assigned to an adequate fatty acid profile and the presence of phenolic compounds 1,2.
There is a new trend for source of natural antioxidant in order to enrich oils towards reducing oxidation and keeping quality; such enrichment benefits human health 3,4. Olive by-products provide a rich source of phenolic compounds (namely, oleuropein, verbacoside, apigenin-7-glucoside and luteo ‡Ilin-7-glucoside...), which may act by different mechanisms to confer an effective defence system against free radicals attack5. Olive leaves are one of the by-products of farming of the olive grove, they can be found in high amounts in the olive oil industries (10% of total weight of the olive)5. An ultrasonic tank, developed by REUS (Contes, France) has been used to perform ultrasonic maceration in order to enrich olive oil in phenolic compounds with olive leaves. An experimental design was used to optimize extraction settings and results shown that phenolic compounds from olive leaves were extracted in high quantity with a time dramatically shortened when compared with conventional method. Total phenolic content extracts was determined using the Folin-Ciocalteu assay. Phenolic compounds identification and quantification was followed during enrichment using HPLC-DAD.

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Keywords
enrichment, olive leaves, olive oil, ultrasound

N° Inno-P10 - Effect of high-pressure/high-temperature processing on vegetable based ready meals.

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Background and motivations of the work: The conventional thermal treatments required for retorted, vegetable based, low-acid canned food products, lead to excessive impact on sensory and nutritional properties of products, due to strong treatments at high temperatures during some ten minutes. Alternative treatment could be high hydrostatic pressure associated with high temperature. Such process should limit the impact on quality while ensuring the destruction of both vegetative micro-organisms and spore forming bacteria. High pressure should allow reducing the required heat treatment time at elevated temperature. The advantages of this process are: (i) preservation of organoleptic qualities (texture, color, taste) and nutritional qualities (preservation of vitamins), (ii) innovation for products that were not acceptable with the conventional heat treatment.
Material and methods: Ready meals were formulated with pre-cooked pasta, pieces of zucchinis, chicken meat cubes and a creamy curry sauce, then packaged in self-stand plastic pouches suitable for retort treatments. For the pressure-assisted thermal processing, the products were preheated at +90°C during 10 minutes, then treated by pressurizing with pre-heated water at 600 MPa and 115°C for several durations, therefore achieving different Fo values at critical point. Conventional retorting treatment at 115°C was used as control.
Efficiency of treatments was investigated with both natural contamination, and artificial contamination using spores of thermophilic thermoresistant bacteria (*Geobacillus stearothermophilus*). Biological stability validations of samples (according to French Standard NF V08-401) were performed to ensure commercial shelf stability and food safety.
Sensory analysis allowed to compare the different products, stabilized with high pressure assisted thermal process or conventional process.
Results: Results indicate that duration time for High Pressure / High Temperature treatment can be reduced of 50%, compared with traditional retort treatment, for same biological stability of low acid canned food contaminated with *Geobacillus stearothermophilus spores*. Sensory qualities of HP/HT food was enhanced compared with retorted control, with reduction of cooking effects, firmer texture of zucchinis and pasta and less browning of the sauce.
Conclusion: Stabilization of low acid canned food by High Pressure Assisted Heat Treatment (HP-HT) is a promising method for the production of shelf stable products with improved quality. This process has great potential, regarding texture preservation of vegetable, global sensorial quality of product and inactivation of thermoresistant spores at reduced temperatures and/or time.

Keywords
Geobacillus stearothermophilus, high pressure, high temperature, low-acid canned food, shelf stability zucchinis prepared meal.

N° Inno-P11 - New processes for production of fruit-derived products with optimised organoleptic and nutritional qualities: the ANR project TEMPANTIOX

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Context and rationale: « Tempantiox » is a project funded by the French national research agency which aims to use innovative technologies to improve both appearance and polyphenols contents of apple-based products, namely cider and fruit desserts. The technologies which we have chosen to test are mild pulsed electric fields as a pre-treatment to pressing, and ohmic heating as an alternative of lower cooking intensity to canning of fruit desserts. The products have been assessed both chemically and by sensory analysis, and consumer tests will be carried out to establish their attractivity and acceptability. It brings together 7 academic partners, one technical center and two industrial partners.
Results: After 36 months (out of 48), the main results are the following:
- A pre-treatment by pulsed electric fields can be applied on apple mash prior to pressing by a belt press. It improves the yield of juice extracted from apples by up to about 5% at the industrial scale. Ultrasound can be applied to increase polyhpenol extraction from dried apple pomace.
- Contradictory effects reported in the litterature on the impact of pulsed electric fields on polyphenolic composition of apple juices can be explained by taking into account the impact of electroporation on oxygen availability in the apple tissues.
- Production of apple puree preserves the fiber content of apple flesh. Impact on antioxidants of hot and cold–break processes are clearly differentiated, with presence of oxidation markers (phloridzin oxidation product, furoic acid) after cold-break.
- Polyphenoloxidase is inactivated faster in presence of polyphenols and their oxidation products or of dehydroascorbate, but presence of ascorbate preserves its activity.
- The texture of apple purees can be manipulated by varying the particles / serum ratio, by changing the particle size and the serum viscosity. Perceived consistency and rheological characteristics increase with the proportion of particules and secondarily with their size. Purees with increased serum viscosity were perceived as less grainy, with a slight increase in consistency.
- Consumers display both distrust and lack of knowledge about new food processes.
Modelling of the processes, in particular of ohmic heating, and of the antioxidant degradation are underway.

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Keywords
apple, juice, dessert, pulsed electric field, ohmic heating

N° Inno-P12 - Optimization of enzymatic liquefaction of jicama (*Pachyrhizus erosus*) by Pectinex Ultra SP L

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Context and rationale: Enzymatic jicama liquefaction process has been optimized to recover the highest yield (volume) and weight loss. Responses such as pH, °Brix, weight loss, alcohol insoluble solids (AIS), volume and weight loss were studied.
Jicama is a tropical legume used for its starchy tuber that is crisp like an apple and succulent, with a light sweet pleasant flavor (Juarez et al*.,* 1994). However, it is underutilized as it is only consumed as a raw vegetable with lemon and chili, in soups or salads, stir fried, conserved in vinegar with onion and chili or as a substitute for the water chestnut (Aquino-Bolaños et al., 2000). Liquefied jicama can be a source of food products (beverages) and ingredients (polysaccharides, oligosaccharides or monosaccharides). The very low amount of lectin and other anti-nutrient factors reported by Noman et al. (2007) showed no threat by anti-nutrients against bioavailability of nutrients in the tuber. From the industrial viewpoint, it is necessary to improve the yield of juice produced (Mélo *et al*., 2003).
Materials and methods: Jicama (*Pachyrhizus erosus* L.) tissue was treated with a commercial enzyme preparation (Pectinex Ultra SP L). Optimization of liquefaction and saccharification of jicama root was done using Response Surface Methodology with a 2 factor (incubation time and enzyme ratio), 5 level central composite rotatable design with 5 experiments at central point and 39 total experiments. The independent variables were the incubation time (X_1) and the Pectinex Ultra ratio (X_2). The response functions were pH (Y_1), total soluble solids (Y_2), weight loss (Y_3), AIS (Y_4) and volume (Y_5).
Results : At the optimum conditions for liquefaction and saccharification (incubation time and enzyme ratio of 10.00 h and 2.40 (v/w), respectively), the pH was 4.24, the total soluble solids (TSS) amount was 9.00 °Brix, weight loss percentage was 95.82%, AIS yield was 0.12% and the volume obtained was 98.00 mL.
Conclusion: Optimal conditions of liquefaction and saccharification of jicama tissue have been found to obtain the highest weight loss and volume. The products obtained have uses in a wide variety of applications in food processing.

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Keywords
polysaccharidases, vegetal cell-walls, response surface methodology

N° Inno-P13 - Physicochemical composition of the papaya powder by foam-mat drying process

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Background and motivation of the work: The foam-mat drying consists basically of three stages: (a) production of stable foam containing the raw material to be dried; (b) air drying of the foam to form a fine layer and (c) compression of the dried mat to result a powder (Karim and Wai, 1999).This process provides a high quality dried product, with commercial possibilities and application in food industry, making possible the drying process with assurance of high quality in a short time. Currently, dried products are each time more used due to the processing of the fruits can reduce significantly the costs with packing, transport, storage and conservation. Brazil is the world's largest producer of papaya, the third most consumed fruit in this country (Caldarelli et al., 2009). According FAO (2010), the Brazilian papaya production in 2008 was approximately 1,8 million ton, equivalent to almost 20% of world total production. The objective of this work was to offer a lower cost conservation method for papaya and the comparative physicochemical composition of dried product by addition of two different additives to foam production.
*Materials and Methods:*The fruits of papaya cultivar Formosa were mature and undamaged. There were used two agents in the papaya (*Carica papaya*) Formosa pulp to obtained the foams associated with Emustab®, a mix of mono and diglycerides and Liga Neutra®, a mix of sugar, guar gum and carboxymethylcellulose (Duas Rodas Industrial, Jaraguá do Sul, Brazil): (a) carrageen powder (1%) and (b) fresh egg albumin (10%). The stable foams formulated were dried at 48 °C ± 2 ºC in a ventilated oven for approximately 48 hours. Moisture content was determined by drying of the product until constant weight. All the compositions are given on a moisture-free basis. Ash, fat, proteins and total dietary fiber were determined according to Association of Official Analytical Chemists- AOAC- official methods. The energy values of papaya powder were calculated by using general energy conversion factors. The color of powder was estimated using the tristimulus color system, and color was expressed as a CIELAB color variable.
Results: The proximate composition of papaya dried by foam-mat drying was investigated and reported on a dry weight basis. The moisture of powders was lower than 5%, adequate for storage. The color of the papaya powders presented means values of L^* = 67.18 , a^* = 13.52 and b^* = 30.43. The dried papaya with albumin presented higher values to protein (4.4 %) and dietary total fiber (29.8). The powder obtained with carrageen additive showed higher content to ash (4.48%) and fat (2.89%). The average energy value of papaya powder was 33.9 kcal Kg^{-1}. The composition between powders was not statistically significant different (ANOVA and Tukey test), except to protein content.
Conclusion: The study showed that the foam-mat is a good alternative for an increment of the life of shelf of the papaya fruit pulp with costs relatively low to familiar agriculture in developing areas.
Acknowledgements: Fundação Araucária and UTFPR- Campus Ponta Grossa.

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Keywords
papaya, foam mat drying, albumin, carrageen.

N° Inno-P14 - Formulation of thermosensitive bilberry anthocyanins in High-Temperature Short-Time extrusion process

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Background and motivations: Extrusion has an important role in the food industry as an efficient manufacturing process. Many commercial products like ready-to-eat breakfast cereals, snacks and pastas are produced by this process. Extrusion cooking involves several operations such as conveying, mixing, shearing, cooking, shaping, and drying. Carbohydrate based biopolymers, mostly starch based, serve as matrix material. They are plasticized at high temperature and sheared in the extruder process room and then forced to flow through a die to form their final shape. High temperature and shear stresses usually result in chemical reactions and degradation of labile functional ingredients such as vitamins and phytochemicals. Phytochemicals such as anthocyanins derived from berries are known as dietary antioxidants, which provide health benefits and can be incorporated into extruded foods to produce health promoting foods. However, they are known to be very susceptible to high temperatures. The main focus of this study is to investigate the influence of typical extrusion parameters such as screw geometry, screw speed, flow rate and resulting residence time distribution as well as barrel and product temperatures on the stability of bilberry anthocyanins.
Materials and methods: Native corn starch was mixed with bilberry anthocyanin extract and extruded in new generation high speed high torque twin-screw extruders (Coperion ZSK 26MC) at different thermal and mechanical stresses. The residence time distribution of the phytochemicals within the process room was measured using a newly developed digital video processing technique. In parallel, the kinetics of anthocyanin degradation was determined off-line under defined temperature-time conditions in and outside of an extruded starch base.
Anthocyanins were extracted from extruded samples using liquid extraction with a mixture of acidified water and methanol. Total anthocyanins were analysed by spectral photometric method described by Bonerz[1] and they were analysed at a molecular level by HPLC-UV-ESI-MS[2]. Anthocyanins stability was evaluated by calculating their remaining percentage after the process.
Results and Conclusion: Bioactive molecules such as anthocyanins can be formulated in high temperature-short time extrusion process at a low degradation rate (< 10 %). However, the variation of extrusion process parameters and system parameters can have a huge influence onto anthocyanins stability. The most significant factor influencing their stability was the thermal energy input. Higher process temperatures (up to 180°C) resulted in higher anthocyanin degradation (up to 60 %).

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Keywords
bilberry extract, extrusion, anthocyanins stability, chromatography

N° Inno-P15 - Design and development of REAlistic food Models with wellcharacterised micro- and macro- structure and composition (DREAM)

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Background and objectives: The DREAM is a trans-disciplinary European Framework Programme 7 funded research project. DREAM project develops realistic, physical and mathematical food models. The project objectives are set toward mimicking food complexity that arises from its structure and composition.
Methods and Materials: From this point of view DREAM project is enhancing knowledge on process-structure-property relationships from microscopic to macroscopic level and facilitates creation of generic food matrices with functional and nutritional properties based on tailored micro-structure. To address wide range of food products four generic structure categories are being used representing plant-origin foods; meat; dairy and bakery products. Structural characteristics, industrial and social needs, risk and benefits assessment, economic importance and sustainability are criteria for selecting the most relevant type of products.
Results: Through the project lifetime three types of models are being developed: Basic Knowledge Models – BKMs (descriptions and guidelines), Integrated Knowledge Models – IKMs (Software packages) and Generic Model Foods – GMFs (standard of operating procedures). These developed food models are going to be used as tools for development of common approaches of risk & benefit assessment and nutritional quality by food research institutes and industry. Developed models will be made available to the stakeholders on a free basis. DREAM project is being disseminated via existing channels and national platforms, federations and regulatory bodies. Among other activities the DREAM project offers its young members opportunity to develop skills necessary for career development within European Research Area.
Conclusion: The DREAM project will bring important contribution to the research and development of food matrices and their functionality. The added value of the food models will be shown trough improved functional and nutritional properties of food.

Keywords
DREAM food models, food structure-function relationships, generic food matrices, trans-disciplinary approach, Framework Programme 7

N° Inno-P16 - Microwave hydrodiffusion, an innovative process for extraction of juice

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Rationale: A number of small fruits are characterized by high concentrations of health-beneficial compounds such as vitamins and polyphenols. They are also often difficult to process into juice, a highly convenient alternative to the fresh fruits. Their pressing may require high concentrations of pectolytic enzymes, and the lengthy incubations during enzyming may in turn result in loss of quality. We have therefore adapted an innovative microwave extraction process and tested it on 8 fruits: plums, apricots, grapes, cherries, cherry tomato, blueberries, rasberries and strawberries. The process uses microwaves for hydrodiffusion of juice from the inside to the exterior of fruit material and earth gravity to collect the fruit juice outside the microwave cavity. Criterias which have been evaluated were yields, concentrations of polyphenols, carotenoids, anthocyans and sugars, and organoleptic appreciation of the product.
Material and methods: Frozen fruits, in aliquots of circa 500g, were heated in a glass vessel by microwave in a modified microwave oven. The juice flowed from the fruits and through the lower opening of the glass vessel. A condenser could be added for steam recovery. Temperature inside the fruits and yields were followed during extraction. Unless otherwise notified, a power intensity of 1W per g of fruit was applied. Collected juice fractions were assayed for chemical composition: total polyphenols and anthocyans, carotenoids for tomatoes, sugars and acids
Results: Of the 8 fruits tested, six gave efficient juice extraction while apricots and strawberries formed a foam upon heating, from which little juice was liberated. Juice extraction was rapid: for plums, the extraction duration varied from 0.3 to 1.0 h for power densities from 1.5 to 0.5 W/g. The juice yield depended on the applied microwave power: the higher the power, the faster the juice extraction but also the lower the yield. This loss of material could be palliated by adding a condensor: for plums at 1 W per g of fruit, almost 40% of the fruit's water was vaporised and could thus be recovered. Composition of the recovered fractions varied along an extraction, with a decrease in concentrations of all solutes at the end of the extraction. Very low extractions were observed for carotenoids, a hydrophobic fruit constituent. Concentrations of sugars, acids, polyphenols and anthocyans in the reconstituted total juice represented 35 to 100% of those in the fruits. The best yields were obtained for total polyphenols, higher than for anthocyans, sugars and acids.
Conclusion: The microwave hydrodiffusion process allows efficient extraction of juices from small, hard-to-press fruits. The extraction is fast and involves a single step without addition of processing aid. The obtained juices are characterised by bright colours and a fresh fruit aroma.

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Keywords
plums, strawberries, cherries, tomatoes, juice yield, polyphenols

N°Inno-P17 - Study of the effects of Pulsed Electrics Fields as an extraction process in red winemaking, on the Cabernet Sauvignon grapes and on the wine

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In order to extract phenolic compounds and characteristic aromas of a red wine, solid parts of the grape soak in the fermenting juice. The extraction of these compounds depends on several factors that have already been studied and which must be taken into account: temperature, SO_2 concentration, ethanol levels, maceration time, pH, crushing, homogenizations and the non compaction of the solid parts. Different winemaking techniques applied before and/or after the fermentations, such as heat treatments, sub-pressure, agitation, use of enzymes, use of SO_2 and/or CO_2 have been developed to enhance this extraction. However these treatments can reduce the quality of wine and be energy and time consuming. On the other hand, if grapes have not been harvested at optimum maturity, the extraction can be limited and that requires an alternative to be found. Pulsed Electrics Fields (PEF) application of several KV during a very short period of time (some ms) on crushed and destemmed grapes can be an effective and profitable solution with low energy consumption (López, et al., 2009) (Puértolas, et al., 2010).
The objective of this research is to observe the grape after electric treatment, to evaluate if pulsed electric field has an effect on cellular organisation which enhances the transfer of polyphenols through cellular walls. The monitoring and quantification of extracted compounds in PEF-assisted winemaking aims to determine the optimum operating parameters as a function of the quality of grapes, energy consumption and the affordability of the process in industry.
The grape skins were observed by optical microscopy after PEF treatment and alcoholic fermentation. During the winemaking and the bottled wine development, the intrinsic characteristics (total acidity, volatile acidity, pH and alcohol content) and optical characteristics (colour intensity, hue, and index of total phenolics), as well as anthocyanins and tanins concentrations were evaluated. The potential effects of PEF on the organoleptic characteristics of wines have also been apprehended by sensory analysis (triangular test and quantitative descriptive analysis) and by measurement of aromas.
Immediately after treatment, the colour of grape juice presented a very intense red colour in contrast with control juice. According to the optical microscope observations, PEF-treatments involve the formation of pores at cellular walls level, thus promoting the release of intracellular contents. This mechanism should be verified by complementary studies on optical and electronic microscopy. The application of PEF significantly increases the extraction of major polyphenolic compounds when compared to classic wine-making. First results have shown that extraction of the flavan-3-ols was more influenced by treatment duration time than by PEF intensity, in contrast to the anthocyanins. The concentrations of sugar, alcohol, total acidity, volatile acidity, pH and temperature have not been affected but the wines' organoleptic characteristics have been modified.
This treatment appears to be a promising alternative to conventional winemaking technology and other technologies for its interesting compounds extraction. Further studies regarding operational parameters are necessary for better understanding of the PEF effect on bottled wine. Finally, the analysis must be conducted during wine development to ensure qualitative definition of the extracted compounds.

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Keyword
Pulsed Electrics Fields, extraction, energy consumption, grape, skin, polyphenols compounds, red wine

N° Inno-P18 - Influence of spatial distribution and use of filters on the color of Golden delicious apples processed by pulsed light

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Background and motivations: Differences in the impact of pulsed light (PL) treatments on both microbial and physico-chemical quality have been recently related with the lack of treatment homogeneity. Non-uniform distribution of fluence may have a determinant impact on the outcome of a PL treatment in different spatial positions of a treatment chamber. Although the composition of the light emitted is important to determine the efficacy of PL processing, scarce studies have been focused on the influence of the light spectrum portion. The potential of PL technology to guaranty safety by sterilizing or reducing microbial population has been proven in model solutions. However, literature lacks information about the effects of PL treatments on fresh-cut fruit properties. Investigating the effect of the spatial distribution of fluence in the PL chamber as well as the effect of filters in the quality of fresh-cut apples could help food processors to obtain practical information about the effectiveness of PL treatments. Fresh-cut apples have been well-received by consumers but surface browning represents a significant hurdle that affects their visual quality. The development of alternative methodologies such as PL is expected to offer some innovative solutions since consumers are demanding a reduction of the overall use of chemicals on fresh products.
Material and Methods: Golden apples were sliced, cut into cubes and placed in different points along the XY plane at a fixed vertical distance of 5 cm from the lamp. Samples were irradiated with 30 light pulses in a Steribeam Xe-Matic-2L-A chamber. Samples were treated with full spectrum light (without filters), without UVC light (using a Pyrex glass filter) and removing all UV light (using a Makrolon polycarbonate filter). CIELAB parameters of the apples were measured with a Minolta CR-400 colorimeter. Color changes were expressed as DE, which defines the magnitude of the total color difference respect to the untreated product. A pyroelectric head was used to measure the fluence at various positions in the PL chamber.
Results: Color of fresh-cut apples varies greatly depending on the spectrum light used for processing. Results suggest that light containing UVC wavelengths helps to better preserve the initial color of apples in comparison to treatments without UVC or UV light. DE values ranging from 2.1 to 4.3 were observed when no filter was used, whereas DE values up to 7.3 were attained when processing with filters, indicating great color variations respect to the untreated fresh-cut apples. Moreover, color changes on PL-treated apples were different depending on the XY-position of samples in the treatment chamber. Samples located at the front of the chamber and at central positions showed the highest DE values when treating with a full spectrum light and when removing all UV light. In contrast, slight color changes on PL-treated apples without UVC light were observed along Y directions towards the front of the chamber. The variability of the results was related with differences on the dose of each PL treatment and the spatial distribution of fluence in the chamber. In general, the fluencies up to 0.25 J/cm^2 with full spectrum light and back positions in the chamber resulted in the most effective treatments in avoiding apple surface browning.
Conclusions: This study evidences the beneficial effects of the UVC band at high fluence levels to preserve color of fresh-cut apples, holding promise for the use of PL technology in minimally processed fruits and vegetables. This research also suggests that the overprediction of fluence depending on position should be considered to improve the effectiveness of the PL treatment. Hence, PL equipments and treatment chambers need to be designed to warrant treatment fluence uniformity and more research is required to clearly understand the extent of antibrowning effect caused by PL.

Keywords
Pulsed Light, fresh-cut apple

N° Inno-P19 - Preservation of antioxidant capacity of wild berry fruits during the concentration of fruit juices by mild membrane processes

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Context and rationale: The market value of membrane technologies for food and beverage processing, e.g. fruit juice concentration, has increased. Emerging technologies are in the status of breakthrough. To avoid degradation of certain natural antioxidant components, loss of amino acids and discoloration in the final product, an alternative membrane procedure - reverse osmosis (RO) - succeeded against the traditional multi-stage vacuum evaporation. Due to the development and improvements, a higher feed concentration can be reached by membrane distillation (MD) and osmotic evaporation (OE). These methods are developed in concentrated fruit juice production to improve quality and reduce energy consumption. This research introduces a coupled operation of MD and OE (membrane osmotic distillation, MOD) for an effective, but still mild concentration of valuable fruit juices.
Fresh juice obtained from cornelian cherry (*Cornus mas* L.) and black current (*Prunus spinosa* L.) can be considered as a valuable, highly nutritive beverage, and is characterized by high level of vitamins and antioxidant capacity. These beneficial properties may be preserved if mild membrane processes are applied for the concentration of the fresh juice.
Materials and Methods: In this work membrane osmotic distillation (MOD) was used to concentrate the juices, where a hollow-fibre membrane contactor was the module, maintaining different bulk temperature on each side of the hydrophobic membrane supplied and using an osmotic salt solution as the receiving phase. Total antioxidant activity – determined by the FRAP assay [1] – , moreover total phenol and anthocyanin contents of the fresh juices and final concentrates confirmed the assumptions, that the membrane technique is suitable not only to produce over 60 % TSS concentrate, but to preserve the valuable compounds of the juices, as well [2,3]. We are testing another membrane process - direct osmosis – to investigate its effectiveness for antioxidant preservation during concentration.
Conclusions: Excellent preservation of the valuable antioxidant capacity was observed, indicating the MOD sequence as an outstanding possibility of treating fruit juices of prominent dietary value.

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Keywords
membrane osmotic evaporation, coupled membrane process, antioxidant capacity, fruit juice, concentration, direct osmosis

N° Inno-P20 - Agro-Environmed project: eco-innovation in food industry

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CRITT Agro-alimentaire PACA

Context: Agro-Environmed is an interregional cooperation project, co-financed by the European Regional Development Fund through the MED Program. Its main objective is to encourage eco-innovation in companies belonging to the Mediterranean Agro-food Sector, particularly SMEs, by the creation of a platform which promotes the transfer of technologies and best environmental management practices.
This platform will enable to reach the following objectives:

- Improve the environmental performance of agro-food companies in the MED area through the implementation of Environmental Technologies
- Foster the economic growth of the agro-food sector through the reduction of its impact on the environment

Agro-Environmed partnership involves 11 regions of 6 countries within the Mediterranean area and 5 agro-food subsectors: Olive Oil, Wine, Fruit & Vegetables, Meat and Dairy Products.
CRITT Agro-alimentaire PACA has chosen to focus on the Fruits and Vegetables which are essential elements of the Mediterranean diet. Thus Europe and especially Mediterranean area is a great producer of fruits and vegetables. The major parts of these products are then processed by the agro-food industry which generates environmental impacts.
Materials and Methods:

- Creation of a techno-environmental platform to help the dissemination of technologies and best environmental management practices.
- Development of an on-line catalogue of technologies and best environmental management practices to enable identification and sharing of information at European level of eco-innovative activities.
- Publication of prospective studies of the technological trends in eco-innovation in different agro-food sectors of the Mediterranean.
- Development of techno-environmental assessments and action plans to help SMEs to improve their environmental performance.
- Implementation of a communication plan for the dissemination of the project results.

Results: The interregional analysis of the fruits and vegetable sectors in PACA region (France) and in Valencia region (Spain) shows that companies processing fruits and vegetables can be very different and face varied environmental issues.
Main environmental issues are energy consumption, waste and waste water.
Those impacts are sensed differently depending on the local situation of the company, particularly for waste and waste water.
Some technologies and practices exist and are implemented in companies to reduce their environmental impacts. To enhance the spreading of these technologies or practices, the efficiency of information spreading is a key element.
Conclusion: Some technologies and practices exist and are implemented in companies to reduce their environmental impacts, such as aero-refrigerating tower, waste sorting or speed variation on electric motors. Employees' involvement is a key point to be effective for the implementation of BAP and BET. It is difficult for the food companies to keep informed on the update solutions to reduce their impacts. In this way, Agro-Environmed project help them for this first step.

Keywords
food-industry, environmental impact, eco-innovation, SMES, web platform, best environmental practice (BEP), bests available technologies (BAT)

N° Inno-P21 - DIC swell-drying: an innovative and sustainable technology for fruits and vegetables processing

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Through standard drying, fruits and vegetables structure undergoes a shrinkage which generates a compactness causing a very long drying process implying high energy consumption and thermal degradation. This implies a poor quality of the final products notified by vitamin loss, poor functional properties, weak rehydration rate and capacity…
In order to alter this tricky chain one has to overcome the shrinkage keeping the fundamental criterions involved within the notion of total quality:

- Sensorial vectors of color, shape and texture
- Functionality and convenience (often revealed through the specific surface area)
- Food safety (requiring lowest microbiological content, and inhibition of allergic activity…)
- Nutritional value (absence of any degradation of protein, preservation of lipid profile, presence of vitamins, antioxidant activity…).

The Instant Controlled Pressure-Drop DIC is an innovative process consisting in a High Temperature – Short Time (HTST) treatment followed by an instant pressure drop towards a vacuum. Inserted during standard hot air/sun drying, it generates among other things a swelling (texturing) of shrunk product. This swelling and drying combination (DIC swell-drying process) leads to an expanded product significantly improves the drying kinetics.
Therefore the necessary time for complete drying (water activity of 0.2) is sharply reduced. Furthermore opened matrix products are more easily grinded than closed and compact ones.
DIC is a green technology (confirmed by industrial worldwide units) characterized by:

- Low energy consumption
- No environmental impact as water spoilage is minimized and no pollutants are rejected
- Highly significant capacity to promote residual solid

Last but not least, the coupled mechanical and thermal impacts allow us to obtain high decontamination levels appropriately defined in order to perfectly master the final product quality. That is to say, DIC further improves the hygienic qualities and economic value of the end product. Moreover, it provides to consumers high added value end products with total quality criteria here above described.
DIC as is complementary technology to standard drying can be inserted in any regular industrial line enhancing the quality at many levels (sensorial, food safety and nutritional value).

Keywords
DIC, innovative, technology, process, drying, fruits, vegetables, industrial, sustainable

N° Inno-P22 - Effects of high hydrostatic pressure, heat treatment and acidification on carrot juice

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It is not usual to find carrot juice on the market made only with carrots. Instead it appears mixed with other fruit juices such as orange juice, which provide stability to the final product. However, these mixtures go against the original fresh sensory attributes since when adding another juice it completely modifies the flavor of reference of the carrot. Industry is willing to offer fresher products while extending their shelf-life.
This study aims to assess the pressurization and pasteurization treatments, as well as acidification, in order to improve the shelf-life of the carrot juice made only with carrots and to keep its distinctive fresh taste. For this reason we have worked with carrot juice with and without acidification. Glucono-delta lactone has been used as acidulant to lower the pH of the juice down to 5.5. Both carrot juices, the acidified and the non acidified one, were processed by high hydrostatic pressure at 600 MPa for 5 minutes and 10ºC, versus heat treated by autoclaving at 80 ºC for 7 minutes. The microbiological stability, accounting for total viable counts, aerobic spores, lactic acid bacteria, anaerobic microorganisms and molds and yeasts of the products, was checked during a storage period of 30 days at 4ºC. Color, pH, acidity and º Brix were monitored.
Results have shown that the applied pressure of 600 MPa reduces microbial growth compared to heat treatment; however there isn't a clear effect due to acidification. And regarding the physic-chemical parameters, nor pressurization, nor heat treatment, nor acidification do affect them except for a slight increase in º Brix when with high pressure.

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Keywords
carrot juice, high hydrostatic pressure, heat treatment, acidulant, shelf-life

N° Inno-P23 - Power density control in microwave assisted air drying to improve quality of food

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Context and motivation: The aim of this study was to improve the quality of dried food by the use of microwaves combined to hot air. The main point was to avoid the appearance of black spots which often occur during a microwaves heating which result from local overheating of the product when it becomes dry.
Materials and methods: Therefore, a microwave/hot air drying system with ability of an automatic control of the power density was developed under LabView®. Two different strategies of microwave/hot air drying were implemented. The first consisted to adjust the microwaves power density to the remaining amount of water (via the weight of the product) every second. In the second strategy the power was adjusted only every 5min. Therefore the weight mass of the samples, as well as the temperature close to the centre of one of them, were measured. All the process parameters, including the power applied were recorded online every second.
Results: From a physical aspect, the tomatoes dried by microwave/hot air using the both control strategies, presented better quality (relating the color and texture parameters) compared to a reference one sold in the trade. In addition, the structure of dried tomatoes observed by Scanning Electron Microscopy (SEM) presented low degradations in reference to fresh tomatoes unlike to dried tomatoes purchased on market which presented high degradations. Chemically, the residual lycopene content of the dried tomatoes obtained by both strategies was around 40 % while only 20% when constant power density was applied in combined microwaves/hot air drying.
Conclusion: Power controls in microwave /air drying of tomato effectively improved its quality by avoiding black spots and increasing nutritional quality.

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Keywords
microwave drying, power density control, tomato, lycopene

N° Inno-P24 - Microbiological stability of Melon spherics processed by high pressure (HPP)

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Background and motivations of the work: The spherification is a culinary technique adapted from biomedical applications. This technique is used to encapsulate food, usually liquids, allowing the sudden appearance of flavors in the mouth when eated. Small balls, called spheric or even caviar due to its similarities in shape and size, are obtained from the gelification of a film of sodium alginate and calcium, all over a circular liquid core. There are two types of spherification, the indirect spherification and de basic spherification in case the liquid contains a source of calcium or not. This idea has been so successful that has brought the product from the restaurant to the industry. Currently there are several companies that focus their activity in producing gourmet products, in particularly of spherics. These spherics receive a commercial sterilization, which is usually closer to an addition of flavoring or coloring. However, not all foods support commercial sterilization since temperature devaluate sensory attributes of fresh product, an no additive can solve it. A clear example happens with melon. Melon caviar obtained with this technique is heat sensitive, as the melon pulp itself. In order to overcome this limitation, High pressure processing (HPP) can be applied. HPP is a well known technology to decontaminate food preparation.This study proposes to evaluate the application of HPP to improve shelf life of such delicate products.
Material and methods: Melon spherics were processed at 600 MPa for 6 minutes and 10ºC. The microbiological stability (total viable counts, enterobacteriaceae, lactic acid bacteria, molds and yeasts, aerobic spores and sulphite-reducing clostrdia) of the products was checked during a storage period of 91 days at 4ºC. Texture, pH, acidity, º Brix and a hedonic sensorial analysis were conducted during this storage period.
Results and conclusion: Results have shown that the applied pressure of 600 MPa enable to extend the microbiological stability at least up to 91 days, however the limiting factor of the shelf life of the product comes from the 20 days due to the modification of flavor.

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Keywords
spherification, melon caviar, high pressure process, shelf life

N° Inno-P25 - NMR Determination of a model of solute released from plant tissues in an aqueous environment

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Introduction: We investigated molecular transfers occuring between a sample of plant tissue and its aqueous environment, such as a sauce. The work was performed considering the general assumption that molecular diffusion through the conductive plant tissues (xylem, phloem) is faster than transfers through parenchyma cells. To test this, the time course evolution of the concentration of some compounds from onions (*Allium cepa* L.) in an aqueous solution was estimated by quantitative one-dimensional proton nuclear magnetic resonance spectroscopy (q ^{1}H NMR).
Materials and Methods: After cutting the top and bottom of onion bulbs (Armstrong variety, growth period 2006), bulbs were peeled off by removing the dry brown scales and sprouts. About 200.00 g of onion were cut in parallelepipeds (1 cm x 1 cm x thickness of scale). The material was introduced into 600.00 g MilliQ water with 0.1 % sodium azide (to inhibit bacterial growth). Solutions were stirred at room temperature. 15.00 g samples of soaking water (< 3 % of the total) were removed at 5 time points between 0 and 264 h (11 days). Samples were centrifuged at 10,000 rpm for 10 min at 19 °C, and the liquid part was filtrated and frozen at - 24 °C.
For quantitative ^{1}H NMR spectroscopic (1D) studies and for two dimensional (2D) ^{1}H-^{1}H NMR analyses [1], samples were prepared by double lyophilization of the frozen solutions. At each step, the solid content was redissolved in D_2O with *p*H adjustment [2]. A capillary tube containing a precisely controlled concentration of the sodium salt of (trimethyl)propionic-2,2,3,3-d4 acid, dissolved in D_2O (0.2 %), was introduced to an NMR tube, for chemical shift calibration and for quantification. A Bruker Superconducting Ultrashield 300 MHz (7.05 Teslas) 54 mm magnet system NMR spectrometer was used. Each spectrum consisted of 64 scans of 32K data points using D_2O as an internal lock, with a spectral width of 6.000 Hz and an acquisition time of 5.3 s, a recycle delay of 25 second per scan and a pulse angle of 90°. All experiments were repeated three times.
Results:
1. Identification. The main extracted components were saccharides (glucose, fructose, sucrose and fructooligosaccharides), amino acids (alanine, arginine, asparagine, glycine, glutamine, histidine, isoleucine, leucine, lysine, phenylalanine, threonine, tyrosine and valine), and organic acids (malic acid, aspartic acid and glutamic acid) [3].
2. Quantification of glucose, fructose and sucrose. The extraction curves were similar for mono- and disaccharides, with a fast extraction at short times, and a stabilisation of the extracted quantities after long soaking times. For the 3 saccharides, the extraction rate in the first hour of soaking was 3 times bigger than after 8 hours of soaking, and the concentrations after 40 and 253 hours were not significantly different: extraction could be said to be complete around 40 hours of soaking.
Conclusion: Using the experimental data, some rate constants for various molecular transfers in the general model can be calculated. Computer simulations of the transfers can be used to validate the calculation results.

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Keywords
onions, quantitative 1D and 2D ^{1}H NMR spectroscopy, modelling, diffusion, transfer

N° Inno-P26 - Effect of High Intensity Pulsed Electric Fields on water-soluble vitamins of fruit juice-milk beverages

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Background and motivations: Today, the growing interest of consumers in the role of food for health and well-being is a primary driver behind the success of functional food market. In this way, beverages based on fruit juices and milk are widely accepted due to the well known antioxidant properties of fruit and the health benefits of milk. Group B vitamins are water-soluble compounds, present in both fruit juices and milk, that are essential in human diet, since their deficiency has been associated with severe diseases such as beriberi, cancer, cardiovascular disease, anemia, neurological and developmental disorders or pellagra. It has been observed that their stability during processing may vary widely among treatment conditions and food matrix. High Intensity Pulsed Electric Fields (HIPEF) is a non-thermal technology that has shown to maintain group B vitamin content in milk or juice based beverages. Therefore, the aim of the present work was to evaluate the effect of HIPEF (35 kV/cm for 1800 µs with 4-µs bipolar square pulses at 200 Hz) or thermal (90 ºC 60 s) processing on the concentration of niacin (vitamin B_3), thiamine (vitamin B_1) and riboflavin (vitamin B_2) in beverages based on fruit juice with whole or skim milk, and their stability during storage (56 days at 4 ºC).
Material and methods: Beverages were prepared by mixing the juice extracted from orange, kiwi, pineapple and mango with whole or skim milk. Group B vitamins were extracted from fruit juice-milk beverages with acid hydrolysis followed by an enzymatic hydrolysis with taka-diastase. Separation and detection of vitamins was performed by HPLC-PDA and quantification was made by calibration curve with commercial standards.
Results and discussion: The concentration of niacin, thiamine and riboflavin in treated and untreated beverages immediately after preparation ranged between 0.85-0.92 mg/100mL, 0.63-0.71 mg/100mL and 0.10-0.19 mg/100mL, respectively. In general, niacin and thiamine in fruit juice-milk beverages were not significantly influenced by the treatment applied. However, it was observed that HIPEF-treated and untreated beverages showed higher riboflavin levels than the thermally treated, immediately after processing and during storage time. On the other hand, the fat content of milk used in the formulation significantly affected the concentration of thiamine and riboflavin of beverages, since beverages with whole milk had higher levels of these vitamins regarding beverages with skim milk. Group B vitamins concentration remained practically constant during 56 days at 4 ºC in all the studied samples, thus evidencing no degradation of these compounds.
Conclusions: HIPEF processing did not affect the concentration of niacin, thiamine or riboflavin in beverages with whole or skim milk and they were stable during refrigerated storage. Thus, HIPEF might be an appropriate technology to preserve blended beverages with fruit juice and milk.

Keywords
High Intensity Pulsed Electric Fields, water-soluble vitamins, juice, milk

N° Inno-P28 - The effects of sample size and temperature on the diffusion of water soluble compounds from onions into aqueous solutions

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Introduction: Onions (*Allium cepa* L.) are widely consumed vegetables, and their bulbs are important ingredients in many dishes. Previous studies [1] identified the main compounds extracted into aqueous solution as sucrose, glucose, fructose, 16 amino acids, and 5 organic acids. The major mechanism of extraction appears to be diffusion in the conductive channels. The effects of onion sample size and temperature on the transfer processes were studied.
Materials and Methods: After cutting the top and bottom of onion bulbs (Armstrong variety, growth period 2006), bulbs were peeled off by removing the dry brown scales and sprouts. About 200.00 g of onion were cut in parallelepipeds of various sizes. The material was introduced into 600.00 g MilliQ water with 0.1 % sodium azide (to inhibit bacterial growth). Solutions were stirred at room temperature. 15.00 g samples of soaking water (< 3 % of the total) were removed at 5 time points until the concentration of extracted compounds was constant. Samples were centrifuged at 10,000 rpm for 10 min at 19 °C, and the liquid part was filtered and frozen at - 24 °C.
To study the impact of the dice dimensions on transfers, 4 sizes of onion samples were used: 1/8 of one bulb; 1 cm x 1 cm x thickness of scale (tos) ; 0.4 x 0.4 x tos; blended (controlled conditions).
The temperatures studied were: room temperature; 50 °C; 75 °C; 100 °C.
For quantitative ^{1}H NMR spectroscopic (1D) studies and for two dimensional (2D) ^{1}H-^{1}H NMR analyses, samples were prepared by double lyophilization of the frozen solutions. At each step, the solid content was redissolved in D_2O with *p*H adjustment [2]. A capillary tube containing a precisely controlled concentration of the sodium salt of (trimethyl)propionic-2,2,3,3-d_4 acid dissolved in D_2O (0.2 %) was introduced to an NMR tube, for chemical shift calibration and for quantification. A Bruker Superconducting Ultrashield 300 MHz (7.05 Teslas) 54 mm magnet system NMR spectrometer was used. Each spectrum consisted of 64 scans of 32K data points using D_2O as an internal lock, with a spectral width of 6.000 Hz and an acquisition time of 5.3 s, a recycle delay of 25 second per scan and a pulse angle of 90°. All experiments were repeated three times.
Results: For all experiments, an initial increase in concentration and dry matter content in the soaking solution is followed by a stabilization, at a time that depends on temperature. The rate of extraction is increased with increasing exposed area, i.e. diminishing dimensions of dice. Extraction occurs faster with increasing temperatures. Our studies further demonstrate that the transversal extraction is limited and that extraction occurs mainly in cut tissue where the cells and conductive tissues are in direct contact with the aqueous environment.
Conclusion: As assumed, size and temperature have an impact on molecular transfers during soaking. Using the experimental results, modeling by analytical equations and by finite element calculations using *Femlab* can be performed.

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Keywords
onion, NMR spectroscopy, diffusion, transfer, temperature

N° Inno-P29 - Effect of high-intensity pulsed electric fields on vitamin c content in broccoli juice

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Background and motivations: Consumption of fruit and vegetable juices are related with prevention of certain chronic and cardiovascular diseases, due to these foods are rich in antioxidants, such as vitamin C. This vitamin is used as an index of the quality of fruits, since it is sensitive to degradation processing. Broccoli is a vegetal with high content of this nutrient. Fruit and vegetable juices are thermally processed for assuring microbiological and enzyme stability. Nonetheless, a thermal treatment causes nutrients losses, resulting in a reduction of food quality. In recent years high intensity pulsed electric fields (HIPEF) is being investigated to evaluate their potential as an alternative to avoid the nutrients degradation. The aim of this work was evaluate the influence of HIPEF preservation on vitamin C in broccoli juice.
Materials and Methods: HIPEF treatments were carried out in a continuous flow bench scale system (OSU-4F, Ohio State University, OH, USA). The HIPEF variables were field strength (15-35 kV/cm), treatment time (500-2000 μs) and polarity mode (monopolar or bipolar), keeping constant pulse width for 4 μs and frequency at 100 Hz. Response surface methodology with a central composite design with three faced centred factors was proposed to evaluate the effect of the HIPEF treatment variables on the broccoli juice vitamin C content, which was analyzed by HPLC.
Results : Vitamin C concentration in fresh broccoli juice was 118.9 mg/mL. The higher vitamin C retention (90.95%) in HIPEF-processed broccoli juice was obtained at 35 kV/cm for 500 μs in monopolar mode. In contrast, the lower vitamin C retention (64.13%) was observed at 25 kV/cm for 1250 μs in bipolar mode. Among HIPEF processing parameters, treatment time (*t*), electric field strength (*E*) and polarity (*P*) influenced vitamin C retention ($p< 0.05$). Vitamin C maintenance was higher when HIPEF-treatment was applied in monopolar than in bipolar mode. On the other hand, increasing *E* or *t* resulted in higher vitamin C content in monopolar mode. In contrast, in bipolar mode the significant interaction between *E* and *t* lead to high vitamin C retention at high *E* during short *t* or at low *E* during long *t*.
Conclusion: HIPEF treatments were effective in maintaining adequate levels of vitamin C in broccoli juice. Therefore, HIPEF processing can be a good alternative to thermal treatment for obtaining broccoli juice with a high vitamin C content.

Keywords
High Intensity Pulsed Electric Fields, broccoli juice, vitamin C.

N° Inno-P32 - Influence of sucrose composition on water sorption isotherms and on glass transition in apricots

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Context and rationale: Water and soluble solids (sugars) are the main fruit components. During fruit processing or storage, phase transitions such as liquid-gas or liquid-solid changes can occur in the aqueous phase of the product. Composition of processed fruit is changed and hygroscopic properties could be modified. The analysis of sorption isotherms coupled to glass transition temperature, Tg, should provide information about the role of water and soluble solids in food. The aim of the present work is to evaluate the influence of sucrose impregnation on desorption isotherms and on glass transition temperature of sucrose impregnated apricots slices.
*Materials and Methods:*Apricots (Royal flam) were osmo-dehydrated at 30°C in sucrose syrups (70% w/w) with agitation (125 rpm) during 10 and 65 min. Desorption isotherms of fresh and osmotically dehydrated apricots have been measured at 30, 45 and 60°C by the static gravimetric method. The differential scanning calorimetry was used to determine the Tg of samples equilibrated with several water activities. GAB, BET, Ferro Fortan and Peleg models (Berg & Bruin, 1981) were fitted to the experimental sorption data and the Gordon and Taylor equation (Gordon and Taylor, 1952) was used to model the water plasticization effect.
Results: The osmotic pretreatment by sucrose solution affected the graphical shape of the desorption isotherms because of biopolymer binding at low water activity values and dissolution of sucrose at high levels of water activity. At 45°C, desorption isotherms of fresh apricots and sucrose impregnated apricots are identical. At 60°C, sucrose impregnation depressed water activity, while at 30°C the opposite effect is observed. Evolution of equilibrium moisture content at the first saturation layer expresses these effects of sucrose impregnation and temperature. The empirical four-parameter Peleg equation and the Gordon and Taylor model were found to represent adequately the experimental data of the fresh and osmotically treated apricots and glass transition curves respectively. A strong plasticizing effect of water on the Tg was found, with a great reduction in this value with increase in water activity. Besides, results showed a significant change in the transition temperatures with the enrichment in sucrose of apricot slices.
Conclusion: Hygroscopic properties of apricots were significantly affected by sucrose impregnation and temperature. The temperatures effect on sorption isotherms is dependent on a_w level. For a_w lower than 0.65-0.8, the equilibrium moisture content decreases with increasing temperature but equilibrium moisture content increased with temperature up to aw~0.65-0.8. This inversion of the effect of temperature induces the crossing in desorption curves, within the water activity range of 0.65-0.8 and for all the investigated temperature range (30°C, 45°C and 60°C). Water acts as a plasticizer in fresh and osmo-dehydrated apricots decreasing its glass transition temperature.

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Keywords
sugar composition, glass transition, sorption isotherms, apricots.

N° Inno-P33 - Optimized ultrasound-assisted water extraction of polyphenols from apple pomace

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Background and motivations of the work: Apple polyphenols have shown interesting properties and applications in various domains by its nutritional values, radical scavenging and antiviral properties (Suárez et al., 2010). Recently, some research groups proved those compounds to be commercially exploitable when extracted from apple pomace, a residue from juice and cider production usually treated as a waste (X. Cao et al., 2009; Cetkovic et al., 2008). Even though the extraction of these compounds has shown good results, the extraction methods use toxic solvent and consume much time and energy. The ultrasound-assisted extraction (UAE) has proved to be very efficient in the agroalimentary industry and has also the advantage of being large-scale applicable and less solvent and energy consuming. In this work, the ultrasounds were used to assist the aqueous polyphenols extraction, which was optimized by a Response Surface Methodology (RSM) after a preliminary solid/liquid ratio study and three compounds were analyzed by HPLC-DAD for degradation evaluation purposes.
Material and methods: The solid/liquid ratio to be used in all extractions was chosen in function of the Total Polyphenols Content (TPC) and samples hydration using samples from 50mg/mL until 350mg/mL in a 50mM malate buffer pH 3.8. A RSM in function of three parameters (temperature, ultrasonic power and time of extraction) gave 20 randomized experiments and the optimized conditions were used in a comparative kinetics study. A scale-up study was also performed using 30L. Three isolated compounds (chlorogenic acid, epicatechin and phloridzin) were then submitted to the optimized extraction conditions and analyzed by HPLC-DAD against standards to evaluate the possibility of degradation due to ultrasounds.
Results: The optimized extraction conditions calculated by the response surface methodology were 40°C of temperature, 40 minutes of extraction and 60W of ultrasonic power in a 150mg/mL solid/liquid ratio. The comparative extraction kinetics showed that UAE has a 30% higher yield (818 mg epicatechin equivalent/L) than the extraction done in the same conditions without ultrasounds (618 mg epicatechin equivalent/L) for TPC. The scaled-up study showed also a better yield and at the same time, the three isolated compounds showed no apparent degradation in the chosen conditions.
Conclusion: The aqueous extraction of polyphenols from apple pomace assisted by ultrasound showed better results when compared to the extraction performed in the same conditions without ultrasounds, proving the technique to be a better alternative to conventional extraction using toxic solvents. Also, the scaled-up studies show this procedure has potential application for industrial purposes, since the evaluation of ultrasound treatment effects on three of major isolated compounds showed no degradation in the applied conditions.

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Keywords
apple pomace, optimization, polyphenols, ultrasound

N° Inno-P34 - Study of polyphenols adsorption on resin - kinetic models and coadsorption

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Context and rationale: Polyphenols are valuable natural compounds on account of their antioxidant properties. The polar fraction of polyphenols is constituted by phenolic acids presents in wastewater coming from agro industrial activities as olive oil, vinasse, wine, spirits, etc. It is known that phenolic compounds are major contributors to the toxicity and antibacterial activity of olive mill wastewater. A treatment with resin could be applied allowing to remove those compounds and to produce a valuable fraction by desorption. So this work concerns the selection of a resin from seven resins. The selection was achieved with a mixture of 9 polyphenols (4-hydroxybenzoic acid, gallic acid, p-coumaric acid, caffeic acid, ferulic acid, synapic acid, anisic, syringic acids and catechin). The retained resin is a weakly anion exchanger resin (Amberlyst® A21). Afterwards a kinetic study was achieved with individual solutions of polyphenols (gallic, caffeic, 4-hydroxybenzoic acids and catechin) for 2 temperatures and 2 pH. The values of pH selected were: 4 corresponding to the natural pH solution and a upper value. But the phenolic acids are sensible to pH. pH 7 have been chosen allowing to work on the first acidity of phenolics acid. On the obtained curves were applied four types of adsorption kinetic models: pseudo-first order, pseudo-second order, Elovich and intraparticle diffusion. Finally a coadsorption study was carried out with solutions containing two phenolic acids and the four acids selected.
Materials and method: during the selection of the resin, we have used a mixture solution with 150 ppm of each polyphenol and 1g of resin. For the study on A21 resin, 200 mL of the individual polyphenols solutions (500 ppm or 300ppm) was introduced with 0.2 g of resin. In all cases after introducing the solution and resin, solution samples were withdrawn every 30 minutes until reach the equilibrium. The samples were analysed by HPLC-UV allowing to calculated the amounts of matter absorbed per gram of resin at time t (q_t) and at equilibrium (q_e).
Results: For all experiment conditions, catechin is the least retained. The experiments have shown that the pH and temperature are not influent except for gallic acid. In the case of gallic acid the q_e decrease for pH 7 and also reveals green solution coloration. An experiment with only gallic have demonstrated a degradation of this compound and consequently decreasing its concentration in solution. The results have shown that the best model for all experiments is the pseudo-second model with r^2 >0.95. In the case of coadsorption, same type of model can be applied. From this model, the initial adsorption rate (h) can be calculated. In the case of coadsorption, its value is superior to that obtained with individual compound solutions.
Conclusion: from all resin tested, the resin retained is a weakly anion exchanger resin (Amberlyst® A21). The study of temperature and pH reveals that there no real effect on adsorption for catechin, caffeic acid and 4-hydroxy benzoic acid. But for the gallic acid, its adsorption capacity has decreased due to degradation. In all case even with mixture of polyphenols, pseudo-second order model is well suited.

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Keywords
phenolic acids, resin, adsorption, kinetic models

N° Inno-P36 - Enzymatic degradation of apple tissue measured by micromechanics: preliminary results

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Context and rationale: The diffusion of micronutrients from vegetables is mainly governed by the breakage of the structures at different scales: vacuole, cells, tissues or whole fruit. The breakage level of fruits and vegetables is commonly evaluated by several methods such as microscopy, image analysis, electric conductivity, X-ray tomography, mechanics… Although the engineering requirement is important, a clear link between the fruit breakage level and the diffusion of micronutrients is not well established and engineering approaches are rare. The aim of this preliminary work is to study the feasibility of micromechanics application to characterize the breakage level of enzymatically degraded apple tissue. Material and methods: Small pieces of apple (Granny Smith) parenchyma (7 x 7 x 13 mm) are mechanically tested with a miniature tensile stage (Deben Microtest, Suffolk, UK) when immersed in either distilled water or enzyme solutions. Ten or twenty cycles (corresponding to 1 or 2 hours) of a compression stage followed by a return to initial position stage are carried on with a 5% (13 mm x 0.05 = 0.65 mm) strain, the speed is 0.2 mm/minute. The load and position are recorded as a function of time and the corresponding curves are modelled. The enzyme Pectofruits XL® (Spindal, Gretz-Armainville, France) concentration varied between 0.1 and 1 ml / 100ml water. Results: When the apple parenchyma pieces are immersed in water, the load vs time curves (which are equivalent to stress vs strain because the speed remained constant) are quasi linear for both compression and return to initial position stages traducing a quasi elastic behaviour. The elastic modulus slightly decreased with time. In presence of enzyme solutions, the shapes of the load vs time curves are modified after a period depending on the enzyme concentration. They can be roughly modelled by exponential decays or growths; the exponential parameter is greatly influenced by both enzyme concentration and time. Further experiments are required with smaller apple parenchyma pieces to better understand the enzymatic degradation mechanisms. Conclusion: A micromechanical device is used to characterize the enzymatic degradation kinetics of apple parenchyma pieces. The preliminary experiments clearly showed modifications of the strain vs stress curves during the degradation process depending of the enzyme concentration.

Keywords
enzyme, kinetics, apple, micromechanics

N° Inno-P38 - Potato starch biofilm with propolis extract and potassium permanganate: active packaging in quality maintaining of grape cv. Italy *(Vitis vinifera* L.*)*

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Background and motivation of the work: Active packaging has been developed to minimize some alterations postharvest on the fresh fruits and vegetables. The main of table grapes postharvest concerns are the rot, stalk dehydration and trash, resulting in loss and damage of the products quality. The use of ethylene absorbents on fruits and vegetables packaging provides the reduction of both physiological activity and microbiological development. The purpose of absorbed potassium permanganate ($KMnO_4$) has been to react by oxidizing ethylene to ethylene glycol and reducing the maturation process in fruits (Sarantópoulos and Moraes, 2009). The propolis has antibiotic, antifungal, amebicidal and antibacterial activities (Vargas et al., 2004). The combination of these substances with polymers of agricultural origin can be used to formulate a biodegradable packaging, with application in fruits and vegetables "in natura". This mix provides films with higher permeability than the conventional films, reducing the formation of deleterious atmosphere for the product, as the CO_2 excess or the lack of O_2 (Gontard and Guilbert, 1996). The purpose of this paper is to investigate the effect of active packaging, added with propolis extract and potassium permanganate, on the quality maintaining of grapes cv. Italy "in natura".
Materials and Methods: The grapes were covered with biofilms produced by using the *casting* method with potato starch (2%) and glycerol (0.7%). The experiment was carried out using a 2^3 factorial experimental design. The independent variables were thickness (0.05 and 0.08 mm), propolis extract concentration (4.25 and 8.60%) and potassium permanganate concentration (1.35 and 1.80%). The response variables were the fruits quality indicators (fresh mass, total titrable acidity, total soluble solids, the ratio of total soluble solids-TSS to titrable acidity-TA, pH, total sugar, total count of mesophilic aerobic) analyzed at 0h, 24h, 240h and 384h. The grapes were separated into berries and packed in polystyrene trays. The biofilms were applied over the trays and a rubber band was used for the close them. The fruits were stored under cooler temperatures (7 ºC ± 2 ºC) during 384h. The results were submitted to variance analysis (ANOVA).
Results: Significant differences ($p \leq 0.05$) were observed in mean values of the quality indicators during the storage period. The fresh mass, the total titrable acidity concentration, total soluble solids, total sugar and the total count of mesophilic aerobic indicates a significant difference between grapes quality until 384h. The grapes showed pH and ratio TSS/TA stability until 240h. The propolis showed significant effect in the fresh mass results, total titrable acidity and total sugar; the propolis interaction with the $KMNO_4$ was significant on the pH and total soluble solids; the thickness interaction with the $KMNO_4$ showed effect on the total titrable acidity and on the fresh mass, at the end of the storage period.
Conclusion: The application of potato starch biofilm added with the propolis extract and potassium permanganate are indicative of great potential as active packaging in the quality maintaining of grape cv. Italy.

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Vargas A.C, Loguercio A.P, Wiit NM, Costa MM, Silva MS, Viana LR. Ciência Rural**,** 34, 159-63, 2004.

Keywords
active packaging, grape, propolis, potassium permanganate

N° Inno-P40 - Isothermal calorimetry approach for the study of fresh-cut fruit stability

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Fresh-cut fruit are minimally processed products that have to maintain their quality similar to those of the fresh product. These commodities represent one of the major growing segment in food retail because they combine the peculiar characteristics of the prime materials (sensory and health properties) with a high convenience. The fundamental principle to consider is that they are metabolic active tissues and show physiological response to preparation procedures as well as to the environment created in the package in which they are enclosed. It is worth noting that quality loss of fresh-cut fruit is mainly due to physiological ageing caused by the loss of cellular compartmentation in operations such as peeling and cutting, that causes the mixing of enzymes with substrates and an overall increase of metabolic activity.
Recently several researches have been carried out regarding fresh-cut fruit quality; anyhow some aspects are still unknown, mainly because no basic research studies have been performed about fresh-cut fruit metabolic response to processing stress.
In this direction, isothermal calorimetry may provide a versatile tool to conduct fundamental metabolic studies. All living organisms produce heat as a result of their metabolism. This heat can be detected directly in calorimeters (heat measurement instruments) and used to assess the level of biological activity. Calorimetric measurements of the rate of heat production have been used to provide a direct indication of the metabolic responses of raw material (1), such as respiration and reaction to wounding stress and/or dipping pre-treatments (2, 3). A calorimeter measures the sum of all the heat produced in the sample, permitting the study of a biological system without going into detail.
In this research, recent results of isothermal calorimetry studies focused on differently processed and stored fresh-cut fruit are presented. Particularly the calorimetric approach has been applied in order to better understand the physiological response of fresh-cut kiwifruit, apple and cantaloupe tissues as a consequence of:

- osmo-dehyration in sucrose solution for different treatment times, on the metabolic heat production of fresh-cut kiwifruit;
- modified atmosphere exposure, on the metabolic heat production of fresh-cut apples, with an innovative instrument set-up;
- storage in different syrup formulations, on the microbial growth heat production on fresh-cut cantaloupe.

Obtained results are very promising, evidencing important aspects such as:

- a progressive metabolic heat reduction of kiwifruit tissue with the proceeding of the osmotic treatment;
- the inhibitory effect of specific gas mixtures with traditional and/or innovative packaging gases in terms of metabolic heat production of apple tissue;
- the potentiality of this technique for the optimization of syrup formulation, in order to increase the microbiological stability of fresh-cut cantaloupe.

These findings confirm that isothermal calorimetry may provide a versatile tool to conduct fundamental metabolic studies of the effect of different processing steps on the quality and shelf life of fresh-cut fruit. This can contribute to gain necessary knowledge base for process development and optimisation in the industry, as well as for predicting and ensuring quality and shelf-life of this kind of products.

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Keywords
isothermal calorimetry, sucrose, osmo-dehyration, fresh cut fruit

N° Inno-P41 - Study of the rheological behavior of combined juices of red fruits

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Background and motivation of the work: Rheology is an important tool to develop and scale-up a process. The rheological behavior and flow properties of fruit pulps have a significant role in food industry as they govern the product development, design, and evaluation of process equipment such as pumps, piping, heat exchangers, evaporators, sterilizers, and mixers (Ahmed et al., 2005a). Besides, the knowledge of fundamental rheological properties of any food can be an indication of how the food is going to behave under various process conditions (Ahmed et al., 2005b). Taking into consideration that there is an increase tendency of products using mixtures of fruits (yogurts, juices, ice-creams, soft drinks) and the importance of the rheological parameters on its production, in this work a new approach using the juice of red fruits was performed. Therefore, the goal of this research was to characterize the rheological behavior of combined juices of strawberry, blackberry and raspberry in two different temperatures using the Response Surface Methodology (RSM) as mathematical and statistical tool.
Materials and Methods: The red fruits: strawberry (*Fragaria vesca*), blackberry (*Rubus fruticosus*) and raspberry (*Rubus idaeus*) were processed in a depulper and centrifuged to juice production. The total soluble solids and pH were determined using a refractometer and a pHmeter with glass electrode. Titrable acidity and moisture were measured according to standard method of A.O.A.C (2000). The proportions of the mixtures were defined by RSM using a simplex-centroid design augmented with ten treatments, in order to obtain the formulations. The flow behavior of the ternary mixtures was studied by a rotational Haake Rheostress 600 rheometer (Haake) at 20 ºC and 60 ºC. The rheological data were fitted by the Casson model.
Results: It was not found statistical differences ($p > 0.05$) between the pulps and juices due to the removal of insoluble solids. All samples of combined juices of red fruits showed a Newtonian behavior and the rheological parameters yield stress (K_c) and plastic viscosity of Casson (K_{oc}) had a decrease in its values with the temperature increase. By the analysis of the ternary diagrams it was evident that the raspberry juice effectively contributed to the higher values of yield stress and plastic viscosity of Casson in both temperatures studied.
Conclusion: All the ternary mixtures studied in this work presented a change and its rheological behavior with an increase in temperature, being the majority of the formulations shear-thinning fluids. The rheological parameters were well represented by the Casson model. The viscosity of the juice fruit mixtures was mainly influenced by the raspberry juice. A reduction on Casson´s equation parameters (K_c and K_{oc}) was observed with an increase in temperature.

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Keywords
combined juices, red fruits, rheology, temperature, RSM

N° Inno-P44 - New processes for improving appeal and nutritional value of processed fruit taking into consideration driving forces of the market: isafruit contribution

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Within the ISAfruit integrated project, Pillar 3 "improved appeal and nutritional value of processed fruits" aimed at developing more attractive processed fruit products while retaining their natural healthy components. Pillar 3 comprised 8 academic teams and 4 SMEs from Poland, France, Ireland, Spain and the Netherlands. Our work was mostly focussed on apples but peaches and small red fruits have also been taken into account for some product / fruit combinations. Considering that an increase of consumption of processed fruit may be achieved under conditions that they fulfil consumers' expectations, significant efforts were devoted towards consumer testing using experimental products.

In workpackage 3.1 the objective was to increase the shelf life of minimally processed fruits, including fresh-cut fruits but also innovative technologies such as microwave cooking, sous-vide or freeze-chill. Most commercial ready-desserts are high in dairy products and low in fruit contents: the opposite has been developed, i.e. fruit ready-desserts with high contents of apple wedges and purees, containing prebiotics, added apple dietary fibre or added apple pomace (dietary fibre and polyphenols). Biopreservation techniques have been evaluated for fresh-cut fruits in addition to the more classic use of firming or antioxidant baths.
Workpackage 3.2 was focussed on improving juice production by introducing new cultivars for production of premium juices. The suitability of scab-resistant apple cultivars for production of juices has been assessed and a data-base of the composition of their juices has been constituted. Enzyme-assisted cloudy juice production from black currant and plum has been developed. Apple and red fruit juices have been submitted to consumer testing.
Workpackage 3.3 investigates dried fruits to improve their convenience and design new means of using them. Consumers' expectations for dried fruits were determined in Poland, the Netherlands and France. Conditions of fruit dehydration were optimised to improve sensory quality and dietary value. The evolution of native functional components (polyphenols) during dehydration as well as enrichment in functional ingredients have been studied.
Finally Workpackage 3.4 developed new refined fruit fractions (primarily polyphenol and dietary fibres) for use in other food products. Variability of pomace composition, optimised methods of extraction, impact of juice production technology and pomace treatment, as well as effect of the extracts on juice colour, stability and taste, have been investigated.

In conclusion we have shown that there are technical possibilities to provide new, high nutritional value fruit products for European consumers, from a better choice of raw material to ad-hoc formulation, through use of innovative technologies. An important point is acceptability i.e. adaptation to the food habits of the different countries.

N° Inno-P45 - Grape seed oil obtained by supercritical fluid extraction: an oil rich in polyphenol compounds

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Context and rationale: Given its oil content of 13% (w/w), grape seeds containing 13% of unsaturated oil (mainly linoleic and oleic fatty acids) can be valorised through oil production. Interest in grape seed oil is also due to its high concentration in phenolic compounds (5-10%, w/w), making it interesting as edible oil.
Screw pressing is the continuous mechanical process traditionally used at industrial scale to expel oil from oilseeds. However, temperature reached during this process is not controlled and can alter oil quality, particularly considering unsaturated oils. Supercritical CO_2 extraction appears as the interesting alternative extraction technique given mild operating temperature and selectivity towards some bioactives [1, 2]. The aim of our work was to study operating parameters of supercritical CO_2 extraction to maximize both oil yield and total polyphenol content of oil.
Materials and methods: Air-dried grape seed were ground to an average particle size of 800-1000 µm. Supercritical CO_2 extraction
was performed on a 2L pilot plant (Separex, France). Four processing parameters were studied through factorial design: pressure (181 to494 bars) temperature (48 to 87 °C)and flow rate (5 to 12 kgCO_2/h)of the supercritical fluid as well as mass of solid (200 to 800g). Time of extraction was set at 80 minutes. Oil yield, (expressed as mass of extracted oil upon initial oil mass in seeds), and total polyphenol content of oil, evaluated using Folin Ciocatleu's assay, were determined.
Results: Oil yields were on average 40%, against 60% generally reached in the case of screw pressing. These lower yields were attributed to the large particle size of the ground grape seeds [3]. Only pressure had a significant impact on the yield, a high pressure leading to a high yield. Total polyphenol content showed on average a twofold increase compared to the oil obtained by screw pressing.
Conclusion: Supercritical extraction is a green technology that meets the consumer demand for natural products and can provide a naturally polyphenol-rich oil from grape seeds without any complex refining process. Further investigations will aim at maximizing the polyphenol content of oil and checking that oil extracted by supercritical CO_2 is really more stable than the screw pressed oil.

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Keywords
grape seed oil, polyphenols, supercritical CO2 extraction

3| Microbial and chemical safety and quality

N° Mic-P01 - Physiological response of *Bacillus cereus* during conservation in anaerobic and cold conditions

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Introduction: Mild processing conditions are widespread in the food industry to produce meals easy to use by consumers, while keeping a good sensory and nutritional quality. Indeed health authorities encourage consumption of fruits and vegetables for their nutritional interest which stresses the need for mild processing of fruits and vegetables. Quality must be preserved without neglecting microbiological safety. Growth of relevant pathogens must be quantified and understood. The bacterial pathogen *Bacillus cereus* is ubiquitous, abundant in soil and contaminates in vegetables. It is a spore-forming bacteria, which resist heat treatments and other stresses it met in the food industry. It is a facultative anaerobe, which can grow in vacuum and modified atmosphere packaging. It is able to grow over a large range of temperatures, between 45°C and 5°C. So far, cold adaptation of *B. cereus* have been investigated in air, whereas many processed foods are packaged without oxygen. We characterised growth of *B. cereus* in those conditions to assess more precisely the risk it represents in vacuum packaged refrigerated cooked vegetables. Our goal was to determine if absence of oxygen prevents cold adaptation.
Material and method: Growth temperature limits under anaerobiosis and aerobiosis were obtained in uncontrolled batch cultures. Then growth parameters at the optimum and the minimum temperature under anaerobiosis were obtained with bioreactor. It permitted to control acidity, agitation, gas sparging, and to monitor redox potential. Fatty acid composition of membranes analysed by GC/MS were used as an indicator of cold adaptation. End product metabolites were used to assess fermentative pathways.
Results: Cold and anaerobiosis reduced synergistically growth of *B. cereus*. The lack of oxygen reduce the production of biomass of *Bacillus cereus* at all temperatures, but this reduction is more important at cold temperatures. Biomass diminish near from 3,5 g/l to 1 g/l at 37°C and near from 4 g/l to 0,5 g/l at 15°C. Another interesting observation is that under cold and anaerobiosis, bacterial cells grow without division. Cells could reach a length order of millimeter (normal size is 3-4 µm). This growth hasn't been observed by cells enumeration methods used classically in food. Under air, cold led to an increase in unsaturated fatty acids, presumably to restore membrane fluidity. Without oxygen, a minimal amount of unsaturated fatty acid was observed, and most branched fatty acids, as a feature of Bacillaceae membranes, disappeared. These modifications could be explained by absence of oxygen and modification of intracellular redox potential. Lack of oxygen led to modifications of the metabolism toward production of ethanol and lactate to maintain redox state. Cold temperature seems to limit ethanol synthesis. The association of cold and fermentative metabolism could unbalance the ratio NADH/NAD+.
Conclusion: Combination of anaerobiosis and cold represent drastic conditions for *B. cereus,* as each condition presumably hinder adaptation mechanisms to the other. This must be considered when assessing the risk of *B. cereus* in vacuum or modified atmosphere packaged foods. This risk is presumably overestimated whenever the available growth parameters, obtained under air, are used.

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Keywords
Bacillus cereus, metabolism, cold, anaerobiosis, membrane

N° Mic-P02 - Thermophilic spore forming bacteria isolated from spoiled low-acid canned food: a nine-years survey.

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Context and rationale: Canning is one of the safest preservation processes which relies on thermal inactivation of vegetative cells and most of bacterial spores. Through the heating process, foods are cooked and products withstand storage at ambient temperature during several years. Production controls involve stability tests. Commercialization and food safety requires that the food remains stable, regarding the development of mesophilic bacteria, which are potentially pathogens. A complementary stability test, performed at 55°C, is used to manage the risk and is nowadays considered as a main hygienic criterion in Good Manufacturing Practices. The goal of our study was to determine which bacteria cause this spoilage at high incubation temperature in collected samples.
Materials and Methods: Since 2002, CTCPA received from French canneries more than 250 low acid canned food products which did not comply with stability test at 55°C. Two groups of products were considered: vegetables-only and meat-containing foods. These groups correspond to two levels of heat treatments. Bacteria were revivified from cans, aerobically or anaerobically, at 37°C or at 55°C. Isolates were identified by microsequencing or by group-specific PCR detection (SporeTraQ™).
Results: Only three genera are responsible for 75% of all the non-stability cases observed at 55°C. Two genera are majoritary *Moorella* and *Geobacillus*. Two species, which are not differentiated by 16S rRNA region sequencing, belong to the genus *Moorella*: *Moorella thermoacetica* and *M. thermoautotrophica*. And a single species, *G. stearothermophilus,* caused the very large majority of flat sour observations. The third genus is poorly described and its taxonomy position was until recently changing. It regrouped several species of *Thermoanaerobacterium,* and some were previously described as *Clostridium thermosaccharolyticum*, a canned food spoilage bacterium. And certain strains were recently renamed *Caldanaerobacter*. All those bacteria are known to form highly heat resistant spores (HRS). *Moorella* was originally and mainly found in vegetables but in recent years it was identified in all kind of canned products. *Thermoanaerobacterium* spp., which is anaerobic and thermophilic as *Moorella*, was responsible for non-stability more frequently in recent years. Beside those genera, *Bacillus* and *Clostridium* were occasionally identified. This relative weaker occurrence is related to their lower heat resistance, compared to previous cited bacteria.
Conclusion: This study presents the first largely documented survey of species causing non-stability at 55°C in low-acid canned food products. Changes in the relative proportion of the identified species were observed with time, during this study running over several years. By knowing which bacterium is responsible for a case of non-stability, microbial contamination of canning manufactures can be more efficiently managed according to Good Hygienic Practices.

Keywords
low-acid canned food, thermophilic, spores, stability, heat resistance

N° Mic-P03 - Effect of lactobacillus fermentation on gallic acid and iron-gallic acid complexes

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Background and motivation: Although minor components such as Fe and Zn, are present in considerable amounts in plants, they are not accessible for humans as they are complexed to phenolic compounds and fibers. It has been shown that phenolic compounds bearing galloyl or catechol groups are able to complex Fe and Zn (Andjelkovic et al., 2006). Examples of these phenolic compounds are gallic acid, protocatechuic acid and syringic acid. Gallic acid, mainly present in tea leaves, is often found in complex molecules, such as tannins, whereby Fe can bind with more than one gallic acid molecule. As it is known that lactic acid bacteria can convert or degrade phenolic compounds, lactic acid fermentations could lead to an increasing amount of bioavailable Fe and Zn.
The aim of this study was to identify and quantify the conversion products of gallic acid during growth of two Lactobacillus strains i.e. *Lactobacillus plantarum* and *Lactobacillus collinoides*. Also the effect of different concentrations of gallic acid on the growth and fermentation pattern was studied. Furthermore, the effect of the two Lactobacillus strains to degrade or to convert Fe-gallic acid complexes in model incubations was investigated.
Materials and Methods: In a first experiment, the effect of different concentrations of gallic acid (0, 0.5, 1.5 and 3 mM) supplemented to MRS-broth on the growth and fermentation pattern of *Lactobacillus plantarum* (LMG6907) and *Lactobacillus collinoides* (LMG9194) was tested. Incubations were performed at 30°C until strains reached stationary phase. In a second experiment, different concentrations of gallic acid (0, 0.5, 1.5 and 3 mM) as well as 10 µg/ml Fe^{2+}, in the form of Mohr's salt, was added to a modified MRS-broth (2g/l galactose as carbon source). *Lactobacillus plantarum* and *Lactobacillus collinoides* were incubated for 14 days at 30°C. During the experiments, samples were taken on regular time points to follow growth (OD_{600} and CFU/ml), pH, fermentation pattern by measuring organic acids and conversion of gallic acid(complexes). To identify and quantify gallic acid and its conversion products and degradation of Fe-gallic acid complexes, samples were extracted and analyzed by UPLC-HDMS-Q-TOF.
Results: From the first fermentation experiment, it was observed that the gallic acid concentrations did not affect the growth of both lactobacilli. *Lactobacillus plantarum* as well as *Lactobacillus collinoides* converted gallic acid into pyrogallol, which implies that the metabolic pathways of the two strains on gallic acid are similar. Both strains started converting gallic acid from the lag phase of their growth.
In the second experiment, when Fe was added to the gallic acid supplemented medium, the colour of the medium turned green immediately. During fermentation with *Lactobacillus plantarum*, a shift in colour of the fermentation medium from green towards red at the end of the incubation was observed. This visual observation suggests that *Lactobacillus plantarum* could degrade or change the Fe-gallic acid complexes. Further analysis using UPLC-HDMS-Q-TOF are in progress to confirm this. No change in colour of the media was seen for incubations with *Lactobacillus collinoides*, suggesting that other mechanisms are involved for the two bacteria.

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Keywords
gallic acid, pyrogallol, iron, fermentation, *Lactobacillus plantarum*, *Lactobacillus collinoides*

N° Mic-P04 - Effects of ultraviolet radiation against Fusarium palidoroseum in 'Galia' and 'Yellow' melons and viability of pathogenic bacteria

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Context and rationale: Ultraviolet radiation (UV) has been used for disinfecting environments and reducing the microbial levels in food and water, but the low penetration capacity of UV radiation restricts its use in the decontamination of surface areas of products. A pulsed ultraviolet radiation has enhanced effects on the control of micro-organisms when compared to continuous UV radiation. This makes pulsed UV a potential process for food conservation. The objective of this study was the evaluation of pulsed UV radiation for fungi control in "Yellow" and "Galia" melons, and the effect on pH, Brix, acidity and loss of mass. The effect of pulsed and continuous UV radiation on *Escherichia coli* and *Salmonella typhimurium* viability was also compared.
Materials and Methods: Pulsed UV at intensities between 1.5 to 1.8 $J.cm^{-2}$ were applied using equipment with two xenon lamps. The melons were inoculated with spores of *Fusarium pallidoroseum*, (10^8 $ufc.mL^{-1}$) and then the pulsed UV was applied, with subsequent storage (Yellow at room temperature and "Galia" at 12ºC with controlled relative humidity). UV pulses were also applied on the mycelium of *Lasiodiplodia sp*. and on *F. pallidoroseum* mycelium and spores.
Suspensions with 8 log10 $ufc.mL^{-1}$ *Escherichia coli* ATCC 11775 and *Salmonella Typhimurium* ATCC 14028, were treated with 0.3 to 1.8 $J.cm^{-2}$ UV pulses, with an average distance of 10 cm between the lamps, and 5, 10 and 15 minutes of continuous UV with a distance of 60 cm from the lamp.
Results: The results showed that UV radiation has effectiveness against spores of fungi, inhibiting germination, if used in the surface layers and at low concentrations. The effect of pulsed UV on mycelium is limited because there is a shading effect, one cell above the others, this depends on the thickness of the mycelium and it is proportional to the intensity of the UV treatment.
Yellow melons showed no changes due to UV treatments. In cantaloupe melons of the "Galia" variety, the experiments showed that the action of the UV radiation increased sensitivity to the attack of spoilage bacteria, and the action of fungi occurred mainly on the stems. In the samples inoculated with fungi, the pulsed UV reduced the mass loss during storage. The melons with pulsed UV showed no changes in Brix, acidity, pH, color and sensory evaluations when compared to a control.
The more intense treatments with pulsed UV showed a reduction of 1.9 log cycles for *Escherichia coli* and 1.5 log cycles in samples of *Salmonella typhimurium*. The 15 minute long continuous UV radiation showed a reduction of 6.0 log cycles in *Escherichia coli* samples and 3.8 log cycles in *Salmonella typhimurium* samples. Comparing the effect of pulsed UV radiation with continuous UV radiation, 6 – 10 pulses have a similar antimicrobial effect to 5 minutes of continuous UV exposure.
Conclusion: UV radiation is effective against spores of *Fusarium pallidoroseum*, as long as they are in surface layers and at low concentrations, and have a limited effect on mycelium. In melons, the pulsed UV showed an increased sensitivity to spoilage, more studies to confirm this action are recommended. The UV radiation effect in *Escherichia coli* and *Salmonella typhimurium* is proportional to the intensity of radiation. *Escherichia coli* is more sensitive to UV compared to *Salmonella typhimurium*.

Keywords
pulsed UV, disinfection, food safety, postharvest, melons.

N° Mic-P06 - Modeling risk-benefit in a food chain: nutritional benefit versus microbial spoilage risk in canned green beans

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Background and motivations of the work: Fruit and vegetables are major sources of vitamins for human nutrition. Microbial risk assessment of fresh and processed foods, including fresh and processed vegetables is increasingly performed (e.g., Afchain et al., 2008). In contrast and surprisingly, vitamin loss assessment during food processing has, to our knowledge, not been performed for processed fruits and vegetables.
We propose to model simultaneously the evolution of some bacteria and vitamin concentrations in a real food chain. We aim to find a compromise on process parameters that optimizes nutritional benefit while keeping risk at an acceptable level. A canned green bean processing chain was modeled. The microbial risk was spoilage of the cans, appearing as can swelling consecutive to growth and gas formation by the thermophilic bacteria *Geobacillus stearothermophilus*. The nutritional benefit was the content in vitamin C and folates (or vitamin B9).
Material and methods: Green beans were sampled at the processing plant at different steps of the chain for determination of vitamin C and folates.
A risk and benefit Monte-Carlo simulation model using literature data and expert opinion was built. Basic microbial and biochemical processes determining changes in bacterial and vitamin concentrations were defined at each step of the industrial process, as well as the most relevant chemical and physical environmental factors affecting those changes. Probability distributions were attributed to each parameter to reflect its variability and/or uncertainty.
Results: The risk model accounted for (i) the inactivation of *G. stearothermophilus* during heating processes (blanching and sterilization), depending on times/temperatures, and cross-contaminations at blanching and juicing and (ii) the probability of survival and growth to cause spoilage after an incubation period of 7 days at 55°C. In the benefit model, the physiological reactions occurring before the blanching step were modeled as a function of time, and the chemical reactions during heating depended on the time, temperature and oxygen levels, using the model proposed by Penicaud (2009). A diffusion model was used to describe transfer of vitamins from green beans to blanching water and in the cooking juice.
Conclusion: Predictions in changes in vitamin concentrations and spoilage rate will be challenged to measured data, to validate the model. A possible method is to use Bayesian inference.

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Keywords
vitamins, *Geobacillus stearothermophilus*, canned vegetable

N° Mic-P07 - Yeast microbiota of natural green table olives from Portugal

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Background and Motivation: Table olives are a fermented food produced and consumed in Mediterranean countries. Cracked green table olives, from the *Manzanilla* variety, are a typical food produced in Portugal, characterized by a fresh natural colour, a rich aroma and a typical bitter taste. The fruits are cracked, washed and kept in brine until they partially lose their natural bitterness and no treatments with NaOH are applied to de-bitter. Yeasts play a critical role in olive fermentation, especially in directly brined green olives and may contribute to their sensorial and microbiological characteristics. In this context, the objective of the present work was to study the yeast population during the fermentation of cracked green olives.
Materials and Methods: Olives were fermented at a laboratory scale from October onwards and yeasts were shown to be the predominant microbial population. Brine samples were taken along the whole fermentation process, diluted and plated on Malt Extract Agar plates. A total of 51 isolated yeast colonies were randomly picked out and identified using a molecular identification that included the restriction pattern analysis of PCR-amplified 5.8S Rrna gene and internal transcribed spacers ITS1 and ITS2 (RFLP) (Esteve-Zarzoso et al., 1999). For some of the RFLP profiles obtained, sequence analysis of the D1/D2 region of the 26S Rrna gene was performed (Kurtzman and Robnett, 1998) and the obtained sequences were compared to the NCBI Genebank database using BLAST.
Results: The referred techniques allowed the identification of the following species along the fermentations: *Aureobasidium pullulans*, *Cryptococcus carnescens*, *Sporobolomyces odoratus*, *Candida fermentati*, *C. membranaefaciens*, *Pichia kluyveri* and *P. guilliermondii*. However, as the biological processes evolved the number of different species decreased with the genera *Candida* and *Pichia* becoming the dominant at the advanced stages of the fermentations. Since yeasts play important roles on the quality of olives, their study could help in the selection of strains with adequate technological properties to be used as starter cultures in the processing of table olives. This could result in the production of predictable fermentation processes with better quality in the final products, as yeasts can contribute to the production or spoilage of this type of food.
Conclusions: Cracked green table olives from the *Manzanilla* variety produced in Portugal are included in the category of "natural olives" which undergo a spontaneous fermentation carried out by fruit and environmental microbiota, with yeasts found to be the dominant group. In this study, it was possible to identify all the yeast isolates by ITS-RFLP and molecular analysis of Rdna partial sequences. However, further studies are needed to understand the role of those species in the transformation of the "raw" green olives into an edible foodstuff. The results obtained are a contribution to the comprehension of the fermentation process underlying the production of one of the components of the Mediterranean diet : green olives.

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Keywords
natural cracked table olives, yeasts, ITS-RFLP, Rdna.

N° Mic-P08 - The effect of pre-treatment and modified atmosphere on quality of minimally processed coleslaw mix

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Context and rationale : In the minimal processing of fruit and vegetables the objective is to reduce changes in raw material tissue, maintain high quality and assure safety. The level of microbial contamination is a major factor affecting product quality.
The study comprised an analysis of raw material disinfection (using chlorine water, an ascorbic and citric acid solution) and modified atmosphere applied in packaging, with high O_2 contents, on microbial quality and selected 121harac-chemical properties of stored coleslaw mix. Chlorine is considered to be one of the most effective disinfectants. However, its use is connected with the occurrence of adverse by-products and the effectiveness of its action to a considerable degree depends on Ph and the content of organic compounds. Thus minimal processing of fruit and vegetables is investigated as a safe alternative.
Materials and Methods: Material for analyses comprised salad, containing 80% of head cabbage and 20% carrot. The comminuted raw material was soaked in chlorine water (100 ppm Cl^-) or in a 0.5% ascorbic and citric acid solution. After separation from the disinfecting solution the raw material was placed on trays and sealed with film with oxygen permeability of 35 $cm^3/m^2/24h*$ bar. The applied film was microperforated (9±2 microopenings in the film sealing the packaging). Tested samples were packaged in air atmosphere and in the atmosphere with a high oxygen content (% O_2/% CO_2/% N_2: 50/30/20; 70/30/0). The product was stored for 12 days at a temperature of 4°C. Analysis of product quality comprised the evaluation of microbial quality, sensory examination, measurements of oxygen and carbon dioxide contents in the atmosphere inside the packaging as well as the determinations of Ph and soluble solids.
Results: The application of chlorine water in raw material disinfection resulted in an inhibition of growth of mesophilic bacteria, coliform bacteria (10^3 CFU/g) and psychrophilic yeasts (10^4 CFU/g) during product storage. The counts of microorganisms in salad soaked in the acid solution remained at the level found in the control samples, which had not been soaked. Packaging of both samples soaked in chlorine water and those soaked in acid solution, in modified atmosphere with a 50% oxygen content and a 30% carbon dioxide content resulted in a reduction of counts of psychrophilic bacteria, bacteria from genus *Pseudomonas* as well as psychrophilic yeasts by 1 – 2 logarithmic cycles in comparison to air-packaged salads. In samples soaked in acid solution packaged in the atmosphere with a 70% oxygen content a further reduction of counts of tested microorganisms was observed (i.e. mesophilic bacteria, coliform bacteria and mesophilic yeasts). In salads soaked in the acid solution no presence of *Listeria spp.* was detected in 0.1 g product. After 12 days of storage of samples packaged in modified atmosphere, irrespective of the applied pre-treatment, were characterized by good sensory quality.
Conclusion: In case of samples packaged in the atmosphere containing 70% O_2/30% CO_2/0% N_2, raw material disinfection with a 0.5% solution of ascorbic and citric acid facilitates a more effective reduction of microbial contamination of stored coleslaw than disinfection using chlorine water.

Keywords
minimally processed, washing solutions, superatmospheric oxygen, modified atmosphere

N° Mic-P09 - The Properties of Pickles Fermented with LAB Isolated From Traditional Pickles in Ankara-Cubuk Region

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Traditional fermented foods have specific characteristics due to different manufacturing procedures and different natural flora of production area. Ankara-Cubuk region is famous for pickles produced by traditional methods. However, the production is limited to small scale enterprise. Despite the large production potential, it is not possible to achieve products in standard quality. For product standardization, it is required to use of selected starter cultures in conjunction with standard raw material and standard manufacturing procedure. The purpose of this study was to develop a starter culture that could be used in pickle production. In this context, micro-scale pickle fermentations were conducted by using LAB isolated from Ankara-Cubuk Region as starter culture.

LAB that was selected according to their suitable technological properties for pickle production was used as starter culture. Cucumbers used in this study were collected from Cubuk Region. The fermentation experiments were conducted in 3 L vessels containing 1.5 kg of cucumbers and 1.5 kg of brine (8% salt, 0.4% $CaCl_2$, 0.4% acetic acid, 2% glucose). Brine was inoculated with 10% (v/v) *L.plantarum* 6C4, *L.plantarum* strain CNBI B-1419, *L.plantarum* strain P5 and mixture of *L.plantarum* and *Pediococcus ethanolidurans* strain IMAU80061 prior to addition to fermentation vessels, except for control vessels. The vessels were incubated at 28 °C for 20 days. The fermentations were conducted in triplicate. Samples were taken in 3 day intervals for Ph, titratable acidity (as % lactic acid), salt, reducing sugar (Miller method) and microbial analysis (plate countings of total mesophilic aerobic bacteria, LAB, yeast-mould and total *Enterobacteriaceae*). At the end of fermentation, sensory analyses were conducted with 18 panelists based on the appearance, color, odor and taste parameters.

According to Ph and titratable acidity results of pickle samples during fermentation, it was observed that the fermentation conducted with mix cultures (*L.plantarum* and *Pediococcus ethanolidurans* strain IMAU80061) showed the highest acidity development and reached 0.87%±0.08 of acidity and Ph 3.26±0.05 at the 20^{th} day of fermentation. The acidity development was slower than the others in control samples and the acidity was 0.69%±0.009 at the end of fermentation, as expected. This result was due to low initial LAB counts in control. The initial salt concentration of brines was 8%. These concentrations decreased to approximately 4.25%±0.063 after 4^{th} days of fermentation and then remained constant.

It was determined that total mesophilic aerobic bacteria reached maximum at the 4^{th} day of fermentation and then started to decrease in all samples. Considering the plate counting results, total mesophilic aerobic bacteria and yeast-mould reached to minimum (log 5.37, 5.56 cfu/Ml, respectively) after fermentation in mix culture sample. It was probably due to high acidity level in this sample. It was not observed any *Enterobacteriaceae* after first day.

Using *L.plantarum* strain CNBI B-1419 as starter culture had a significant effect on sensory properties of pickles that it gave the highest score in terms of the appearance, color, odor, taste and total acceptability (4.1, 4.1, 4.1, 3.9 and 4.0, respectively) by the tasting panel.

Keywords
pickle, starter culture, Ankara-Cubuk region

N° Mic-P10 - Decontamination of fresh produce by sequential wash in weak organic acid solutins

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Context and rationale: Demand for fresh minimally processed fruits and vegetables increasing as consumers perceive it as being healthy, and convenient. However, fresh produce poses a risk of food-borne outbreaks as pathogenic bacteria can contaminate raw agricultural commodities through various pathways. Therefore, there is a need for effective decontamination of fresh produce.
Currently, chlorinated water is the most commonly used wash agent to reduce the number of microorganisms on fresh produce. Washing fresh produce in chlorinated water reduces microbial load by 10 to 100-fold[1,2]. However, there has been an increasing concern over the potential for formation of harmful by-products such as chloramine, chloroacetic acid, trihalomethanes and organochlorine[3] when fresh produce is washed in chlorine-based wash waters. Chlorinated washes are not permitted for use on organic produce. Washing of fresh produce in chlorinated water is not permitted in some EU countries, such as Germany and Denmark. As an alternative to chlorine, there is a trend to move towards the use of organic acids for the washing of fresh produce. There are some commercially available wash agents containing mixes of organic acids that are currently used to wash fresh produce. However, their decontamination power is limited and mostly not as effective as chlorine.
Materials and methods: various organic acids were used on their own and in combination to decontaminate some fresh vegetables and herbs by employing sequential wash in different combinations. Response surface method was used to investigate the effect of concentration, wash water temperature and contact time on decontamination efficiency determined by total viable and *Enterobacteriaceae* counts.
Results: Initial results indicating that fresh produce could be decontaminated efficiently when they are sequentially washed in weak organic acid solutions in a particular combination.

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Keywords
fresh fruits, chorine, decontamination

N° Mic-P11 - The survey of the incidence and level of patulin contamination in baby food on the Serbian retail market

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Context and rationale: Patulin is a mycotoxin produced by certain species of *Penicillium, Aspergillus*, and *Byssochylamys* moulds, which may grow on a variety of foods. Patulin has been identified in apples, oranges, peaches, apricots and tomatoes and its products. The maximum residual levels for patulin in EU were set at 10 mg/kg for the products intended for infants.
Materials and Methods: A certain amount of apple juice (10 ml) was filtrated through a membrane filter (0,45 μm). An Oasis® HLB cartridge (60mg/3ml; Waters) was conditioned with 2 ml of methanol and 2 ml of water and 10 ml of infant apple juice was applied on the HLB cartridge. After loading, the sample was washed with sodium bicarbonate (1% solution), followed by acetic acid (1% solution). The cartridge was dried in vacuum for about 3-5 minutes, followed by eluation with 1ml of ethyl-acetate in diethylether (10% solution). The solvent was evaporated under the stream of nitrogen, until dry. The sample was reconstituted in 0.5ml 0.1% acetic acid solution.
For the HPLC analysis, an Agilent 1260 liquid chromatograph was used, equipped with VWD. The purified extracts were analysed on Zorbax Eclipse Plus C18, 100x4.6 mm, 3.5mm; The column was kept at 40 °C. The mobile phase was a mixture of 2% CH3COOH and acetonitrile (95/5, v/v), with a flow rate of 1mL/min. Patulin was detected by the absorption at λ=275nm.
Results: The performance characteristics of the method were established by on single laboratory validation using the method of standard additions with patulin free, patulin spiked and reference material (FAPAS T1638). The standard curve for patulin was linear from 0.02 to 2.00 mg/ml (R2=0.9999), equivalent to 1.0 to 100.0 mg/kg of patulin in samples. The limits of detection and quantification were calculated from spiked samples at the estimated level at six replicates, LOD and LOQ for patulin were 1.0 mg/kg and 4.0 mg/kg, respectively. Patulin-free samples were spiked with standard patulin solutions at levels of 10, 25 and 50.0 μg/kg. All levels were tested in three replicates. The average recoveries of patulin in this range were 91.2 to 111.5% and RSDs were 2.1 to 9.3%. Within laboratory RSDr and RSD_R for the 10 mg/kg spike level in clear juice was found to be 9.3% and 9.5%, respectively.
Conclusion: The SPE procedure was successfully applied to the extraction of patulin from baby food. The recovery rates and the coefficient of variations were 91.2-111.5% and 2.1–9.3%, respectively, the minimum detectable level was 1 mg/kg. The application of the method to 55 samples from market inspection and retail market in Serbia, in two-year period, has demonstrated that 100% were in compliance with current regulations, although one of the samples contained patulin at the limit of quantification.

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Keywords
patulin, Oasis HLB, HPLC, baby food

N° Mic-P12 - Evaluation of analytical methods for determining pesticides in baby food

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Context and rationale: Babies and small children a particularly sensitive population to be exposed to the environmental contaminants. Their small mass and developing systems, including brain development may show adverse health effects from even low levels of contamination on a chronic or single dose case. In this paper one extraction method and two detection techniques for determining pesticides in baby food were evaluated. A liquid chromatography- tandem mass spectrometry technique combined with electrospray ionization (ESI), (LC–MS/MS) and gas chromatography – mass spectrometry detection (GC/MSD) technique was applied for the detection of 55 pesticides in baby food. The sample preparation procedure is described, the so-called QuEChERS sample preparation procedure.
Materials and methods: Extracts were obtained using the acetonitrile-based QuEChERS sample preparation technique (EN 15662). For the LC analysis, an Agilent 1200 HPLC system with a binary pump was used. This was equipped with a reversed-phase C8 analytical column of 150×4.6mm and 5 mm particle size (Agilent Zorbax Eclipse XDB). The mobile phase was methanol and Milli-Q water with 0.1% formic acid in gradient mode, with the flow rate 0.6 ml/min. For the mass spectrometric analysis, an Agilent 6410 Triple-Quad LC/MS system was applied. The Agilent Mass Hunter Data Acquisition; Qualitative Analysis and Quantitative Analysis software was used for method development and data acquisition. For the gas chromatography determination a Thermo Finnigan Trace GC coupled with Finnigan Trace DSQ MSD (Austin, TX, USA), equipped with split/splitless injector and a capillary column DB-*5 (methyl phenyl siloxane*, 30m×0.25mm I.D.×0.25 micrones film thickness) was used. Xcalibur 1.3 Data System software was applied for the data collection and processing. The carrier gas (helium) was of purity greater than 99.9995%.
Results: All the baby food examined was apple based. The matrix influence on linearity and recoveries and their effects on ionization were evaluated for this matrix. Calibration range for both techniques was from 5.0 to 250.0 ng/ml. The recoveries were investigated at the 5, 10 and 50 mg/kg levels. The pesticides that were investigated by GC/MSD were: diazinon, gamma-HCH, pirimicarb, chlorpyriphos-methyl, vinclozolin, metalaxyl, pirimiphos-methyl, fenitrothion, malathion, chlorpyriphos, parathion-ethyl, triadimefon, penconazole, procymidon, triadimenol, methidathion, hexaconazole, myclobutanil, fenvalerate, difenoconazole, deltamethrin, azoxystrobin, kresoxim-methyl, endosulfan alfa, , endosulfan beta, cyproconazole, propiconazole, tebuconazol, epoxiconazole, bifenthrin, bromopropylate, fenpropathrin, metconazol, phosalone, lambda-cyhalothrin, pyrazophos, fenariomol, permethrin, beta-cyflruthrin and cypermethrin. The average recoveries for all analites were 82.3 to 101.4% (RSDs 2.63 - 16.29%). The pesticides that were investigated by LC-MS/MS were: aldicarb sulphone, aldicarb sulphoxide, carbendazim, methomyl, 3-hydroxycarbofuran, aldicarb, bendiocarb, carbaryl, carbofuran, ethiophen-carb, metiocarb, propoxur, oxamyl, maloxon, azoxystrobin, malathion, triadimefon, quintozene, triadimenol, prochloraz, metalaxyl, azinphos-ethyl, myclobutanyl, propyzamide, bitertanol, hexaconazole, kreoxim-methyl, pirimifos-methyl, prochloraz and resmethrin. Average recoveries for all analites were 61.0 to 114.2% (RSDs 7.41 -12.93%).
Conclusion: The proposed method was applied for the routine analysis of approximately 50 samples of baby food manufactured in Serbia. The results showed that the concentration of pesticide residues in all the samples analyzed was below the EU Maximum Residue Limits.

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Keywords
pesticide residues, baby food, QuEChERS, LC-MS/MS, GC/ MSD

N° Mic-P13 - Assessment of inhibition assays in microarrays platforms to measure individual allergenic components in foods.

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Background and objectives: From the last years, the microarray platform containing individualized allergens has been successfully used to measure specific IgE antibodies. Inhibition studies to evaluate the airborne or environmental allergens also have been used and the results seem to be promising.
With this in mind, the aim of this work was to evaluate the platform array concept, to measure the detection of individual allergenic components in foods.
Material and methods: The selected foods (rice, yoghurt cake mixture, farmer soup, egg pasta, red wine, potato dumpling mixture, bread roll mixture, for pancake mixture, pizza mixture and flour mixtures) with and without reported egg content were purchased in the supermarket. The samples were homogenized by an IKA rotor-speed mill.
ELISA was carried out according to Tomkova and cols (2010). Inhibition assay was carried out using the ISAC platform (ImmunoCAP ISAC, Phadia AB), human serum with specific IgE anti-ovoalbumin (20 ISAC units) and ovoalbumin (SIGMA) at different concentrations as inhibitor. Linear regression was applied to correlate ELISA and ISAC-inhibition results.
Results and discussion: Inhibition curves demonstrated linear interval between 100 and 1 ng of inhibitory ovoalbumin and the detection limit of the assay was 1 ng. The correlation between both methods (taking the ELISA as reference) was good (r=0.912).
Six per cent of samples (1 sample) revealing positive tests in ELISA were negative by ISAC-inhibition.
The main weakness of the inhibition assay for this proposal is the use serum containing antibodies to the different involved allergens. However, these results and the characteristics of this platform make it useful to detect allergens like LTP, profilins, PR10, lectins, thaumatins or other still non available isolated allergenic proteins.
Conclusion: Performance of the inhibition assay using microarray platforms is useful to detect allergenic protein in foods with results comparable to those caused by ELISA.

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Keywords
allergen, protein microarrays, ovoalbumin, inhibition-immunoassay, ELISA

N° Mic-P14 - Solid particles from flash-release treatment of grapes: homogenous physical structure, but yeast nutritional heterogeneity

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Among different physical treatments used to damage plant cell and vacuolar membranes, flash release (FR) process is expected to degrade the cellular structures.
Over and above the powerful extraction capabilities of this process, FR treatment of grapes was initially used for the production by direct fermentation of the sole liquid phase of very fruity and astringent wines, with less animal sensory characters. Grape phytosterols are generally extracted during the maceration phases, and assimilated by yeast cells during their growth, orientating ester production by yeasts. It is therefore very surprising that no data could be available in the literature on the type, the quality and the quantity of particles generated by the FR process, and more generally by all the thermo treatment process applied on grapes. The purpose of this study is to evaluate the physical structure of the fine solid particles generated by flash release process on grapes, and to assess the availability of grape phytosterols for yeast growth within these particles.

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Keywords
solid particles, grape must, flash release, yeast nutrients.

N° Mic-P15 - Oxygen consumption by the must of cider apple at the beginning of fermentation

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Introduction: The availability of oxygen in musts in fermentation is an important factor in controlling the selective development of floras. Traces of oxygen are required for the synthesis of sterols in yeast fermentations (Deytieux *et al*., 2005). However, the presence of polyphenoloxidase (PPO) of plastid origin in apple musts is a factor determining the level of oxygen available. This enzyme is associated with suspended particles entrained during pressing. The aim of the present work was to measure the ability of different apple musts to consume oxygen according to their physicochemical characteristics and their PPO activity.
Methodology: The study focused on five varieties considered representative of the diversity of French cider apples. Each variety was studied at harvest and after ripening for six weeks. For each must, three methods of clarification have been implemented. The rate of oxygen consumption was measured using a device comprising a sealed cell of 300 ml and a flow system of the juice, coupled to a Clark electrode. Oxygen was provided in a known quantity through a distribution system in silicone. Meanwhile, the PPO activity was measured using an oxygraph on a solution of 4-methylcatechol (40 mM) in a 20 mM malate buffer at pH 5.
Results and discussion: Oxygen consumption of musts varied from 100 to 300 µmoles.min^{-1}.L^{-1} depending on the variety. Musts from sweet or bittersweet apples showed the highest speed. Maturation had no noticeable effect. The consumption rate was only partially correlated with the levels of PPO activity. Indeed it was between 1000 and 8000 µmoles.min^{-1}.L^{-1} depending on the variety but the rate (PPO activity / oxygen consumption) increased from 25 for sweet apples to 100 for sharp apples. The differences in pH and polyphenol composition of must also explained the rates of oxygen consumption. Moreover, neo-formed oxidation products inhibited the PPO. This inhibition was even more important than the rate of oxygen consumption was high. This confirmed previous observations made in synthetic medium (Le Bourvelec *et al.*, 2004)
Conclusion: In practical terms, these results are to be considered for understanding the competition between the yeast flora and biochemical system for the resource in oxygen. They should be set in relation to the estimated quantity of oxygen that can get a mash of apple from pressing to the beginning of fermentation.

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Keywords
polyphenoloxydase, phenolic compounds, sweet apple;,bitter apple

N° Mic-P16 - The mixed yeast flora in cider fermentation

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Introduction: The ciders fermented with only *Saccharomyces sp.* exhibit an organoleptic neutrality. Research on cider fermentation (Michel *et al.*, 1990) have demonstrated that the development of the yeast *Hanseniaspora valbyiensis* was essential for the flavour of cider. It is the wish to keep the aromatic complexity associated with this initial flora complex, which explains the absence of inoculation of musts in French cider making until now. The fermentation conditions that allow an efficient implementation of non-Saccharomyces in cider fermentations are now defined and inoculation in a mixed flora becomes possible. The aim of the presented work was to assess the real impact of the presence of *H. valbyensis* on cider at a small cider-maker level (1000 L) in a simple experiment (assay against standard).
Methods: The apple must was homogenised and divided into two tanks of 10 hL and inoculated as follow: i)"Simple flora": *S. uvarum* alone (3.10^4 CFU/mL) ; ii) "Mixed flora": *S. uvarum* (3.104 CFU/mL) and *H. valbyensis* 2.10^6 CFU/mL.
The two flora were monitored by selective counts during the first 21 days. For both tank, samples of 100 litres were made at different density (1020 kg/m3 and 1010 kg/m3) and micro-filtered (membrane filtration at 0.45 µm), then carbonated to 5g/L, bottled and stored at 2°C for analysis of volatile compounds and sensory evaluation.
Results and discussion: There was a significant growth and a persistence of *H. valbyensis* flora in the modality "mixed flora". In this condition, *S. uvarum* growed less. This confirmed, in the industrial situation, the inter-species competition already observed experimentally during previous work on simultaneous growths of the two yeasts.
Of all the volatile compounds quantified, seven compounds were significantly different between the two fermented products. Especially "mixed flora" cider are richer in isoamyl acetate (fruity marker, banana) in acetoin (butter) and ethyl lactate. These same products are also less rich in methionol (smell of sulfur reduction).
Three descriptors that can be called the fruity characteristics were discriminating in sensorial assessment at the threshold of 5%, all of them being high in the mixed flora cider.
Conclusion: This experiment shows that it is now possible to control mixed flora in order to enhance the fruity flavour of the cider. The sensorial data are consistent both with the microbiologic data and the analysis of volatile compounds.

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Keywords
Saccharomyces uvarum, *Hanseniaspora valbyensis*, isoamyl aetate, acétoin, ethyl lactate, methionol, sensorial analysis

N° Mic-P17 - Antimicrobial activity and composition of the essential oils of origanum spp. cultivated under the good agricultural practics in Turkey

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Context and rationale: The genus *Origanum* (Lamiaceae) is widely distributed in the Mediterranean. Oregano speciesis known as "Kekik" in Turkey and is commercially cultivated in Turkey. It is also cultivated in France, Spain, Portugal, Hungary, Bulgaria and Greece. Oregano commonly is used as aromatic plants. Oregano oil is the essential oil extracted from aerial part of Oregano species. The oil produced contains a high proportion of carvacrol, which produces the oregano smell. The aim of the present study was to investigate the antimicrobial activity and composition of the essential oils from the aerial part of oregano species (*O. onites*, *O. majorana* and *O. vulgare*). There is worldwide trend to explore new alternatives to control foodborne diseases, giving priority to methods that reduce disease incidence and avoid negative and side effects on human health. Western society is experiencing a trend of "green" consumerism, desiring fewer synthetic additives in foods together with their increased safety, quality and shelf-life. Among promising alternative methods, such as biological control and natural based chemicals much attention is being paid to the use of essential oils
Materials and methods: Origanum spp.(O. onites, O. majorana and O. vulgare) was cultivated, whichorganic content was 3% under controlled conditions in the experimental field of Agricultural Faculty, Selçuk University in Konya. Samples of *Origanum spp* was collected in the beginning of flowering period. Chemical composition of essential oil obtained from origanum spp.was identified by gas chromatography-mass spectrometry (GC-MS). The antimicrobial activity of essential oils from *origanum spp.* were examined against microorganismsby disc-diffusion method. The minimum inhibitory concentration (MIC) were determined based on a micro-well dilution method against the strains of *E. coli, S. enteritidis, S.cholerasuis, P. aeruginosa, S. aureus, B. cereus, S .lutea, C. albicans.*
Results: Carvacrol as a dominant component was detected between 48-90 % in the essential oil of *Origanum spp.* The antimicrobial activity of the essential oils is dependent on a)-the composition of essential oil b)- concentration of essential oil c)- type of test microorganism d)-concentration of the microorganism.
Conclusion: Oregano(*Origanum spp.)* cultivated according to GAP (Good Agricultural Practices) has been more effective on various bacteria with comparison to cultivated conventionally.

Keywords
oregano, essential oil, antimicrobial activity, cultivation (gap)

N° Mic-P18 - Quality of kale (*Brassica oleracea* var. *acephala*) at the application of minimal processing and modified atmosphere packaging with microperforation of packaging material

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Context and rationale: The rate of metabolic processes in minimally processed kale depends on the quality of raw material, the degree of its processing, the composition of applied modified atmosphere, the type of applied packaging material and storage conditions. In case of Brassica vegetables, including kale, the factor determining the quality of packaged product is connected with changes in aroma. The application of high-oxygen atmospheres and microperforation of packaging material in packaging of Brassica vegetables may prevent changes in aroma and facilitate an extension of product shelf life.
The study comprised an assessment of the effect of modified atmosphere packaging using microperforation of packaging material on sensory and microbiological quality and on changes in selected physico-chemical properties of minimally processed kale during 12-day storage at a temperature of 4°C.
Materials and Methods: The analyses were conducted on green kale (*Brassica oleracea* var. *acephala*) cv. Reflex. Leaves of kale were sealed using two types of packaging film with different oxygen permeabilities: 35 $cm^3/m^2/24$ h*bar and 2500 $cm^3/m^2/24$ h*bar. Samples were packaged in modified atmosphere containing 10% O_2/10% CO_2/80% N_2, 30% O_2/10% CO_2/60% N_2 and 55% O_2/10% CO_2/35% N_2 and in air atmosphere. Microperforation of packaging film at 2*10 and 3*10 openings (±2) with a diameter of 70 mm was applied over the width of the tray with the product. Packaged product was stored at 4ºC for 12 days.
Sensory examination of samples was conducted according to a 5–point scale. The following parameters were evaluated: colour, taste, aroma and consistency. Contents of oxygen and carbon dioxide in packagings with kale were measured using an Oxybaby apparatus (Witt-Gastechnik). Moreover, values of pH and solids content were determined in the samples. Analysis of microbiological quality of the raw material and the product covered the following indicators: counts of mesophilic and psychrophilic bacteria, counts of moulds and yeasts, counts of lactic acid bacteria and the count of coliform bacteria.
Results: On the basis of conducted experiments it was found that the application of microperforation of packaging material significantly improved sensory quality of samples of minimally processed kale during 12 days of its storage in comparison to samples packaged without microperforation. Significantly higher scores in the sensory examination of taste and aroma ($p \leq 0.05$) were recorded for samples packaged using microperforation of 2*10 in comparison to microperforation of 3*10. Packaging of samples with the microperforation of 2*10 for a longer time retained modified atmosphere conditions, particularly a higher level of carbon dioxide (4.9%) in comparison to microperforation of 3*10 (2%). The application of film with oxygen permeability of 2500 $cm^3/m^2/24$ h*bar result a significantly higher sensory quality of product than in samples packaged using film with oxygen permeability of 35 $cm^3/m^2/24$ h*bar.
On the basis of the conducted microbiological analysis no significant differences were found in microbiological quality of samples packaged in modified atmosphere in comparison to the control (air-packaged sample). In most analysed samples microbial contamination increased during 12 days of their storage.
Conclusion: The microperforation of packaging film to packaging minimally processed kale in modified atmosphere significantly improved the quality of the product during 12-day storage, particularly its aroma and taste, in comparison to samples packaged without microperforation.

Keywords: minimal processing, modified atmosphere, packaging film microperforation

N° Mic-P19 - Comparison of volatile compounds of fresh and fermented aplle juice from different apple varieties

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Background: The fermentation of apple must is complex process involving several biochemical reactions. Aroma of cider is influenced by many factors: apple variety, yeast strains, fermentation temperature. Main aroma compounds of cider are esters, higher alcohols, fatty acids, aldehydes, ketones, terpenes, lactones. Aroma plays significant role in the quality of cider, and it is very important to determine influence of each compound to quality of final product.
The aim of current research was to evaluate volatile compounds of fresh and fermented juice, depending on used apple variety and apple ripening index.
Materials and methods: For experiments five variety apples (‘Auksis’, ‘Lietuvas Pepins’, ‘DJ-41-7’, ‘Remo’ and ‘Kerr’) grown in the Latvia State Institute of Fruit Growing were used. Juice was obtained by mechanical press after harvesting, and also after storage of apples (two and four weeks). Apple ripening index were determined before juice processing. Fermentation was performed using commercial *Saccharomyces bayanis* yeast. For comparison of aroma profile of fermented drinks two commercial French ciders were analysed. Extraction of aroma compounds was performed using solid phase microextraction (Car/PDMS fibre). Analysis of volatile aroma compounds were made using a Perkin Elmer Clarus 500 GC/MS equipped with a capillary column Elite-Wax ETR (60 m x 0.25 mm i.d.; DF 0.25 μm). Compounds were identified by comparison of their mass spectra with mass spectral library Nist98 and retention times of the standards.
Results: The volatile compounds of analysed juices from pple varieties grown in Latvia differed. The main aroma compound of ‘Auksis’ apple juice is 2-hexenal, whereas of ‘Lietuvas Pepins’ acetic acid butyl ester. In fermented juices the most important aroma compounds were 2-hydroxyethylhydrazine, 3-methyl-1-butanol, and hexanoic acid ethyl ester, acetic acid hexyl ester. Generally, esters were one of the prevailing groups of chemical compounds found in fermented products. From terpenes in juices limonene very identified. In commercial ciders as main compounds also 3-methyl-1-butanol, 2-hydroxyethylhydrazine were identified.
Conclusion: Aroma composition of fresh apple juice during fermentation changes formed new chemical compounds as 2-hydroxyethylhydrazine, 3-methyl-1-butanol, and hexanoic acid ethyl ester, acetic acid hexyl ester. Main aroma compounds of fermented apple juices and commercial ciders were similar, but their concentrations differed.

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Keywords
apple, volatile compounds, ester, aroma composition

N°Mic-P20 - Enzymatic processing of the aleurone cereal fraction increases its antioxidant capacity

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Context and objectives: Many studies have related the antioxidant effects of ferulic acid (FA) with the prevention of some diseases. FA is the most abundant phenolic acid in wheat bran and it is often presented as the major contributor to the antioxidant capacity of wheat grain fractions (Mateo Anson et al., 2008). Among all the wheat bran layers, aleurone is the richest layer in FA derivatives. This compound is mainly situated in the cell wall of the aleurone layer esterified to arabinoxylans (AX) reducing thus its bioaccessibility. Our aim is to increase the antioxidant properties of the aleurone layer by increasing the bioaccessibility of FA by simple and combined enzymatic treatments with xylanase and feruloyl esterase (Fase). The variation of the antioxidant capacity resulting of the different enzymatic treatments will be related to the FA state of structuration.
Material and Methods: Four different fractions were prepared: intact aleurone, aleurone treated with xylanase, aleurone treated with xylanase and Fase and free FA (commercial). The FA content (total, conjugated and free) in the aleurone fractions was determined by HPLC. The arabinoxylan solubilisation rate was checked by gas chromatography. The antioxidant capacity of the fractions was determined by two different tests. The first one is based on the capture of the ABTS radical with a method adapted from Serpen et al (2008). The second one aims at evaluating the protection of dietary lipids by the consumption of plant products in the early phase of gastric digestion. The aleurone fractions and FA are tested as inhibitors of metmyoglobin-initiated lipid oxidation of bovine serum albumin-stabilized oil-in-water emulsions as in Lorrain et al (2010)
Results: Xylanase and Fase enzymatic treatments were efficient to solubilise the AX from the aleurone cell-wall and the FA from AX, respectively. The combined action of these two enzymes gave the highest release of conjugated and free FA. The fraction obtained presented the highest antioxidant capacity measured by the ABTS test (72 mmol TEAC/kg against 57 and 25 for aleurone treated with xylanase alone and intact aleurone, respectively). In the gastric model, first results showed that intact aleurone reduced lipid oxidation comparing well with free FA. A higher reduction could be expected from enzyme hydrolysed aleurone.
Conclusions: The antioxidant capacity of the aleurone cereal fraction is linked to the integrity of the structure embedding the phenolic compound FA. It can be increased by combined enzymatic treatments releasing FA. Moreover, food containing wheat aleurone could exert health benefits through the protection of dietary lipids in the gastric tract.

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Keywords
wheat aleurone layer, enzymatic treatment, ferulic acid, antioxidant capacity and gastric digestion

N° Mic-P21 - Effects of ethyl formate on dates (deglet nour) quality and carob moth pest mortality

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Context and rationale: Dates fruit (*Phoenix Dactylifera*.), from Deglet Nour variety has the most important economical value in several countries, such as, Tunisia, Algeria, Israel and United States. This variety overcomes serious pest attack, especially from Carob moth (*Ectomyelois certaniae*).This infestation causes, annually, serious losses in quantity and quality of this crop.
Metlyl bromide (MB), which was the fumigant used to kill carob moth in dates fruits, is now associated with depletion of the Earth's ozone layer and is under the restriction of the Montreal Protocol, phased out in January 2005. Other tested alternatives to MB, such as Phosphine and sulphuryl fluoride, require long exposure time of fumigation and have a residue impact on the fruit. Hence, postharvest dates sector needs to find an adequate solution to replace existent fumigation method. Currently, industrials are still in search of a solution in order to substitute these fumigants by a new alternative which have a positive effect on insect and, at the same time, will be friendly with the environment, economic and ensure product quality during storage.
The purpose of this study was to test Ethyl formate (EF) as a new alternative to MB for post harvested dates. Hence, effects of EF on: (1) Insect pest mortality were analyzed on dates artificially infested with carob moth in different maturity stages (2) fruit quality and (3) fumigation residue were measured in high quality dates.
Materials and methods: Dates, variety Deglet Nour, in the maturity stage Tamar were harvested from palms in Tozeur (south-west of Tunisia) in fall 2009. Samples dates composed of 205g dry dates and 205g semi dry dates were used. Each date was artificially infested. The tests run included different egg stages (day 1, day 2, day3), larvae (third-instars; fifth-instars) and pupae. Each sample was placed in 1liter glass jar sealed with rubber stopper. Ethyl formate was injected into the jar using a microsyringe. Samples were then exposed to a range of EF concentration: 1, 2, 3 and 4 % during 2 hours at 24°C. Each test was run in triplicates.
Carob moth mortality was then determined. Dates color was analyzed using a Minolta chromameter (model CR-300; Rasemey, NJ) in CIE L*a*b*. Residue was checked for acetataldeyd , ethanol, ethylacetat, and ethyl formate using a gas chromatograph (GC-9AM, Shimadzu Scientific Instruments, Columbia, MD).Analysis were run after different storage periods: 0 day, 7 days ,14 days at different temperatures: 0°C, 5°C and 20°C.
Results: EF fumigation showed that carob moth fifth-instars larvae is the most resistant to EF comprising eggs and pupae. The optimum EF concentration tested provides a control of carob moth in all stages. No significant difference in dates treated and untreated was observed on date color and on volatile content. Residue levels were almost the same as a control sample for acetataldeyd, ethanol, ethylacetat during the storage for 7 day and 14 day.
Conclusion: Ethyl formate may be used efficiently to control carob moth infestation in post harvested dates. Dates color was not affected by the EF fumigation. No toxic residue was observed in the treated samples. A further investigation will be done adding vacuum or CO_2 to EF in order to reduce EF concentration and exposure time in a commercial-scale

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Keywords
ethyl formate, methyl bromide, carob moth, volatile content, date fruit, *Phoenix dactylifera*

N° Mic-P22 - Effect of cultivar and fruit storage on composition of clear and cloudy pear juices

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Context and rationale: Pears are nowadays more and more frequently processed into juices and nectars. Due to low acidity, pear is a good raw material for the production of multifruit nectars containing highly acidic fruits. Pears are often processed into purees, especially purees for baby food production. Due to direct consumption of the above mentioned products it is justified to determine chemical composition of pear juices, evaluation whether their composition is in accordance with AIJN Code of Practice requirements and investigation of the effect of cultivar and fruit maturity on products quality.
Materials and methods: Fruit of two cultivars, 'Lukasówka' and 'Konferencja' for the experiment were picked in two harvest seasons 2008 and 2009 and stored in the normal atmosphere. Juices were produced from fruits in a few days after picking and after 3 months of storage. The aim of this procedure was the evaluation of the effect of fruit ripeness on quality of juices. Clear juices were produced after mash enzymation using pectolytic enzyme Rohapect MA PLUS (AB Enzymes, Darmstadt, Germany) at 20 ^{o}C for 1 h. For fruit disintegration Fryma perforated disc mill was used and for pressing rack and cloth press (Bucher, Niederweningen, Switzerland). The raw juice in all cases was depectinised using Rohapect 10 L (AB Enzymes, Darmstadt, Germany) for 1 h at 50 ^{o}C, and filtrated with diatomaceous earth filter. Cloudy juices were pressed from the mash directly after fruit disintegration; raw juice was centrifugated using a continuous flow centrifuge.
Both kind of juices were pasteurized using plate heat exchanger and filled into 0.25 L screw cap bottles; due to low juice acidity the addition of citric acid was essential to keep pH below 4.6. Juices were analyzed, among others, for the soluble solids, turbidity, mineral compounds, acids, sugars and sorbitol, total phenolics content and antioxidative activity.
Results: Average pressing yield of clear juices was 76.4% for 'Konferencja' cultivar and 74.3% for 'Lukasówka', in case of cloudy juices the yield was consistently lower by about 3%.
Processing of 'Konferencja' fruit stored for three months in normal atmosphere at +1.3 ^{o}C resulted in yield decrease compared to fruits processed after harvest; this was not observed in case of 'Lukasówka' in 2008, where juices produced from stored fruits were characterized by a slightly higher yield compared to fresh fruit processing.
Soluble solids content in clear juices was 12.0 to 12.9% and 11.9 to 13.4% for cloudy juices. Measurements of $ABTS^{\cdot+}$ and total phenolics content showed that cloudy juices were characterized by a higher antioxidant activity and phenolic compounds than the clear ones. A few months' storage of fruits in the cold room in normal atmosphere did not affect the antioxidant activity and phenolics of juices.
Conclusion: Pears are suitable for the production of clear and cloudy apple juices. The most important factor affecting the antioxidant activity is the technology of juice production. Cloudy juices as a rule have higher antioxidant activity than the clear ones. Fruit storage, on the contrary to e.g. apples, does not decrease their suitability for cloudy juice production.

Keywords
pear, clear juice, cloudy juice, antioxidant activity, phenolic compounds

N° Mic-P23 - Multi-scale measurements of porosity in fruits by Magnetic Resonance Imaging

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Background and motivations of the work: Magnetic Resonance Imaging (MRI) is an appropriate technique for studying plants. Because of its non-invasive and non-destructive character, MRI allows making repetitive measurements of the same sample and can thus be applied to study growing, ripening, development of internal disorders and fruit processing. Additionally to the morphological images, quantitative MRI data such as relaxation maps are suitable for plant investigations as the relaxation times are known to be strongly related to the water status in the plant tissues (water content, water mobility and interaction between water and macromolecules) and to the tissue microstructure.
In the present study we used the MRI to investigate the macrostructure of tomato fruits, i.e. the presence of air spaces in the locular tissue and their shrinkage during ripening. Further, the microstructure of the tomato and apple fruits was investigated using an original MRI method for microporosity quantifying.
Material and methods: Experiments were carried out on 0.2 T (Open) and 1.5 T (Avanto) whole body MRI scanners (Magnetom, Siemens). The 5-mm median plans of fruits were imaged with 1mm² pixel size. The MRI methods used for macrostructure and microstructure investigations were described in (1-2).
Tradiro tomatoes grown in the greenhouse were picked at the late green stage and stored under controlled conditions (18°C and 55% RH) during the period of the 3-week experiment. They were used for both macrostructure and microporosity investigations. Royal gala apples procured from the local market were used for the microporosity measurements.
Results: The small areas of the signal void corresponding to the air spaces were observed closed to seeds on the images of the green tomatoes. They decreased continuously during ripening and disappeared before the end of the experiment. At the same time, very small gas bubbles developed in outer pericarp of few tomatoes.
Microporosity maps was measured in red tomatoes and revealed the heterogeneity of microstructure, the core having the biggest proportion of gas bubbles (14%). For apples, porosity decreased gradually from the cortical tissues near to seeds (24%) to the tissues near the skin (16%).
Conclusion: This study showed that fruit macrostructure and microstructure can be successfully studied by MRI. The method is promising for investigation of gas transfer in fruit during postharvest life.

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Keywords
MRI, microstructure, macrostructure, porosity, fruit

N° Mic-P24 - Effects of percolation and water content in the NIR spectrum of acai pulp

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Context and rationale: Açaí (*Euterpe oleracea* Martius) is a palm native to the Amazon forest. Its fruits are marketed in Brazilian and international market due to high nutrient content, fiber, vitamins and other secondary compounds of phenolic nature. The drink açaí is classified based on water content as such: thick or special (type A) with 14% of soluble solids (SS); medium or regular (type B) with 11 to 14% of SS, and slim or popular (type C) with 8 to 11% SS [1]. The water has a fundamental importance for biological processes, as well as influencing the texture, appearance, flavor, and changes in susceptibility to spoilage. It is known that the life of a food is not only related to total amount of water that is present in it, but as the water is interacting with the components of this solid, this interaction is expressed by water activity [2]. This highlights the importance of establishing stricter criteria on the water content in a mixture of fruit sold as pulp, at risk of breaching health to consumers and the loss of markets in the future [3]. This study aimed to obtain the NIR spectrum of *lyophilized* pulp with different water contents.
Materials and Methods: Three spectra were collected at zero, one and two minutes after the deposition of water on the sample surface for each water content. Initially were deposited 0.6 grams of *lyophilized* açaí in a cylindrical glass tube with an internal diameter of 12.75 mm. It was deposited 5% distilled water (w/w) on the surface of sample and collected the three spectra. The process was repeated by adding 10% of dry matter in water up to 145%. Finally added 185% of dry matter in water and then further 3.33% for reconstitution of the beverage. The spectra were obtained with the model Spectrum 100N, FT-NIR – PerkinElmer, wavenumber from 10000-4000 cm-1, accumulation of 64 scans and resolution 16 cm-1. The percolation flow velocity (estimated by the area change between the three spectra of each sample) remained constant in the measurement conditions. The *lyophilized* pulp and the same pulp washed with hexane were observed with microtomography SkyScan - model 1172, with a resolution of 4 microns.
Results: The first sample had a porosity of 34.5% and the second 9.1%, calculated with the software CTAnalyser v.1.10.9.0. It can be seen that as time wore on, the water content and area spectrum showed to nonlinear behavior (sigmoid growth). It were observed, across the table from NIR absorption, gradual increases exactly in the bands of H_2O and it remain stable since the increase of 185% of dry matter in water. The statistical model fitted to these data was logistical.
Conclusion: Many conservation methods are based on the control or reduction of water content of foods, trying to associate them with quality maintenance on a global basis. Studies show that more is needed to better understand how water is prepared in the food and the way she behaves in front of each mixture of fruit pulp.

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Keywords
lyophilized açaí, NIR, water content

N° Mic-P25 - Segregation analysis of mandarin and clementine volatile compounds during fruit ripening and evaluation of peel impact on aromatic property during juice processing

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Context and rationale: Mandarins (*Citrus reticulata* Blanco) and especially clementines (*Citrus reticulata* x *Citrus sinensis*) are become very famous in Europe and have of great importance in the fresh fruit market. The mandarin and clementine productions are estimated at about 15.2 million tons in the world. A constant progression in the demand of small fruits obliged the farmers to increase their production and extend the period of productivity. Hybridization represents great opportunities for developing new citrus varieties more suitable for producer and consumers necessities. For fresh fruit market, flavours and organoleptic properties are crucial points in citrus selection programs. The aim of this work is firstly, to characterize the volatile compounds (VCs) of mandarin and clementine fruits, observe the evolution of these compounds during the fruit maturation phase and determine the amounts of VCs contamination from peel for the juicing, secondly to study the segregation of VCs properties in a progeny. This study should inform us about the possibility of control by crossing the obtaining of particular VC properties.
Materials and Methods: Mature fruits were randomly collected from trees of clementine (*C. reticulata* x *C. sinensis* var. Commune), mandarin (*C. reticulata* Blanco var. Willow Leaf) and their 65 cross pollinated hybrids. All the hybrid plants were grafted on Carrizo citrange (*Poncirus trifoliata x C. sinensis*). The characterization of the VCs was obtained using the HS-SPME coupling with GC for the quantification and with GC/MS for the identification.
Results: HS-SPME/GC and GC/MS analysis of the juices obtained from both parents (mandarin and clementine) and 65 hybrids led is to identify 44 compounds which represented 90.2–99.8% of the total volatile compounds. Among them, 25 components were monoterpenes (94.5–98.8%), nine were sesquiterpenes (0–5.8%) and 10 were non terpenic compounds (0.1–2.8%). The major components were limonene (667.3–1259.9 mg.L^{-1}) and g-terpinene (38.7–422.9 mg L^{-1}). Flavour is more important in mandarin juice than in the clementine juice. The statistically analysis indicated that the hybrid samples were symmetrically distributed around the both parents.
Levels of volatile compounds in fruit juice changed according to the degree of fruit maturity. Components concentrations increased during ripening and until the commercial maturity stage when the juice was obtained from peeled fruits, whereas their concentrations increased until the post-maturation stage when the juices were produced from whole fruits.
We observed significant differences according to the process of juice extraction (with or without peel). The relative volatile concentration was higher when the juice was extracted with peel, and the juicing process induced differences in the relative volatile concentrations of about 20 to 40%.
Conclusion: We showed that hybrids had not different VC profiles from their parents and so we could calibrate the production period of clementines and mandarins longer. The concentration of VC increased with fruit ripening and the method for obtaining juices (with or without peel) was an important parameter for the flavour.

Keywords
volatile compounds, HS-SPME, GC, GC/MS, Citrus

N° Mic-P26 - Relationship between browning and related enzymes (PAL, PPO and POD) during storage of different carrots varieties

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Context and rationale: Carrots are susceptible to mechanical damage during harvest, transport, storage and during minimum processing. Mechanical impact causes physical stress, which damages the plant tissue and alters the phenolic metabolism (Alasalvar et al 2005). It leads to surface browning associated with increased phenolic content and activity of the phenylalanine ammonia lyase (PAL). In plant tissues, browning induced by mechanical damage has been attributed to polyphenol oxidase (PPO) and peroxidase (POD) activities acting on phenolic compounds, causing their oxidation and polymerization with the development of a brown color.
The objective of this study was to evaluate PAL, PPO and POD activities and changes in phenolic content during the development of browning for different varieties of minimal processed carrots stored in different conditions.
Materials and methods: Some varieties of carrots (*Daucus carota* L.) were selected and stored at 4°C or 20°C. Internal and external tissues were analyzed separately. Phenolic compounds extracts were determined colorimetrically using Folin–Ciocalteu reagent and gallic acid as a standard (Slinkard and Singleton 1977). PAL, PPO and POD activities were tested by measuring the increase of absorbance at 290nm, 410nm and 470nm respectively. The browning of carrot samples was assessed using a colorimeter to determine CIE (International Commission on Illumination) color space co-ordinates, L* (light), a* (red and green) and b* (yellow and blue) values.
Results: The most important color changes were observed during the first days of storage at 20°C. Samples stored during a longer period at 4°C showed no significant color changes. The initial phenolic content in carrot tissue was approximately 13mg/100g fresh tissue. Carrots stored at 4°C remained nearly constant in phenol content in both internal and external parts. External tissue from samples stored at 20°C showed a rapid increase in phenol content. These results clearly indicated a phenol synthesis process in the external area of damaged roots, in contrast to the internal tissue, which underwent no important changes. POD activity was greater at 20°C than at 4°C and much higher in the external tissues than in internal tissues. PPO and PAL activities were also affected by temperature and were higher at 20°C than at 4°C. We also found sizable varietal differences in the content of total phenolic compounds.
Conclusion: From our results, it's possible to correlate epiderm browning with increase in phenolic concentration and enzymes activities. Phenolic compounds increase more rapidly when the storage temperature is 20°C. Cold storage maintains a constant color over time. Moreover, phenolic compounds contents and enzymes activities seem to be related to the carrot's varieties. Therefore, the choice of the variety of carrot is a key parameter for the process industries.

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Keywords
carrots, browning, phenolic compounds, PPO, PAL, POD.

N° Mic-P27 - Useful and rapid tools for fruit quality determination before processing

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Two wavelength regions in the infrared range have been tested in our laboratory for fruit quality analysis. The near-infrared (NIR, 800-2500 nm) range has been applied on intact fruits and the mid-infrared (MIR, 4000-650 cm^{-1}) one on fruit slurries. The type of samples, fruits or slurries, is dependent on the depth of light penetration. Among the quality parameters, these techniques appear suitable for the characterisation of dry matter, sugar and acid composition such as soluble solids content, titratable acidity, levels of sucrose, glucose, fructose, malic acid and citric acid.
Since 2005, our work has concerned the study of a very large phenotypic variability of apricot and tomato fruits. The cross-validation procedure has been used for the establishment of models. External validations have been performed to test the robustness of models which have been used on fruits outside the original experimental set, such as other years and genotypes. As example, in mid-infrared, models established in 2007 on tomatoes allow a good prediction of quality parameters of fruits studied the next year, in 2008. The errors of prediction (root mean square error of prediction, RMSEP) were 4.0 % for dry matter, 3.7 % for soluble solids content and 7.6 % for titratable acidity.
The infrared spectroscopy allows a considerable reduction of time of analysis compared to the current techniques. This is relevant for fruit sorting and for characterisation of raw materials before processing.

Keywords
NIR, MIR, PLS, apricot, tomato

N° Mic-P28 - Intra-fruit texture variation in apricot fruits and relation with the texture after cooking

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Background: Apricot texture, which is one of the most important determinants for harvest date, quality at consumption and postharvest manipulations, is greatly affected by processing and particularly by thermal processing. Apricot flesh exhibits different tissue zones which differ in texture. To better understand texture in apricot fruit, we have studied change in texture through the different tissue zones of fresh apricot fruits and the relationships among these tissue zones. Thereafter, correlations were established between firmness of fresh tissues and firmness after thermal processing. In addition, cell-wall from the different tissue zones and those of cooked fruits were characterized in order to investigate the cell-wall polysaccharides implicated in intra-fruit texture heterogeneity and cooked fruits texture.
Material and methods: Nine apricot varieties of contrasted texture were used. Nine tissue zones were defined in fresh apricot fruits in order to study differences in texture from the peduncle to the pistil zones and from the external to the internal tissue. Firmness at each tissue zone was measured by penetrometry test. In parallel, entire apricot fruits were directly steam-cooked and whole firmness of cooked fruits was then determined by Kramer shear test. Only one apricot variety was chosen for cell-wall characterization. Cell-wall materials as alcohol insoluble solids (AIS) were prepared from each fresh tissue zone and from cooked fruits. Water-soluble pectins and CDTA-soluble pectins were then extracted and characterized for their monosaccharide composition and their molecular weight distribution.
Results: In the nine apricot varieties used, tissue firmness decreased gradually from the external to the internal tissue. However, from the peduncle to the pistil zone, the variation of texture seemed to be variety-dependent. Overall the textures measured for the nine tissue zones were highly correlated, indicative of the major differentiation between soft and firm fruits. Tissue firmness of the raw apricots explained about 2/3rd of the variability of firmness of cooked apricots. High correlations between texture after cooking and prior to cooking were found for four (external equatorial, external pistil, median equatorial and median pistil) out of the nine tissue zones. Texture was strongly correlated with water-soluble pectin (WSP), firmness being inversely proportional to WSP contents of the different tissue zones. CDTA-soluble pectin (CSP) underwent noticeable variation between tissues but no clear relationship was observed with firmness. Hemicelluloses extracted together with WSP also appeared to be implicated in tissue texture; highly positive correlation coefficients were observed between firmness and hemicellulosic sugars. After cooking, CSP was the only class of pectin which underwent a substantial degradation indicating that CSP was the pectin fraction the most implicated in heat-inducing softening process in apricot fruit.

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Keywords
Prunus armeniaca L., penetrometry, texture, hemicellulose, pectic fractions, cooking

4/ Nutritional qualities of processed products

N° Nutr-P01 - Evolution of allicin contents on minimally processed garlic (Allium sativum L.) cloves

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Context and rationale: In the last decade, consumption of minimally processed fruits and vegetables has increased due to convenience, freshness and security perceived by consumers. Garlic (*Allium sativum* L.) has been extensively used not only as a food but also as a medicine, due to its recognized hypolipidemic, antithrombotic, antioxidant, and anticancer effects. Garlic is rich in organosulphur compounds, which confer the characteristic pungency and spicy aroma and are responsible for most of its therapeutic properties. One such compound is allicin, the main thiosulfinate formed when cloves are cut, crushed, or chopped. Allicin medicinal importance is provided at levels above 4.5 mg per gram of dried garlic [1]. However, allicin is unstable and reactive, rapidly decomposing during garlic processing.
Previous studies have proven that freshly diced garlic cloves, sanitized by dipping in a 5 % solution of hydrogen peroxide, for 2 minutes, and stored at 4 ºC, under ambient air, could adequately retain their quality up to 10 days [2]. The effect of disinfection with hydrogen peroxide against the classical use of hypochlorite, regarding allicin contents, was investigated.
Materials and Methods: Garlic produced in Portugal (purple variety) was purchased in a food market, and stored under controlled conditions until processing. Cloves were peeled, washed in tap water at 0 ºC, cut into small cubes (0.5x0.5x0.5 cm) and then, submitted to one of the following treatments: hypochlorite (OCl^-) (130 ppm; 1 min.) or hydrogen peroxide (H_2O_2) (5%, 2 min.), and centrifuged to remove water excess. Samples were stored at 4, 8 and 12 ºC for 192, 144 and 96 hours, respectively. Chromatographic analyses were based on methods reported in literature [1**,** 3].
Results: Overall, there was a decrease in allicin levels during storage: garlic stored at 4 ºC treated with OCl^- presented allicin contents higher than 4.5 mg/g, up to 144 hours; garlic treated with H_2O_2 didn_'t retain these values at 96 hours of storage.
Conclusion: The use of hydrogen peroxide, when compared with hypochlorite, despite previously confirmed quality benefits, has a detrimental effect on allicin contents of minimally processed garlic cloves.

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Keywords
disinfection, diced garlic cloves, hydrogen peroxide, hypochlorite, thiosulfinates

N° Nutr-P02 - Espresso coffee composition: influence of technological parameters

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Context and rationale: Coffee is one of the most consumed beverages all over the world, being espresso coffee particularly appreciated in Portugal. Coffee consumption was, for many years, negatively connoted. Recently, several investigations reported potential beneficial health effects associated to a moderate consumption of this beverage, namely a reduction on the development risk of neurodegenerative diseases, type II diabetes, cirrhosis and asthma, among others[1]. Although widely consumed, this beverage is still poorly characterized, especially in what concerns to its bioactive compounds and technological factors that influence its chemical composition.
The aim of this work was to improve the knowledge about chemical composition of espresso coffee and the factors involved: coffee species (arabica and robusta), roast degree (light, medium, dark) and volume (short, normal, long).
Materials and Methods: Samples of both coffee species, roasted at different degrees were provided by a local industrial coffee roaster. Brews were prepared in a domestic espresso machine. Several bioactive compounds (β-carbolines, vitamin E, total phenolics, isoflavones, chlorogenic acids and derivatives, trigonelline, and caffeine), and hazardous chemicals, as well as the anti-radical activity of espresso coffee were evaluated. To achieve that, several analytical methodologies were developed and/or applied, namely spectrophotometric techniques and chromatographic methods (HPLC-DAD-FD, LC-DAD-ESI-MS and GC-MS).
Results/Conclusion: Although a decrease of some bioactive compounds was observed along the different roast degrees, the presence of undesirable compounds is also minimized. The addition of robusta coffee to the blend might be considered biologically beneficial: increases the anti-radical activity of the brew and the levels of several bioactive compounds (β-carbolines, total phenolics, isoflavones, and chlorogenic acids and derivatives). However, also increases the caffeine content. Although robusta addition causes a reduction on the brew vitamin E amount, this might be compensated by using servings or capsules to prepare the espresso coffee. In a general way, long (70 ml) espressos double the compounds amounts of "short" ones (20 ml). Vitamin E is an exception being extracted at the beginning of percolation (till 30 ml).

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Keywords
espresso coffee, bioactive compounds, species, roast, brew volume

N° Nutr-P03 - Modulation of bitterness and astringency of French ciders by the choice of treatments from pressing to bottling

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I*ntroduction*: Pressing conditions (Renard *et al.*, 2011), the mode of clarification before fermentation (Hubert *et al.*, 2007), reduction of biomass during fermentation and post-fermentation fining may modulate the polyphenol composition of apple musts and ciders. These methods may therefore help modulate the bitterness and astringency of French ciders. The aim of this study was to test different technological routes to control the taste of ciders from different raw materials.
Methodology: A fractional factorial design of resolution IV was used for processing 32 ciders. The two type of cider apple (bitter or sour) were pressed slowly at low temperature (2°C) or quickly at high temperature (15 °C). The musts thus obtained were treated according to four modalities of clarification. After inoculating by *Saccharomyces uvarum*, the fermentation was carried out in two ways: with or without reduction of biomass and oxygenation. When the density had reached 1019 kg/m3, half the volume of each fermentor was bottled. The other half was fined using gelatin and bentonite and bottled.
Results: The juice samples collected at different stages of the process were analyzed for their polyphenol composition. Although the choice of apple varieties was important to type the must and the cider, other steps had an influence on the polyphenol profile. Slow pressing reduced by 31% and 41% the phenolic content of musts from bitter and sour varieties, respectively. It also decreased by 10% the average degree of polymerization (ADP) of flavan-3-ols. Pre-fermentation clarification affected only procyanidins and aDP. Fermentation did not alter the composition of polyphenols of cider. Post-fermentation fining has a significant effect on the ciders that have not been fined before fermentation. Finally, for the same crude must, a whole range of ciders with varied profiles in polyphenols was obtained. These 32 ciders were assessed for their taste and classified according to the bitterness and astringency.
Conclusion: By selecting appropriate technologies, the cider maker can maintain or reduce the bitterness and astringency of cider. It can especially alter these two parameters independently, to some extent. A tool for decision support must be developed.

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Keywords
phenolic compounds, pressing, clarification, fining, sensorial analysis

N° Nutr-P04 - Lycopene oxidation and isomerization kinetics depend on the food matrix

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Different epidemiological studies have suggested an inverse relationship between diets rich in lycopene and the risk of chronic diseases. The most important dietary sources of lycopene are tomatoes, which are often consumed as processed products such as sauces, juices, and soups. During the processing steps, lycopene can undergo changes due to oxidation and due to trans-to-cis isomerization. On the one hand, oxidation causes lycopene loss and should be avoided. On the other hand, cis-lycopene isomers might be of special interest because of their higher antioxidant capacity compared to all-trans-lycopene *(1)*. Moreover, cis-lycopene has been found to be more bioavailable *(2)*.

The objective of this research was to investigate lycopene oxidation and isomerization during thermal processing using a kinetic approach. Different matrices including plain tomato pulp, olive oil, and an olive oil/tomato emulsion were considered. After thermal treatment (70-140 °C), lycopene was extracted and a RP-HPLC analysis was applied to accurately separate and quantify the most important lycopene isomers.

The results demonstrated the high stability of lycopene during the thermal treatment of plain tomato pulp. Below 130 °C no significant decrease in the total lycopene content was observed and hardly no isomerization occurred. The presence of lipids, in which lycopene can dissolve, remarkably accelerated the oxidation and isomerization reaction. In olive oil and in an olive oil/tomato emulsion, lycopene oxidation occurred quickly at temperatures above respectively 90 and 100 °C. After prolonged heating of an olive oil/tomato emulsion, the contribution of cis-isomers reached a temperature-dependent equilibrium state. However, after treating lycopene in olive oil at high temperature, the initial increase of the 13-cis-lycopene contribution was followed by a decrease.

The lycopene oxidation and isomerization kinetics clearly depended on the reaction matrix. The kinetic data obtained in this study can be a useful tool for process design and can be applied to minimize total lycopene loss and maximize the total-cis contribution in different tomato matrices.

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Keywords
lycopene, oxidation, isomerization, kinetics, thermal processing

N° Nutr-P05 - Evaluation of ascorbic acid and sugar degradation products during fruit dessert processing under conventional or ohmic heating treatment

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Context and rationale: Browning has been considered one of the major causes of quality loss during the processing and storage of food products, e.g. during apple puree processing. Protection of fruit-derived products against enzymatic browning is generally obtained by the use of ascorbic acid, added as a processing aid after crushing apple pieces and before conventional thermal treatment or innovative technology such as ohmic heating. During heating, some furanic compounds are produced from the degradation of sugars and ascorbic acid by heating, including 5-hydroxymethylfurfural (5-HMF) and furfural (FF). 2-furoic acid (2FA) and 3-hydroxy-2-pyrone (3H2P) also represent final degradation products of heated dehydroascorbic acid, the oxidation form of ascorbic acid (Yuan and Chen, 1998).
The objective of this study was to gain insights into **1**) the AA degradation reactional ways (oxidative / thermal) during processing, by the determination of residual AA content as well as on 5-HMF, FF, 3H2P and 2FA formation in apple derived products submitted to thermal treatments and **2**) to compare the effects of conventional *vs* ohmic heating on the rate of sugar and AA degradation and the overall quality of the processed apple products.
Materials and methods:

- ***Chunky apple desserts products :*** Apples (var. Golden Delicious) and peaches (var. Pavie) were used to prepare chunky apple desserts from appertized apple carrying phase and peach dices at the CTCPA (Avignon, France) using combinations of conventional and ohmic heating.
- ***AA degradation products analysis :*** The contents of residual AA, markers of sugar caramelization (5-HMF, FF) and compounds produced during AA oxidation and heating (2FA, 3H2P) were determined in processed apple purees, peach pieces and chunky fruits desserts products. Analysis of the extracted and filtered samples was performed by HPLC-DAD with a Synergy 4 µ Polar-RP, 80 Å, 150 * 3 mm column (Phenomenex). Elution rate of 20 mM ammonium phosphate buffer at pH 2.5 (AA elution) and of the gradient of water (pH 2.5) / acetonitrile (5-HMF, FF, AF and 3H2P separation) was 1 $mL.min^{-1}$. Detection and quantification of the injected samples (20 µL) was performed at 244 (AA), 253 (AF), 278 (FF), 285 (5-HMF) or 295 (3H2P) nm using external standardization.

Results: Contents of sugar degradation products found in apple desserts submitted to conventional heating were in average 3300-2600 and 570-350 $\mu g.g^{-1}$ fresh matter for 5-HMFand FF respectively. Conversely, levels were 3 to 9 times lower in the corresponding ohmic heated samples, attesting that ohmic heating did not generate 5-HMF during process and had a low impact -if any -on sugars thermal degradation.
Variable losses of AA added at the first steps of the process were observed, depending on both the processing time and temperature conditions as well as the addition of sanitizer chemicals used during aseptic packaging of apple puree and presenting strong oxidant properties.
Levels of 3H2P and AF found in processed products highly depended both on the intensity of the thermal treatment and on AA oxidation, first giving rise to dehydroascorbic acid via chemical and enzymatic reaction ways during processing. As a result, most of 3HP content originated from the initial apple carrying phase and peach pieces production. Compared to ohmic heating treated samples, conventional heating produced a slight increase in AF level (~ 290 *vs* 400 $\mu g.g^{-1}$ fresh matter).
Conclusion: Indicators of AA and sugar degradation products selected in this study allowed showing that:

- During apple products processing, severe thermal treatment and/or oxidation reactions can occur, leading to a decline in products sensorial quality,
- Ohmic heating technology provides apple derived-desserts with quality similar to or better than those apple derived-products obtained by conventional heating,
- Results also showed that in processed samples, furane compounds are good indicators of a severe thermal treatment, whereas levels of 3H2P and AF give information to the oxidative status of fruit products at the various steps of the process.

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N° Nutr-P06 - Biochemical and nutritional characterization of baobabs' pulp of Madagascar and continental Africa

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Context: The fruit of baobab (*Adansonia sp*) is well known in Africa for its virtues so medicinal as social. It is a tropical fruit very promising but little studied for the African species (*A. digitata*) (Chadare *et al.*, 2009; Cisse *et al.*, 2009) while Malagasy fruits of the species were no studied. Very widely consumed in Africa (Wickens and Lowe, 2008), the economic importance of the baobab was recently increased with this entrance and acceptance on the European markets. To estimate the nutritional and medicinal characteristics of baobab fruits, studies on the biochemical composition of fruits pulp were undertaken. Fruits of five species of baobab resulting from Madagascar and one of Ivory Coast were studied. The contents in major compounds were determined and the contents in vitamin C, polyphenols and minerals were estimated according to various standardized methods
Material and Methods: Fruits of five species of baobab resulting from Madagascar (*A. Grandidieri* Baill, *A. Madagascarensis* Baill, *A. Perrieri* Capuron, *A. Rubrostipa* jum, *A. Suarezensis* H and *A. Za* Baill.) and a species of Ivory Coast (*A. Digitata*) were studied. The biochemical basic characterization among which the humidity, the protein, lipid, and carbohydrates content was realized by following classic methods of analysis. The contents in Ca, Na, K Mg, and P were determined by spectrophotometric of atomic absorption whereas Fe, Cu, and Zn were it by the photometry of flame. The content in vitamin C was determined by oxydoreduction by dichloro-2,6-phénolindophénol. The antioxidant power was estimated by ORAC (Oxygen Radical Absorbance Capacity) whereas the total polyphenols were determined by following the method described by Georgé *et al,* (2005).
Results : Pulps of all the species are characterized by weak moisture content (6-15 %), a strong acidity and contents important in carbohydrates. The content in proteins and in lipids is weak varying 2,45 to 6,32g / 100g MS and from 0,05 to 2,05 g / 100 g MS respectively.
The pulp of the endemic species Malagasy has a composition in minerals similar to that of the species *A. Digitata*: 1500 mg K/100g MS, 80 mg P/100g, 340 g Ca/100 g MS and 200g/Mg Mg/100 g MS.
On the other hand, the contents in total polyphenols of the fruit vary strongly from a species to the other one, going from 329 to 1706 mg / 100g MS.
The studied species present rather important antioxidant powers, included between 109 and 158 µmolesTE / g MS, superior of numerous fruit and vegetables of big consumption as the orange (µmoles 0,29 µmolesTE /g), kiwi (µmoles 0,27 µmolesTE/g) (Besco *et al,* 2007). The content in vitamin C varies from 60,2 to 137,8 mg/100 g MS following the species. It's superior however always to that of fruit of passion (30 mg / 100g) and of papaya (62 mg / 100g) (Rodrigues *et al*, 2001). fruits rich in antioxidants and in vitamin C.
Conclusion: This study allowed to show a big variability in the biochemical, mineral and nutritional characteristics between 5 endemic species of Malagasy baobabs and the soudano-Sahelian species *A. digitata*.

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Keywords
baobab, antioxidants, vitamin C, polyphenols

N° Nutr-P07 - Influence of ultrasound treatment on the stability of all-E-béta, béta-carotene

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Background: Carotenoids are widely used in food applications, mainly colouring agents. They are also known for their antioxidant activity which could partly explain that their consumption could reduce the risk of developing cardio-vascular diseases, age related macular degeneration and some types of cancers.
On the other hand, in recent years, industrial food processing has paid special attention to new processing technologies. In order to reduce processing time and costs, save energy and food quality, different technologies were tested, like radio frequency, microwave heating and ultrasounds. Ultrasounds are described to offer advantages concerning productivity, quality and are nature friendly (1)(2).
The main goal of this work is the study of the stability of all-E-béta, béta carotene submitted to ultrasound treatment with the determination of main involved factors.
Material and Methods: All experiments were performed with a thermostatic reactor equipped with a titanium ultrasound probe at a 20 kHz frequency with a 130 W maximum input power. All-E-béta, béta-carotene was put in suspension into water under an atmosphere of air. Box-Wilson design, called central composite design (CCD), was used to achieve maximal information about the process from a minimal number of possible experiments. The kind of CCD used in this study was central composite face-centred (CCF) experimental design to determine the maximal degradation conditions of béta, béta-carotene. Three independent factors: temperature, sonication time and ultrasonic power were evaluated, as their interactions.
Degradation of all-E-béta, béta-carotene was measured by visible absorbance based on all-E-béta, béta-carotene maximum wavelength of absorption. Degradation products were tentatively identified by UPLC/MS.
Results and discussions: Main results are:

- Increases of time and power appear to have largest influence on degradation of all-E-béta, béta-carotene, with a slight interaction between them. The higher the temperature, the lower is the loss of all-E-béta, béta-carotene. This phenomenon is probably due to an increase of vapour pressure which leads to bubbles screen formation (3)(4).
- Concerning chemical transformations, we have noticed that all-E-béta, béta-carotene decline is associated with
  - an increase of Z isomers / all-E isomer ratio.
  - the formation of known cleavage products like aldehydes and ketones containing cleavage products.
  - the formation of unknown products, some containg epoxides or alcohols functions.

Conclusion: Results show that ultrasounds in aqueous medium under ambient atmosphere can induce degradation of all-E-béta, béta-carotene. This effect could be due to Reactive Oxygen Species (ROS) of radical type since, under ultrasound treatment, water is known to produce ROS like hydroxyl radical HO° (5). The results from CCD point out that the sonication time is the main factor inducing the degradation of all-E-béta, béta-carotene, followed by ultrasonic power. Whereas, increasing temperature decreases the degradation rate of all-E-béta, béta-carotene probably by making ultrasounds ineffective.
These results could be helpful for optimising ultrasound treatment in food containing carotenoids in order to preserve nutritional value of food.

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Keywords: processing, ultrasound, carotenoid, stability, degradation

N° Nutr-P08 – Impact Analysis of season and process on in vitro biological activities of spinach extracts

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Context and rationale: Studies suggest that the beneficial health effects of vegetables may be in part associated with their phytochemicals content which has been linked to preventive effects on several diseases such as cardiovascular disorder or obesity[1]. Spinach (*Spinacia oleracea*), an important dietary vegetable rich in bioactive constituents such as vitamin C, flavonoids and phenolic acids, is commonly consumed raw or cooked either fresh, frozen or canned. Effect of cultivar, maturity, culture or storage conditions on its antioxidants composition has been widely studied[2, 3], but process and season influence on its health-promoting capacities are less described. This preliminary study has investigated the effects of season harvesting and process of spinach on its biological activities by means of an *in vitro* approach. Several extracts obtained from fresh or frozen spring and autumn spinach samples were analyzed for their phytochemical profile, their antioxidant and human pancreatic lipase inhibition activities.
Materials and methods: Fresh spring and autumn spinach underwent no postharvest transformation, whereas frozen ones were subject to rapid washing, blanching, draining and were then deep frozen in a -30°C environment. Fresh or frozen samples were lyophilized at -80°C then homogenized. Spinach extracts were obtained by using two different polarity solvents (methanol/water M, or ethyl acetate E). Extracts chromatographic analyses were performed using a reverse-phase C_8 column with an acetonitrile gradient and detection made with a diode array detector. Cardioprotective effects were evaluated by testing extracts for their capacities to protect human LDL from copper-induced oxidation. Inhibition of pancreatic lipase activity, a digestive enzyme which hydrolyzes triglycerides, was measured by a colorimetric method (Enzyline® lipase color, Biomérieux, France).
Results : Apart from season or process conditions, chromatographic analyses of M and E spinach extracts showed two distinct profiles with many potential bioactive compounds. Comparison of fresh/frozen HPLC results has shown some qualitative and quantitative differences that can suggest an impact of the process and season. Crossed analysis of *in vitro* results showed that M extracts induced a dose response decrease in LDL oxidative rate compared to LDL-Cu control, whereas E extracts had a weaker effect. No effect of process or season was observed. Inhibition of human pancreatic lipase was more efficient with E (4-58%) compared to M (1.5-22%) spinach extracts. In this assay, slight differences in efficacy were observed concerning process, whereas no consistent effect of season was noticed.
Conclusion: Spinach extracts showed cardioprotective properties by protecting human LDL from oxidation and potential anti-obesity effect according to their pancreatic lipase inhibition activity. Process and season may have a limited impact on *in vitro* biological activities of spinach extracts despite slight modifications on their chromatographic profiles. Further analysis of spinach phytochemicals families and relation to their health-promoting activities has to be done.

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Keywords
Spinacia oleracea, process, extracts, antioxidant capacity, pancreatic lipase.

N° Nutr-P09 - Native fructose extracted from apple improves glucose tolerance in mice

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Since decades, fructose and glucose used for food conception are not provided by fruits but by starch or inulin conversion. We first patented a sweet method of apple carbohydrates extraction based on innovative assembly of technologies including continuous process using immobilized enzymes. We then investigated the acute and long term effect of these native carbohydrates on glucose metabolism in C57Bl6/j mice. We have shown that FructiLight® (95% fructose) has a very low impact on glycemic index and insulin response during acute treatment. It has also brought out beneficial properties when administrated as a long term treatment. Moreover, as for two other sugars extracted from apple (FructiSweet®Apple and FructiSweet®67), FructiLight® exposure during 21 weeks in beverage has promoted an enhancement of glucose tolerance compared to glucose treatment without changes in food intake and weight. These results indicate that apple-extracted sugars open a promising way to develop new foods and sweet beverages more readily accepted by consumers. Sensory profiles were then performed by hedonic assessment: native fructose-made yogurt, jam, ice-cream and syrup got highest score according to consumer panel.

Keywords
fruits, fructose, immobilized enzymes, glycemic index, insulin

N° Nutr-P10 - An in vitro model to quantify the lycopene diffusion from processed tomato to a lipid phase as occurrs in the stomach bolus

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Carotenoids are bioactive secondary metabolites present in many plant foods, and especially in tomatoes, which contain large amounts of lycopene, responsible for their red colour. Lycopene was described as beneficial to prevent for example prostate cancer, or cardiovascular disease. However, the real nutritional benefit of a molecule depends on its bioavailability i.e. the proportion of the ingested portion that reaches the human blood. As lipophilic compounds, the bioavalability of the carotenoids include their diffusion from the food matrix to the lipophilic phase of the stomach as a prerequisite to their absorption. This study focussed on this initial step called bioaccessibility. It aimed at quantifying and characterising the lycopene diffusion from a standard tomato juice to lipophilic phases: first to pure oil (to assess the diffusion parameters in various conditions), and then, to an oil-in-water emulsion (as can occur in the stomach). Standard experimental conditions have been set up for an accurate and reproductible measure of the diffusion.
The standard diffusion assay was carried out by mixing 50 ml of a tomato juice to 50 ml of oil in a 200 ml beaker thermostated at 37°C. Stirring was achieved using a 3cm-diameter propeller at 900 rpm. Two millilitre aliquots were sampled after different durations of mixing, and then centrifuged to separate the oil from the juice. The carotenoids that diffused to the oil were quantified by spectrophotometry against a standard of lycopene in oil (at 480 nm). The carotenoids of the juice were analysed by HPLC. The partition factor (PF) and the diffusivity (D) of lycopene were calculated as follows: PF as the maximum percentage of the initial lycopene that diffuse from the puree to the oil, D as to the slope of the first linear par of the kinetic curve. The variation of D and PF was then assessed for various oil-to-tomato-juice ratios. In a second part, diffusivity and PF were evaluated by replacing oil by an emulsion containing 43% of oil in a sodium acetate buffer, stabilised with bovine serum albumin.
In the mix containing 50 %-oil, the PF was reached after 20 minutes, and was 14.0 ± 0.09%. Changing the proportion of oil to juice from 10 to 90% modified the PF from 7.55% to 30.03%, indicating that even under non limiting conditions (i.e. a large excess of oil), 60% of the lycopene remained encapsulated within the tomato particles. The diffusion was the same for all operating conditions when lycopene concentration in oil was expressed relative to its plateau obtained during the assay ($[C_{lyco}]t/[C_{lyco}]t_{inf}$), and followed Fick's law. The diffusivity calculated from the model was $3.0x\ 10^{-11}$ $m^2.s^{-1}$. When oil was replaced by an emulsion, the PF remained the same for an equivalent oil/tomato ratio, but the diffusivity was increased to $6.5x10^{-11}$ $m^2.s^{-1}$, and PF was reached after only 7 minutes This diffusivity was 2 orders of magnitude below that of sugar in water [1]but one order of magnitude higher than luteïne diffusion in hexane[2].
Lycopene diffusivity and partition factor against oil (as pure oil or as emulsion) were determined for a tomato juice. This system will be used for classifying tomato-based products, in order to evaluate the impact of technological treatments on lycopene bioaccessiblity in tomato based foods.

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Keywords
Lycopene, bioaccessibility, tomato product

N° Nutr-P11 - What happens to folate when green beans and spinach are cooked in home conditions?

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Context: Folate (vitamin B9) participate to the health beneficial effect of fruits and vegetables. Folate are well known for reducing the risk of neural tube defect. It has also been demonstrated that folate are involved in the reduction of the risk of stroke. In our country fruits and vegetable are mostly consumed as industrial and domestic processed. Those process can impact on the nutritional quality particularly on folate amount. The aim of our study is to quantify folate in green beans and spinach which have been differently prepared.
Material and methods : Fresh, frozen and canned green beans and spinach were bought at the local supermarket. An aliquot of fresh product was directly stabilized by freezing in liquid nitrogen. The rest of the sample was boiled during respectively 8 and 2 minutes or steamed during 20 minutes, and then stabilized by freezing in liquid nitrogen. An aliquot of frozen samples was directly stabilized by freezing in liquid nitrogen and the rest was boiled during 15 and 10 minutes and stabilized by freezing in liquid nitrogen. Vegetables of cans were drained and directly stabilized by freezing in liquid nitrogen. The covering liquid was directly put at -80°C. In all experiments the cooking liquid was recovered and stored at -80°C. Folate extraction and derivatization were carried out according to the method of Ndaw *et al.* **[1]**. The analysis of samples were recorded thanks to an HPLC Shimadzu with fluorimetric detection adapting from the protocol of Freisleben *et al.***[2]**. All samples have been analyzed in triplicate for statistical analysis.
Results: Folate contents in raw green beans and spinach were respectively of 6.5 and 20.6 mg/kg DM. In steamed product, this amount was 6.1 mg/kg DM for green beans and 30.7 mg/kg DM for spinach. The amount for boiled green beans was 6.1 and 9.97 mg/kg DM for spinach. Folate amount in frozen green beans was 5.4 mg/kg DM and 6.71 for spinach. In cans, folate amount was 2.95 for green beans and 13.2 mg/kg DM for spinach.
Those results showed a trend to decrease between raw fresh and boiled spinach and green beans, and in frozen products before and after boiling.
Folate concentrations in covering juice were 0.41 mg/l for green beans and 1.12 mg/l for spinach. The concentrations in cooking water of fresh and frozen product were around 0.15 mg/l for both spinach and green beans. There has been extensive diffusion of folate from matrix to juice during canning, and noticeable losses in the water used for boiling.
Conclusion: In all samples of spinach and green beans cooked in domestic conditions, folates were still present in significant concentrations. The degradation of folate was moderate during those different treatments. Diffusion phenomenon appeared to be involved in the loss of folate. More work is needed to understand and hierarchize the mechanisms involved in the degradation, during heat treatment, and the diffusion of folate directly on plant matrix.

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Keywords
folate, green beans, spinach, cooking treatment, vitamin

N° Nutr-P12 - Impact of local cooking on β-carotene bioaccessibility from orange fleshed sweet potato derived products made in Uganda

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Background: Orange fleshed sweet potato (OFSP) is currently promoted in Uganda where sweet potato is a staple crop, to tackle the vitamin A deficiency problem. Studies in Uganda[1] have shown that use of OFSP flour in porridge chapati or mandazi is widely accepted by consumers. Porridge is also a staple food in the eastern parts of Uganda. However, information on bioaccessibility of β-carotene in OFSP derived product is limited and further knowledge on this subject is needed to fully evaluate the nutritional potential of OFSP derived products consumption for reducing vitamin A deficiency.
The aim of this study was to evaluate β-carotene bioaccessibility, from different OFSP derived products using an *in vitro* digestion procedure. Porridge, Chapati, mandazis were processed locally in Uganda using in part flour (30%) from OFSP. The present study aims to evaluate the influence of the cooking process on carotenoids bioaccessibility of the final product, after boiling (porridge) and after frying (chapati, mandazi). These OFSP food products will be compared to simply boiled sweet potato (whole root).
Materials and Methods: Extraction and HPLC analysis of carotenoids from micelles and from OFSP food products were carried out according Dhuique-Mayer *et al*. (2007)[2]. OFSP food products were extracted with ethanol-hexane (4:3, v/v) HPLC analyses were performed with an Agilent 1100 system. Carotenoids were separated along a C_{30} column (250 x 4.6 mm i.d., 5 µm YMC (EUROP GMBH, Germany). Carotenoid bioaccessibility from OFSP food products was assessed using an *in vitro* digestion (Dhuique-Mayer *et al*. 2007).To simulate gastric and small intestinal phases of digestion, 5g of sweet potato, porridge, 3g chapatti, or mandazi in saline solution were incubated at 37 °C with pepsin (pH adjusted at 4) for 30 minutes. Then the pH was adjusted 6 and a mixture of porcine bile extract and pancreatin were added for 30 minutes to complete the digestion process. Micelles were collected in aqueous fraction after centrifugation and filtration (0.22µm).
Results: Chapati and mandazi presented similar *all*-trans β-carotene content (31.5 and 32.9 mg/Kg) whereas that of porridge was only 8.7 mg/Kg. Boiled OFSP had the highest content of *all*-trans β-carotene (94 mg/Kg). After *in vitro* digestion, we evaluated the bioaccessibility of carotenoids, i.e their transfer into micelles. The percentage of micellarized *all*-trans β-carotene was a lot higher in products cooked with oil (chapatti, mandazi 73 and 49 %) as compared with the boiled ones porridge (16%) and boiled sweet potato (10 %). For all products, the incorporation into micelles was significantly higher for *all*-trans β-carotene β-carotene. Taking in account, the bioaccessibility of *all*-trans β-carotene and 13-*cis* isomer, an edible portion of porridge, mandazi or chapatti could provide from 20 to 100 % of the daily vitamin A requirement of a child under 6 years.
Conclusion: Beside the poor micellarization efficiency of β-carotene from boiled OFSP, the OFSP cooked products could be promoted for consumption in Uganda. The results highlight the importance of OFSP cooked as significant source of vitamin A that contributes to tackle vitamin A deficiency.

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Keywords
bioaccessibility, beta-carotene, orange fleshed sweet potato, provitamin A.

N° Nutr-P13 - Assessment of antioxidant effects of some cereal grains using in vitro test systems

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Context and rationale: Cereals are the grasses of Poaceae family with edible properties. Among them, especially oat, rice, and wheat are important crop plants containing remarkable levels of proteins, lipids, vitamins, dietary fibers, and minerals as well as the food plants for both human and animals. In this study, our goal was to determine antioxidant effects of the ethyl acetate and ethanol extracts obtained from 8 varieties of oat (*Avena sativa* L.), a variety of barley (*Hordeum vulgare* L.), a variety of triticale (*Triticale* sp.), a rye variety (*Secale cereale* L.).
Materials and methods: The ethyl acetate and ethanol extracts obtained from 8 varieties (Faikbey, Y-1779, CI-8357, Cheokota, Seydişehir, Y-330, Sivas, and YVD-18) of oat (*Avena sativa* L.), a variety (Larende) of barley (*Hordeum vulgare* L.), a variety (Tatlicak 97) of triticale (*Triticale* sp.), a rye variety (Aslım 95) (*Secale cereale* L.) cultivated at the experimental farm of Selcuk University (Turkey) were investigated for their antioxidant effects in seven test systems including 2,2-diphenyl-1-picrylhydrazyl (DPPH), *N*,*N*-dimethyl-*p*-phenylendiamine (DMPD), nitric oxide, and hydrogen peroxide radical scavenging activity along with metal-related antioxidant methods such as iron-chelation, ferric-reducing antioxidant power (FRAP), and phosphomolybdenium reducing power. Total phenol and flavonoid contents were calculated using Folin-Ciocalteau and $AlCl_3$ reagents, respectively.
Results : In radical scavenging activity tests, the extracts were found to have a low profile of effect. The highest DPPH scavenging activity (27.73%) was shown by the ethanol extract of the barley, while the best iron-chelation capacity was observed to occur in the ethanol extract of the "Sivas" variety (50.68%) among the ethanol extracts. The ethyl acetate extracts of all the cereal species herein have shown better activity in this test, ranging between 25.57 and 71.32%. All of the extracts exerted lower activity in reducing power experiments. Equations for total phenol and flavonoid contents were calculated as $y=0.9752x+0.0712$ ($r^2=0.9979$) and $y=5.66x-0.0003$ ($r^2=0.9995$), respectively.

Conclusion: Our findings indicate that the ethyl acetate and ethanol extracts of the studied cereal grain species show antioxidant effects in varying levels and changeable according to the antioxidant method applied. Therefore, it might be suggested that consumption of the cereals may contribute positively to human health through their antioxidant effects shown by different mechanisms.

Keywords
cereal grains, Poaceae, oat, barley, rye, triticale, antioxidant activity

N° Nutr-P14 - Comparative studies on neuroprotective potentials of different terebinth coffee commercial brands and the unprocessed fruits of Pistacia terebinthus L. and their phytochemical analyses

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Context and rationale: Terebinth coffee is one the most consumed herbal coffees in Turkey, which is produced from the dried fruits of terebinth (*Pistachia terebinthus* L.). In the current study, we aimed to investigate neuroprotective effects of the ethyl acetate and methanol extracts obtained from four different commercially available terebinth coffee brands as well as the unprocessed fruits of the plant through enzyme inhibition tests against acetylcholinesterase and butyrylcholinesterase, which are the key enzymes in pathogenesis of Alzheimer's disease along with tyrosinase, an important enzyme in Parkinson's disease. Since neuroprotection is strongly associated with oxidative stress, antioxidant activity of the extracts was also determined. In order to establish the phytochemical content of the extracts, the fatty oils of the terebinth coffee brands and the fruits as well as the essential oil of fruits were examined. Besides, total phenol and flavonoid contents of the extracts were also calculated.
Materials and methods: Enzyme inhibitory activity of the ethyl acetate and methanol extracts from four commercial brands of the terebinth coffee sold in Turkey and fruits obtained in Kilis province was examined using ELISA microplate reader at 25, 50, 100, and 200 mg/mL concentrations. Antioxidant activity of the extracts was measured using the scavenging activity tests based on radical formation against DPPH (2,2-diphenyl-1-picrylhydrazyl), DMPD (*N*,*N*-dimethyl-*p*-phenylendiamine), super oxide, and hydrogen peroxide radicals as well as metal-related antioxidant activity tests including iron- chelation capacity, ferric-reducing antioxidant power (FRAP), and phosphomolybdenium reducing power tests. Total phenol and flavonoid contents were calculated using Folin-Ciocalteau and $AlCl_3$ reagents, respectively. Chemical composition of the fatty oil and essential oil as well as *n*-hexane extracts of the coffees was identified by gas chromatography-mass spectrometry (GC-MS).
Results: The extracts were found to have a selective inhibition against butyrylcholinesterase, whereas they were completely inactive against acetylcholinesterase and tyrosinase. On the other hand, the extracts displayed potent radical scavenging activity against DPPH, while they were not able to scavenge other radicals. They exerted strong activity in FRAP and in iron-chelation tests and moderate activity in phosphomolybdenium reducing power test. Palmitic, oleic, and linoleic acids were identified as the major fatty acids in the *n*-hexane extracts, while a-pinene was the main component in the essential oil.
Conclusion: The terebinth coffee brands had higher antioxidant activity than the fruits *per se*. This may show that roasting procedure applied to the fruits of *Pistacia terebinthus* in order to prepare terebinth coffee might be causing an obvious increase on antioxidant activity. This finding is also in accordance with our other data that the extracts obtained from the terebinth coffee brands have much higher total phenol and flavonoid amounts than the fruits. It may be concluded that the terebinth coffee might provide neuroprotection to some extent, based mostly on their butrylcholinesterase inhibitory and antioxidant effects.

Keywords
terebinth coffee, *Pistacia terebinthus*, neuroprotection, antioxidant activity, fatty oil, essential oil

N° Nutr-P15 - Evaluation of neuroprotective effects of the Maydis stigma extracts from four corn varieties using in vitro experimental models

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Context and rationale: Maize (or corn), *Zea mays* L. in Latin (Poaceae), is one of the oldest and important cereal types of food plant and cultivated widely throughout the world. Tea of the corn silk (*Maydis stigma*), the stylus of the female flowers, is consumed for diuretic purpose in the Anatolian folk medicine. Neuroprotective effects of the ethyl acetate (EtOAc) and ethanol (EtOH) extracts from the silks of four *Zea mays* L. varieties (var. *intendata*, var. *indurata*, var. *everta*, var. *saccharata*) have been evaluated in this study.
Materials and methods: Inhibitory activity of the extracts against acetylcholinesterase (AChE) and butrylcholinesterase (BChE), the enzymes related to Alzheimer's disease, and tyrosinase relevant to Parkinson's disease was tested using ELISA microplate reader. Since free radical formation and iron accumulation were reported during neurodegeneration, antiradical activity of the extracts was evaluated against 2,2-diphenylpicrylhydrazyl (DPPH) and superoxide (SO), while two iron-related antioxidant methods (iron-chelation capacity and ferric ion-reducing antioxidant power) were applied to the extracts. Total phenol and flavonoid contents in the extracts were determined spectrophotometrically.
Results: The EtOAc extracts exerted high inhibition against AChE between 83.93±1.12 and 96.69±2.06% at 200 mg/ml, while only the extracts of *Z. mays* var. *saccharata* remarkably inhibited tyrosinase. The extracts showed better activity in iron-related antioxidant assays. The calibration equations for total phenol and flavonoid contents were calculated as $y=1.464x+0.097$ ($r^2=0.962$) and $y=2.780x+0.086$ ($r^2=0.998$), respectively. The total phenol-richest extract was the EtOH extract of *Z. mays* var. *intendata* (10.48±0.18 mg/g extract), while its EtOAc extract had also the most abundant total flavonoid amount (41.08±3.64 mg/g extract).
Conclusion: The antioxidant methods used were applied to these four maize varieties for the first time herein. It can be suggested that flavonoid derivatives seem to be responsible high anti-AChE and iron-related antioxidant activity and the EtOAc extracts standardized according to flavonoids might have a potential to be used for neuroprotective purposes. To the best of our knowledge, we present the first study on neuroprotective effects of corn silks.

Keywords
corn silk, *Zea mays*, Poaceae, neuroprotection, enzyme inhibition, antioxidant

N° Nutr-P16 - HPLC and LC-MS analysis of ferutinin in Ferula eleaochytris root: A natural aphrodisiac growing wild in Hatay province (Turkey)

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Context and rationale: The exclusively old-world genus *Ferula*, belonging to the family Apiaceae, has some 130 species distributed throughout the Mediterranean area and Central Asia. These plants are often used as spices and in the preparation of local drugs. Plants from the *Ferula* spp. have a long history of medicinal use and their hormonal effects are well-documented in both the human and the veterinary practice. Biological activity is mainly attributable to ferutinin, an aromatic ester of a daucane alcohol. *Ferula eleaochytris* rootis known as an folk medicine due to its aphrodisiac effect and named as "caksir" by local people, growing wild in Hatay province of Turkey.
Materials and methods: Plant material was collected in July of 2010. Dried and powdered roots of *Ferula eleaochytris* were extracted with acetonitrile. Ferutinin standard was purchased from Alexis Biochemicals (product code: 350-098-M005). Ferutinin determination and quantification were achieved by liquid chromatography-mass spectrometry (LC-MS).
Results: According to LC-MS analysis, *Ferula eleaochytris* root of Turkish origin was found to be rich in terms of ferutinin content (2.54 %).
Conclusion: The results showed that Turkish *Ferula eleaochytris* root has a rich content of ferutinin. Further chemical and pharmacological research will help to understand and prove the use of this plant species as an aphrodisiac by local people.

Keywords

Ferula eleaochytris, ferutinin, aphrodisiac, HPLC, LC/MS

N° Nutr-P18 - Assessment of cholinesterase inhibitory and antioxidant properties and quantification of rutin and fatty acids in buckwheat (*Fagopyrum esculentum* Moench)

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Context and rationale: Buckwheat (*Fagopyrum esculentum* Moench) is a popular food crop plant from Polygonaceae. It is a Eurasian plant species with rich starch and protein contents. Buckwheat has been also shown to contain a flavonoid derivative, rutin, and inositol derivatives in a plentiful amount and its noodles are widely consumed in some countries. Buckwheat contains no gluten and thus, can be eaten by people with coeliac disease or gluten allergies. In this study, our target was to investigate the ethyl acetate and ethanol extracts obtained from the seed, stem, and aerial parts of the plant for their acetylcholinesterase and butyrylcholinesterase inhibitory and antioxidant activity.
Materials and methods: Enzyme inhibitory activity of the ethyl acetate and methanol extracts of the plant cultivated at the experimental farm of Selcuk University (Turkey) was examined using ELISA microplate reader. Antioxidant activity of the extracts was measured using the scavenging activity tests based on radical formation against DPPH (2,2-diphenyl-1-picrylhydrazyl) and super oxide radical scavenging activity as well as metal-related antioxidant activity tests including iron- chelation capacity and ferric-reducing antioxidant power (FRAP). Total phenol and flavonoid contents were calculated using Folin-Ciocalteau and $AlCl_3$ reagents, respectively. Chemical composition of the fatty oil of the plant was identified by gas chromatography-mass spectrometry (GC-MS) and rutin quantification was achieved by liquid chromatograpgy-mass spectrometry (LC-MS).
Results: The extracts did not inhibit acetylcholinesterase, while they were more active against butyrylcholinesterase. They were highly able to scavenge DPPH radical, whereas they did not scavenge super oxide radical. The best FRAP activity was caused by the ethyl acetate extract of the aerial parts and the ethanol extract of the stems. None of the extracts had capacity to chelate the iron. On the other hand, the extracts were found to be rich in total phenol (as gallic acid equivalent) and total flavonoid (as quercetin equivalent). According to LC-MS analysis, the richest plant part in terms of rutin was found to be the seeds. GC-MS analysis revealed that the seed oil was dominated by oleic (33.15%), linoleic (31.93%), and palmitic (13.15%) acids.
Conclusion: The results showed that buckwheat may provide a moderate level of neuroprotection through butyrylcholinesterase inhibition and antioxidant activity. High antioxidant activity of the buckwheat might be attributed to rich flavonoid, especially rutin, and phenolic composition.

Keywords
Buckwheat, *Fagopyrum esculentum*, cholinesterase inhibition, antioxidant activity, rutin quantification, seed oil, fatty acids

N° Nutr-P19 - Changes in the antioxidant properties of dried fruit during storage

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Context and rationale: Drying is an effective method of fruit preservation. In Poland the most frequently dried fruit are apples, pears and plums. With the development of the food concentrates industry, however, the demand for dried products of other fruit species is growing [1]. The aim of the work was to evaluate changes in the level of antioxidant activity of fruit processed using the oven-drying or freeze-drying method, and stored for 12 months in chilled conditions (2 – 4°C) and at room temperature (18 – 22°C).
*Material and method*s*:* The material investigated consisted of fresh sour cherries, strawberries and blackcurrants prepared for drying and of dried products obtained from these fruits. Dried products were analysed directly after processing and after 4-, 8- and 12-month storage. Antioxidant activity was measured using the DPPH radical [2]. The gravimetric method was used in dry matter measurements [3].
*Result*s*:* Antioxidant activity in sour cherries prepared for drying was 31 μM Trolox/g fresh matter and 212 μM Trolox/g dry matter; in strawberry 41 μM Trolox/g fresh matter and 303 μM Trolox/g dry matter; and in blackcurrant 69 μM Trolox fresh matter and 381 μM trolox/g dry matter. Oven-drying brought about a significantly greater decrease in antioxidant activity than freeze-drying. The antioxidant activity in oven-dried sour cherry, strawberry and blackcurrant immediately after processing was 15 – 37% lower than in the raw material, while in freeze-dried products it was 4 – 17% lower. There was a further gradual decrease in this parameter during the storage period. Compared with the raw material, after 12-month storage antioxidant activity decreased by 24 – 42% in sour cherry, 35 – 54% in strawberry and 39 – 64% in blackcurrant, depending on the drying method and the storage temperature. Antioxidant activity retention in freeze-dried products was 13 – 34% higher than in oven-dried fruits, and 11 – 28% higher in chill-stored products than in those stored at room temperature.
Conclusions: Compared with oven-drying, freeze-drying resulted in significantly better antioxidant activity retention in dried sour cherries, strawberries and blackcurrants. Losses in dried fruit products stored in chilled conditions were significantly lower than in those stored at room temperature.
This work was supported from means on science in years 2009-2012 as a scientific project No. N312 441837 by the Ministry of Science and Higher Education.

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Keywords
sour cherry, strawberry, blackcurrant, antioxidants, drying, storage

N° Nutr-P20 - Changes in vitamin C content in selected cabbage vegetables depending on the drying method and storage conditions of dried products

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Context and rationale: In many European countries cabbage species are among the most popular vegetable crops due to their palatability and high levels of several valuable nutritional compounds [1]. Freezing is the method most frequently used to process vegetables; the use of other methods, including drying, has been fairly limited. The aim of this work was to evaluate the effect of two drying methods, oven-drying and freeze-drying, and two different storage conditions, room temperature (18 – 22°C) and chilled storage (2 – 4°C), on the vitamin C content in three species of cabbage vegetables.
Material and methods: Changes in vitamin C content were evaluated in raw cauliflower, broccoli and Brussels sprouts and directly after drying and after 4, 8 and 12 months of storage. The content of vitamin C was measured using the HPLC method according to Polish Norm [2]. The gravimetric method was used to measure dry matter content [3].
Results : Vitamin C content in the inflorescences of fresh cauliflower prepared for drying was 72.9 mg/100 g fresh matter and 951 mg/100 g dry matter; and respectively 106.8 and 914 mg/100 g in the inflorescences of broccoli; and 177.4 and 1015 mg/100 g in Brussels sprouts. Vitamin C content in oven-dried cauliflower, broccoli and Brussels sprouts immediately after processing was 44%, 50% and 42% lower respectively, and 26 – 27% lower in freeze-dried vegetables. After 12 months of storage the vitamin C content in freeze-dried cauliflower stored at 2 – 4ºC and 18 – 22ºC was respectively 55% and 41% of the content in the raw material; the corresponding figures were 58% and 39% for broccoli, and 62% and 51% for Brussels sprouts. In oven-dried products stored in the same conditions, this parameter fell to 38% and 27% in cauliflower; 26% and 17% in broccoli; and 44% and 36% in Brussels sprouts. After one year of storage vitamin C retention in oven-dried products was consistently lower than that in freeze-dried products: 31% and 34% lower in cauliflower; 54% and 56% in broccoli; and 30% in Brussels sprouts. Vitamin C retention in dried vegetables stored at room temperature was 17 – 35% lower than in those stored in chilled conditions.
*Conclusion*s: The fresh cabbage vegetables evaluated were a rich source of vitamin C. The loss of vitamin C in cauliflower, broccoli and Brussels sprouts resulting from oven-drying was almost double that following freeze-drying. Chilled storage was effective in limiting vitamin C loss during one-year storage of dried cabbage vegetables.
This work was supported from means on science in years 2009-2012 as a scientific project No. N312 441837 by the Ministry of Science and Higher Education.

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Keywords
cauliflower, broccoli, brussels sprouts, vitamin C, drying, storage

N° Nutr-P21 - Effect of dietary fat on sweet corn carotenoid bioavailability

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Background and overall objective: Diets rich in fruits and vegetables are associated with a reduced prevalence of several diseases (cancers of the upper aerodigestive tract, cardiovascular diseases, eye degenerative diseases...). The beneficial effect of fruits and vegetables has been attributed in part to the plant pigment carotenoids. Carotenoid bioavailability is modulated by a number of factors, including food matrix, food processing, culinary practices and presence of fat, fibers and other micronutrients [1, 2]. The objective of the present study was to assess the effect of different types of fat on the bioavailability of lutein and zeaxanthin present in sweet corn.
Material and methods: We used the coupled *in vitro* digestion/Caco-2 cell uptake model [3] to determine the effect of different dietary fats (butter, palm oil, olive oil, sunflower oil and fish oil) on the bioaccessibility (% incorporation in mixed micelles) and intestinal uptake of lutein and zeaxanthin in canned sweet corn (supplied by Bonduelle).
Results : Lutein and zeaxanthin bioaccessibility was significantly greater with butter, palm and sunflower oils than with olive and fish oils (*e.g.* +26% and +47%, with butter as compared to olive oil, for lutein and zeaxanthin, respectively). Furthermore, when fish oil was added, carotenoid bioaccessibility was significantly decreased due, in part, to oxidative degradation of the carotenoids in presence of this source of polyunsaturated fatty acids. The uptake efficiency of lutein and zeaxanthin by the human intestinal cell line (Caco-2 clone TC7) was significantly higher in the presence of butter, palm and olive oils than with the sunflower and fish oils (+26% in mean for lutein and zeaxanthin). The bioavailability (combined effect of bioaccessibility and cellular uptake) of sweet corn carotenoids was markedly affected by the type of fat added with sweet corn in the digestion model. Butter and palm oil, rich in saturated fatty acids, significantly increased lutein and zeaxanthin bioavailability (*e.g.* +12% and +25%, respectively, as compared to olive oil for lutein), whereas sunflower and fish oils, rich in polyunsaturated fatty acids, significantly decreased lutein bioavailability (-17% as compared to olive oil).
Conclusion: Our data suggest that the bioavailability of the two major carotenoids in sweet corn is influenced by the type of fat present in the meal, and in particular the degree of fatty acid unsaturation.

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Keywords
carotenoid bioavailability, dietary fat, sweet corn

N° Nutr-P22 - Effect of Thermal Treatment on Bioactive Compounds and Antioxidant Activity of Some Garlic Verities (Allium sativa)

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Context and rationale: Epidemiological studies have shown that garlic protect against several diseases such as stomach, colorectal and prostate cancers. Moreover, garlic has been reported to be effective in cardiovascular disease, because of its hypocholesterolemic, hypolipidemic, antihypertensive, antidiabetic, antithrombotic and antioxidant effects.
Generally people consume garlic as cooked food. Cooking may affect the antioxidant content in vegetables, especially components such as carotenoids, ascorbic acid and polyphenols. Thus, the purpose of this study is to determine the effect of thermal treatment (boiling for 15 min) on phenolic contents and total antioxidant activity of some garlic verities.
Materials and Methods: Ascorbic acid was determined using the 2,6-dichloroindophenol method. Carotenoids were extracted in dark with 10 ml of hexane:acetone:ethanol and the absorbance of the upper layer was measured at 430 nm. The amounts of thiolsulfinates were determined according to Kaymak-Ertekin and Gedik (2005) method. Total phenolic were determined with using Folin-Ciocalteu reagent. The absorbance was measured at 720 nm. The flavonoids contents were determined using a method based on aluminum chloride complex formation. The absorbance was measured at 370 nm. The total anthocyanins were extracted with ethanol 95%: HCl 1,5N (85:15 v/v) and the absorbance read at 535 nm. All the results are expressed as mg/100 g DM except for thiolsulfinates which are expressed as µmol /g DM.
The antioxidant activity of garlic was determined by measuring the antiradical scavenging activity witch is estimated by the reduction of the radical DPPH and the reducing power.
To evaluate the effect of thermal treatment on phenolic contents and antioxidant activity, analyses were performed before and after cooking. For cooking, garlic cloves were boiled in water during 15 min.
Results: The losses of ascorbic acid after boiling garlic for 15 min ranged from 34,73% (red garlic II) to 60.54% (purple garlic). The losses of carotenoids after cooking for 15 min vary between 8.9% (red garlic II) and 97% (garlic powder). These losses are due to the passage of these compounds from garlic to the water during boiling and to their thermal degradation. Thiosulfinates losses vary between 79,83% (garlic powder) and 98,23% (red garlic I). These losses are probably due to thermal inactivation of alliinase. The losses of polyphenols after boiling for 15 min ranged from 30,71% (red garlic II) to 80.16% (red garlic I) . For flavonoids, losses vary between 52,69% (red garlic II) and 92.56% (garlic powder). The losses of phenolic compounds are due to their solubilization in cooking water and to their degradation. Losses in the radical scavenging activity and the reducing power of garlic after boiling for 15 min ranged from 57,1% (garlic powder) to 78.46% (red garlic I) and from 80,47% (purple garlic) to 93% (garlic red I), respectively. These losses result from the migration of antioxidants from garlic cloves to the cooking water and to their thermal degradation.
Conclusion: Boiling for 15 min causes a reduction of levels of all antioxidant compounds analyzed and antioxidant activity. These losses are due to the migration of antioxidants to the cooking water or to their thermal degradation. The rate of loss of antioxidants during cooking depends on the variety and size of garlic sample (cloves, powder) and the chemical nature of antioxidants.

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Keywords: garlic, boiling, ascorbic acid, carotenoids, polyphenols, antioxidant activity.

N° Nutr-P23 - Dietary supplements and teas: comparison of phenolics content and antiradical activity

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Context and rationale: Tea plant (*Camellia sinensis*) is appreciated worldwide due to its organoleptic characteristics and medicinal properties. This plant contains a high concentration in polyphenolic antioxidants, namely flavanols (catechins) and flavonols (quercetin)[1,2]. For this reason, its moderate consumption has been associated with a lower incidence of injuries related to oxidative stress, including cardiovascular and neurodegenerative diseases, as well as some cancers[3]. These beneficial effects have led to the inclusion of this plant in several mixtures used as food supplements and commercial beverages. Additionally, other plants, like Rooibos (*Aspalathus linearis*) and Borututu (*Cochlospermum angolensis*) are also traditionally used as a source of antioxidants and can be easily found in the market.
Materials and Methods: This study aimed to evaluate total phenolics content and antiradical activity of dietary supplements (n = 9) and soft drinks (n = 3), with and without green tea in its composition, sold in commercial areas as potential antioxidants. Samples (bags, leaves and/or dried roots, extracts and soluble mixtures) were prepared as brews, according to the manufacturer_'s instructions. Total phenolics and antiradical activity were determined by Folin-Ciocalteu and DPPH assays, respectively.
Results/Conclusion: Total phenolics contents ranged from 30 to 340 mg EAG/200 ml. Commercial beverages without green tea showed the lowest levels.
A dietary supplement composed by a blend of green tea, pineapple and hibiscus presented the highest content. The antiradical activity was highly correlated with the phenolics amount, being both influenced not only by the recommended preparation method, but also by the composition of the mixture

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Keywords
dietary supplements, phenolics, antiradical activity

N° Nutri-P24 - Improving quality and health-related properties of grape juice

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Grape juice represents an important dietary source of health-promoting antioxidant molecules. Unlike wine it does not contain alcohol, thus can be consumed by children, pregnant women, elderly and teetotal people. Nevertheless, literature is lacking in information concerning grape juice composition and the concentration of antioxidant molecules represented in general by phenol compounds. This is in particular true for juices obtained from *V. vinifera* cultivars and in relation to physiological aspects of the berries (e.g. ripening stage, fruit tissue properties) and technical aspects of juice extraction and processing.
Grapes (cv Sangiovese) were harvested at two different dates in correspondence of a °Brix concentration of 19,1±0,1 (early harvest, EH), and 22,8±0,3 (commercial harvest, CH). Immediately after harvest bunches were treated with the gaseous hormone ethylene at 1000 ppm for 48h. Control bunches were maintained in an ethylene-free air stream. At the end of the 48h treatment berries were used for juice extraction. A lab-scale protocol was setup: grapes were manually de-stemmed, crushed and left at 4°C for 24 hours in contact with skins and seeds that were subsequently separated from the juice through a three-step filtration. Unpasteurized samples were bottled in glass-capped jars. Specific samples underwent pasteurization in a water bath at 75°C for 30 minutes, controlling the juice heating with an on-line temperature detector. Dry and fresh weight per berry, total soluble solids, pH and titratable acidity were determined for all the grape samples in triplicate. Total content of polyphenols, flavonoids, flavonols, hydroxycynnamates, flavan-3-ols, anthocyanins and proanthocyanidins was determined in all the juice samples through spectrophotometric-based techniques. The effects of ripening, ethylene treatment and pasteurization were statistically analyzed by 3-way ANOVA .
All the experimental factors considered were effective in affecting the phenolic content of grape juice. Ripening effect was evaluated comparing EH and CH grape juice samples: most of the observed variance for total polyphenols, total flavonoids, hydroxycynnamates and flavonols is related to this parameter. Total flavonoids showed the highest change, with an increase of 38,6% in CH juice samples compared with EH samples. Postharvest ethylene treatment significantly increased the juice sugar content, in particular for EH samples (from 18,0 to 19,0 °Brix). Proanthocyanidins and flavan-3-ols content resulted to be markedly affected by ethylene treatment, (+17,1% and +38,4%, respectively). Finally, juice pasteurization had a more limited effect on phenolic compounds, with the exception of anthocyanins and flavan-3-ols content, that showed an increase of 40,5% and 24,7%, respectively. These results demonstrate that improvement in quality and health-related properties of grape juice is feasible through management of grape harvest, postharvest procedures and juice pasteurization process. Further research is needed to clarify the effect of the investigated factors on juice taste and sensorial-related aspect.

Keywords
grape juice, Sangiovese, polyphenols, berry ripening, postharvest, ethylene, pasteurization

N° Nutr-P25 - Structure activity relationship of apo-lycopenoids in the inhibition of metmyoglobin-induced lipid peroxidation

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Background: Lycopene, the main pigment of tomato, is known to participate in the prevention of degenerative diseases. The mechanisms underlying its biological activity are not fully elucidated and could be a combination of an antioxidant activity in the gastro-intestinal (GI) tract and specific cellular effects after absorption. Not only (all-*E*)-lycopene itself but also its putative metabolites as apo-lycopenals detected in lycopene-containing foods and quantified also in plasma [1] could be responsible for the biological activities.
During the LYCOCARD european project (Role of lycopene for the prevention of cardiovascular diseases), we studied the antioxidant activity of lycopene and some apo-lycopenoids using an experimental model mimicking an oxidative stress of dietary origin in the GI tract.
Material and Methods: Lycopene, apo-6_'-, apo-8'- and apo-12'-lycopenals were provided by DSM. Aldehydes, carboxylic acids, ethyl esters and alcohols from the apo-10', apo-14' and apo-11-series were obtained by multistep organic synthesis [2].
The peroxidation of linoleic acid initiated by metmyoglobin ($MbFe^{III}$) is carried out in absence or presence of lycopene or apo-lycopenoids in a pH 5.8 sodium phosphate buffer containing Tween 20 at 37°C [3].
HOMO energies were calculated using the PM3 program (HyperChem software).
Results: The accumulation of conjugated dienes (CDs, mainly lipid hydroperoxides) followed at 234 nm in presence of lycopene or apo-lycopenoids proceeds with a lag phase followed by a propagation phase. During the lag phase, most of the antioxidant is consumed and the accumulation of CDs is very slow. During the propagation phase, the CDs concentration increases rapidly with a rate close to the rate of uninhibited peroxidation. A mathematical analysis of the curves expressing the period needed to accumulate a given CD concentration as a function of the antioxidant concentration was developed to estimate IC50 parameters and achieve a quantitative comparison between the investigated antioxidants. HOMO energies were also calculated as a first estimation of the ionisation potential of the antioxidants and thus of their electron-donating capacity.
Some interesting relationships between chemical structure and antioxidant activity can be outlined :
1. Chain length: Compounds with longer chains were more active. Apo-6'-lycopenal, the longest apo-lycopenal tested, was the best inhibitor and the most reducing compound (highest HOMO energy).
2. Terminal function: For the apo-10'- and apo-14'-lycopenoids, the order of increasing reactivity was: -OH < $COOC_2H_5$ ≤ -CHO < -COOH . Despite their higher reduction potential, apo-lycopenols are weaker antioxidant than the corresponding apo-lycopenoic acids.
Conclusion: Lycopene and apo-lycopenoids are good inhibitors of lipid peroxidation induced by heme iron in acidic conditions. A long chain and a terminal COOH group favor the antioxidant activity. Indeed, the terminal group is expected to deeply influence the lipophilic/hydrophilic balance of the antioxidant and consequently its distribution between the aqueous and lipid phases. Short-chain apo-lycopenoic acids could also access the heme crevice of $MbFe^{III}$ for a direct reduction of the hypervalent iron species involved in the initiation of lipid peroxidation whereas the action of more lipophilic derivatives (long-chain acids, aldehydes, ethyl esters) is likely restricted to the lipid phase (reduction of lipid peroxyl radicals).

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Keywords
lycopene, apo-lycopenoids, lipid oxidation, antioxidant, structure/activity relationship

N° Nutr-P26 - LC-MS quantification of caffeicin-like phenolic compounds in apple juices and ciders

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Accounting for 64 million tons per year, apple is among the main fruits produced in the world[1]. An important part of the production is processed into apple sauces, juices, concentrates and ciders. In the course of apple processing, enzymatic oxidation occurs when fruits are crushed and pressed allowing contact between polyphenoloxydase, phenolic substrates and oxygen[2]. As a consequence, a great multiplicity of phenolic oxidation products are formed[3]. Among them, caffeicin-like products corresponding to caffeoylquinic acid dimers have been previously characterized by LC-MS[4]. Depending on their concentration, these neoformed phenolic compounds may influence organoleptic and nutritional properties of apple juices and ciders. However, as far as we know, data concerning their concentrations are not available in literature. This may be explain through the difficulty to separate and detect them clearly among the pool of native and oxidized polyphenols. Consequently, their contribution to the overall quality of fruit processed products is largely unknown and likely underestimated.
We present here our recent work concerning the development and the validation of a new LC-MS method adapted to the quantification of caffeicin-like dimers in complex matrixes. Two cafeoylquinic acid dimers were synthesised, purified and used as standards of calibration. Several detection modes including UV, SIM and MS^2 were compared. The repeatability, reproducibility and the detection levels were evaluated. Then, the method was applied on series of samples including apple juices and ciders showing concentrations of several milligrams per litre for each dimers (varying from 0.7 to 35) with strong variations depending on the nature and the origin of apple products.

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Keywords
polyphenol oxidation mass spectrometry

N° Nutr-P27 - Identification of phenolic compounds from pomegranate (*Punica granatum* L.) juice of Moroccan cultivars

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Aim: Recently, chemical constituents and their bioactivities in all parts of pomegranate (*Punica granatum* L.), including leaf, seed, juice, husk and peel, have been investigated (Lansky et al., 2007; Gil et al., 2000).The aim of this work was to quantify the phenolic compounds from pomegranate juice, by using HPLC, and evaluate the antioxidant activity of each cultivar by the DPPH 2,2- Diphenyl-1-picrylhydrazyl method (Brand-Williams et al., 1995), in order to compare and differentiate cultivars as valuable sources of antioxidant compounds.
Methods and results: Pomegranate juices of twenty four cultivars Moroccan were analysed by HPLC to identify individual phenolic compounds. Extracted pomegranate juice was diluted (1:1) by methanol and filtered through 0.45 mm Millipore filter and injected onto HPLC. HPLC elution was carried out at room temperature and utilized as solvent A, the mixture of formic acid and water (5:95, v/v), and as solvent B, (acetonitrile/ water/ formic acid 80:15:5). The elution profile was, at a flow rate of 1.0 mL/min, 15% solvent B isocratic for 5 min followed by a 15–30% linear gradient for 15 min, and 30–50% linear gradient for 10 min with solvent B and holding with 50% solvent B for an additional 10 min, and finally followed by a 50–15% linear gradient with solvent B for 10 min. The chromatogram was monitored simultaneously at 280, 320 nm and 360 nm with 2nm bandwidth. The antioxidant activity is determined by DPPH method 100µl of juice diluted with methanol: water (6:4) was mixed with 2ml of 0,1 mol/L DPPH in methanol. After 30min in the dark, the absorbance of the mixture was measured at 517nm. Radical scavenging activity was expressed as the inhibition percentage. Our results show that phenolic compounds identified in pomegranate juice were gallic acid, chlorogenic acid, ferulic acid, coumaric acid, catechin, phloridzin and ellagic acid, with some variability among the cultivars studied and antixidante activity is very high for all juice analyzed and the highest values were observed for G4, G6, G12 and GR1 cultivars.
Conclusion: The composition of individual phenolic compounds and antioxidant activity are very varied among the different pomegranate juice.

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Keywords
pomegranate, phenolic composition, antioxydant activity, DPPH.

N° Nutr-P30 - Berry seeds: a source of speciality oils with high nutritional value

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The food industry is continuously searching for novel vegetable oils with a high nutritional profile rich in PUFAs, an ideal omega 6/omega 3 ratio and nutraceutical components. Moreover, the food industry is trying to reduce waste streams or to produce valuable components from these residues. In addition, consumers are willing to use alternative oil resources to be used as food ingredients or cosmetics.
This tendency is exemplified by berry seed oils obtained during the production of fruit juices. The seed oils are generated from the pomace by drying, separation of the skin and cold pressing. An alternative method is supercritical extraction of the seeds.
The quality, the unique fatty acid composition and the presence of minor components (tocopherols, sterols, polyphenols and squalene) have been determined for raspberry, cranberry, blackberry, blueberry, strawberry and kiwi seeds.
The majority of the oils have a low free fatty acid content but high peroxide and p-anisidine values due to the high content of PUFAs (68-85%). Especially kiwi oil is extremely rich in C18:3 (60%). All the oils have high concentration of phytosterols (400-700 mg/100g). The tocopherol concentration is variable from 100 mg/kg (kiwi) to 2200 mg/kg (raspberry).
It is observed that there is a good relationship between the oxidative stability and the content of PUFAs and tocopherols. It is also remarkable that kiwi oil contains very high amounts of squalene (8500 mg/kg) comparable with olive oil. The polyphenol concentration in the berry seed oils is in the range 200 mg/kg (blueberry), 5000 mg/kg (cranberry) and 16000 mg/kg (strawberry).
A comparison between the pressed and supercritical (SC) extraction reveals similar fatty acid composition and a slightly higher concentration of tocopherols and sterols for the SC oils.
Berry seed oils are novel high value oils from waste streams rich in essential fatty acids, tocopherols and phytosterols and can be considered as excellent sources for salad oils and cosmetic ingredients.

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Keywords
berry seed oil, essential fatty acid, minor components, phytosterols, tocopherols, polyphenols, supercritical extraction, cold pressing

N°Nutr-P31 - The quality evaluation of marmelade candies during the storage

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The natural fruit and vegetable marmalade candies is the product which is made from fruit and vegetable puree heated together with sugar and pectin.
The aim of this experiment was to evaluate the quality and stability of bioactive compounds and physical properties of natural fruit and vegetable marmalade candies packed in different materials during the storage.
The experiments were done in Faculty of Food Technology, Latvia University of Agriculture (LLU). The pumpkin, sea buckthorn, apple, and blackcurrant purees were the main raw material for preparation of the marmalade candies. There were two types of marmalades made from these purees: pumpkin - sea buckthorn, and apple – blackcurrant marmalade. Both marmalade candies were packed in polymer material Multibarrier 60 HFP in medium of 100% CO_2, 30% CO_2+70% N_2, and air medium as control 1, and control 2 – without packaging. All samples were stored at room temperature (+25 - +29 ºC) for a month. The contents of ascorbic acid (vitamin C), anthocyanins, total carotenoids, colour (in CIE L*a*b* system), texture, weight losses, and moisture content of samples during the storage were analysed.
The largest changes of vitamin C were obtained in first two weeks of storage. The highest ascorbic acid content after the storage of four weeks were detected in all marmalade samples packed in 100% CO_2 medium. The changes of anthocyanins in apple-blackcurrant samples during the storage were little for all packed samples, while the unpacked control sample lost more than 50% of anthocyanins after four week storage time. It was noticed the rapid decrease of carotinoids for all pumpkin-sea buckthorn samples during the first three week period, and the total losses was even more than 5 times compare to the beginning of storage. Notable changes were detected also to colour (in CIE L*a*b* system) values during the storage of marmalade samples. The weight losses for all packed samples did not exceed 2% after storage of four weeks, while the control samples without packaging lost more than 35%.

Keywords
marmelade candy, pumpkin, apple, sea buckthorn, blackcurrant, storage, bioactive compounds

N° Nutr-P32 - Antioxidant properties and phenolic composition of juice from cladodes of Prickly Pear (*Opuntia ficus indica*) of Moroccan origin

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The Cactus pear (*Opuntia ficus-indica*), is becoming increasingly important because of its ecological role in the development of drylands, as well as cosmetic and medicinal use [1,2].
In order to enhance the cladodes of prickly pear of Moroccan origin, we are interested in the identification by HPLC of the phenolic composition and evaluate their antioxidant powers.
The antioxidant activity of extract of cladodes of different cultivars was evaluated by three methods: DPPH (2.2-diphenyl-1-picrylhydrazyl), TEAC (Trolox equivalent antioxidant capacity), FRAP (Ferric Reducing Antioxidant Power) [3].
The results of HPLC analysis showed that the extracts of cladodes of Opuntia ficus indica cultivars are richs in polyphenols. We found that the number of peaks detected by HPLC is higher than that observed in most varieties of apples and grapes.
The results of antioxidant activity also showed higher values than those obtained for other fruits (apples and grapes) in the region of Maine-et-Loire (49 - France).
We also found a correlation between the methods of determination of antioxidant capacity and levels of polyphenols.

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Keywords
Opuntia ficus indica cladodes, HPLC, DPPH, TEAC, FRAP antioxidant activity, polyphenols

N° Nutri-P33 - A comparison of anthocyanins, phenolic compounds, and antioxidant activity in different species of berry fruit grown in Poland and in their juice

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Context and rationale: Fruit and vegetables are rich sources of phenolic compounds that are antioxidants. Due to the seasonal availability of some fruits such as berries, they need to be processed immediately after harvest. Juice is the most frequently consumed product obtained from fruit and vegetables. Unfortunately, losses of health-promoting compounds may often occur during juice processing. Phenolic compounds may be degraded due to the use of high-temperature processes, such as blanching or heating, or may be retained in the pomace after juice pressing. Therefore it is preferred to select varieties with high contents of health-promoting compounds, and those for which losses of these compounds are minimal.
In this study contents of anthocyanin pigments and phenolic compounds, and antioxidant activity were examined in different species of berries fruit grown in Poland and in their juices.
Materials and methods: All berries used in the investigations were either grown on farms or were wild-growing in Poland in 2010: black currant (cv. Bono, Tisel, Ciben, Ben Lemond), highbush blueberry (cv. Toro, Nelson, Earliblue, Spartan, Brigitta, Chandler), elderberry (cv. Sampo and two wild-growing varieties) and chokeberry (two breeding plantations). Juice from fruit was produced by pressing. The following processes were used in juice production: heating for 10 minutes at 80° C with an addition of water at a 1:0.2 ratio, cooling and pressing on the hydraulic press. Enzymatic treatment was not applied in the production.
Contents of anthocyanin pigments in fruit and juice were determined by ph-differential spectrophotometry, while total phenolic compounds were determined with the use of the Folin-Cocialteu reagent and antioxidant activity was determined using the ABTS assay.
Results: Contents of anthocyanin pigments in fruit depended on the cultivar and ranged from 72 to 283 mg/100 g for black currant, and from 87 to 177 mg/100g for highbush blueberries. Elderberry and chokeberry fruit contained more anthocyanins than other species. In our elderberry samples it ranged from 238 mg to 648 mg for the wild varieties and cv. Sampo, respectively. The highest anthocyanin content was observed in chokeberry fruit (617 to 714 mg/100g). Chokeberry fruits had also the highest phenolic content, approx. 2000 mg/100g. The lowest antioxidant activity ranging from 25.8 to 44.0 mmol Trolox/g was observed for highbush blueberry. Juices processing caused a reduction of contents of anthocyanins and phenolic compounds as well as a decreased antioxidant activity. The smallest loss was observed in juices from black currants. Anthocyanin content in black currant juice ranged from 62 to 212 mg/100 ml. In blueberry juice losses of anthocyanins reached up to 50%. The smallest reduction of phenolic contents from 16 to 25% was found in the elderberry juice. Antioxidant activity of chokeberry juice was 97 and 143 mmol Trolox/ml of juice, and values of 51 - 73% were reported for fresh berries.
Conclusions: Antocyanin content, phenolic compound content and antioxidant activity differed significantly depending on the species and cultivar or variety of tested fruit.
Chokeberry fresh fruit and juice had the highest anthocyanin pigment content, phenolic compound content and antioxidant activity of all tested berries.
The lowest levels of health-promoting compounds were recorded in highbush blueberry fruits and juices.
On average juices contained about 30% less anthocyanins and phenolic compounds and their antioxidant activity was approx. 30% in comparison to fresh fruit before pressing.

Keywords
berry fruit, juice, anthocyanin, phenolic compounds, antioxidant activity

N° Nutri-P34 - Influence of harvest season in anthocyanin content of açaí pulp (*Euterpe oleracea* Mart.)

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Context and rationale: Açaí (*Euterpe oleracea* Martius) is a palm native to the Amazon forest. Its fruits are marketed in domestic and international markets due to the high nutritional value, in addition to phenolics and anthocyanins. Anthocyanins are water soluble pigments, intensely colorful and widely distributed in the plant kingdom, but its concentration is influenced by genetic components, environmental and maturation. Others factors may also influence the composition of fruits and its pulp, as the harvest season, soil type, water quality and flood land. It is believed that the above factors can exert influences on the quality of the final marketed product [1]. Anthocyanins are dyes and natural antioxidants. The human body produces some endogenous antioxidants or can be consumed as food. Most flavonoids have the ability to react with free radicals and exert antioxidant functions in the body [2]. This study aimed to evaluate the influence of harvest time in total anthocyanins in açaí.
Materials and Methods: In 2010 the drinks were purchased from a supplier in the Northeast of Pará/Brazil in: February, April, May, June, July, August, September, October, November and December. The harvest of açaí occurs from September to December and offseason from January to August. The drinks were lyophilized for 96 hours and the total anthocyanin content of these pulps was determined with three replicates, according to the AOAC method 2005.02 [3]. After two hours of rest, the extract was filtered and measured the absorbance values at wavelengths of 520 and 700 nm by UV spectrophotometer – 1601PC SHIMADZU®. The coefficient of variance (Cv) was determined by $Cv = (\sigma / \mu)$ where $\mu > 0$ and σ correspond to standard deviation.
Results: Observed mean levels of 0.58% (w/w), 0.54% (w/w), 0.81% (w/w), 0.64% (w/w), 0.53 % (w/w), 0.60% (w/w) for the months of February, April, May, June, July and August, respectively. These months correspond to the period between offseason. For the period of harvest, we found the average content of 0.80% (w/w), 0.67% (w/w), 0.87% (w/w), 0.75% (w/w), 0.53% (w/w) and 0.60% (w/w) for the months of September, October, November and December. The Cv of the harvest period was from 0.107092809 and 0.16426533 Cv of the offseason.
Conclusion: It can be stated that in the harvest, the deviations from the mean reach around 11% of this value. However, in the offseason the deviations from the average reached 16% of this value. As the drinks were purchased from a company that uses fruit from different origins in the beverage preparation, this may also have contributed to failure of such a significant effect between crop harvests and the content of total anthocyanins. We conclude that the small difference between the periods is because during processing of season are used only ripe fruit, quite purple, with a maximum of anthocyanin in the pericarp.

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Keywords
açaí, anthocyanins, harvest season.

N° Nutr-P35 - Valorization of mediterrenean wines by-products: phenolic caracterization and antioxidant activity

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Grapes, one of the world's largest fruit crops, generate after the wine making process a huge amount of solid waste. Pomace, which is composed of seeds and skins, has been evaluated as a potential source of antioxydants polyphenols [1, 2] which could be used as nutraceuticals or food additives. Actually, phenolic compounds are known to have some health benefits such as a chemopreventive [3] role toward cardiovascular and degenerative diseases.
Indeed, the most important factors affecting the polyphenol contents in grapes, pomaces and wines are the grapes varieties, vineyard location and wine-making process. Thus, the aim of this study was to evaluate the correlation between antioxidant potential and total phenolic content of grape, pomace and wine from five important Vallé-du-Rhône's red wine cultivar (Carignan, Counoise, Grenache, Mourvèdre and Shiraz). The antioxidant potential of each sample was determined by different antioxidant test (ABTS·+, DPPH, FRAP and ORAC) whereas the phenolic contents and profiles was established by HPLC-UV-Fluo in order to determine relationship between antioxidant activity and grape variety. Moreover, ratio of initial phenolic compounds from grape to wine and waste in pomace was also estimated.
Our first results showed that seeds extracts from grapes and pomaces contain exceptionally higher amounts of totals polyphenols than skin's extracts and consequently presented a higher antioxidant capacity. HPLC-UV-fluo analysis revealed that pomace contains an appreciable amount of monomeric and oligomeric proanthocyanidin as well as some anthocyanins (glucosides, acetylated glucosides and coumarylic glucosides) despite the vinification process. Extracts from Grenache, Shiraz and Counoise conferred the highest antioxidant capacities among the studied varieties.

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Keywords
grapes by-products, Mediterrenean wines varieties, antioxidant activity, total phenolic content

N° Nutr-P36 - Identification and characterization of phenolic compounds extracts from olive by-products

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The olive industry is one of the emergent industries in Morocco as a country producer of olive oil. However, this industry generates significant pollution, mainly caused by the olive waste water that affect the soil quality. In this context and purpose of being able to enhance the pomace and olive waste water we are interested in the problematic of the olive industry by-products. In fact, the present work is in a gouvernemental project called Green Morocco Plan. The present work integer, also, thematic axes of the Moroccan national priorities in terms of scientific research for the period 2009-2012. Our work began by collecting samples during the January-April 2010 period, the collecting was in 40 olive mills spread across the Moroccan Tadla Azilal area. The collecting for the second year will start in December and will last until March 2011 and will cover five Moroccan areas. In order to identify the main functions existing in the chemical structures for both solid and liquid olive wastes, the samples are analyzed by Fourier Transform Middle Infrared (FT-MIR) spectroscopy. Identification of phenolic compounds of olive pomace and waste water samples is achieved by high phase liquid chromatography (HPLC) coupled to mass spectroscopy (LC-MS). The chemical determination of total polyphenols contents of the extracts was made by the Folin Ciocalteau method. For both solid and liquid olive wastes, a comparison of phenolic compounds in samples, after parameters such as geographical origin and type of mill or the variety of olive tree, will be discussed to distinguish physicochemical characteristics of the byproducts after these biological activities.

Keywords
olive pomace, olive waste water, extraction, Soxhlet, phenolic compounds, Folin-Ciocalteau, FT-MIR, UV spectroscopy, LC-MS.

N° Nutr-P37 - Bioactive phytochemicals in byproducts of industrial tomato processing

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Introduction and scope: Tomato (*Lycopersicon esculentum*) is the second most important vegetable crop next to potato, with annual world production at 100 million tons. Tomato processing results in the production of waste byproducts comprised by seeds, pulp and skins. As tomato is known to contain certain amounts of health-promoting phytochemicals like lycopene, carotenoids and polyphenols, we sought to investigate the presence of these microconstituents in industrial tomato byproducts, in order to evaluate their potential use as food additives.
Materials and Methods: Heinz hybrid tomato byproducts were freeze-dried, homogenized, and extracted with polar and non-polar solvents. The non polar extract was analysed for lycopene and β-carotene by spectrophotometric methods, sterols and triterpenes by GC/MS, tocopherols by HPLC. In the polar extract, the total phenolic content was determined by the Folin-Ciocalteu assay and simple polyphenols were quantified by GC/MS.
Results: The phytochemicals determined in the tomato byproducts (water content 73.97±1.10% w/w) were as follows
(i) Carotenoids: On a dry weight (DW) basis, the byproducts contained β-carotene and lycopene at concentrations equal to 15.0±0.6 and 41.4±8.0 mg/100g DW, respectively.
(ii) Tocopherols: Total tocopherol content of the byproducts was 4.7±0.1 mg/100g DW, with α-, (β+γ)- and δ- homologues present at 2.6±0.2, 2.0±0.1, and 0.02±0.01 mg/100g DW, respectively.
(iii) Sterols: Campesterol, stigmasterol, β-amyrin (2 isomers), cycloartanol, lanost-8-en-3-β-ol, cholestanol and β-sitosterol, were present at concentrations equal to 6.6±0.6, 15.2±2.5, 19.7±3.1, 5.2±0.7, 1.1±0.2 and 37.9±5.4 mg/100g DW, respectively. Cholesterol was present at 4.2±0.2 mg/100g DW. These data are in agreement with those provided for tomato surface wax (Bauer et al 2004) and seed oil (Eller et al 2010).
(iv) Terpenes: Squalene and ursolic acid were found at concentrations of 0.91±0.04 and 5.8±0.4 mg/100g DW, respectively. Also, low amounts of the sesquiterpene alcohol 2-*cis*-6-*trans*-farnesol and the terpenic dehydroabietic acid were detected (not quantified).
(v) Polyphenols: The total phenolic content of byproducts was 421±16.8 mg gallic acid equivalents (GAE)/100g DW. The simple polyphenols determined by GC/MS were mainly flavonoids and phenolic acids. Naringengin predominated at 32.9±9.3 mg/100g DW, followed by chlorogenic acid (5.0±1.4), caffeic acid (3.4±1.3), chrysin (2.2±0.5) and *p*-coumaric acid (1.1±0.6), being generally in agreement with data reported by Minoggio et al (2003).
Conclusions: The results obtained indicate that tomato byproducts contain significant amounts of bioactive phytochemicals, most of them with antioxidant properties. Within the concept of sustainability, these value adding constituents could be isolated from the byproducts to be used as natural additives for the formulation of functional foods, or to serve as natural antioxidants in food systems to elongate their shelf life.
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Keywords
carotenes, tocopherols, lycopene, phytosterols, terpenes, polyphenols, tomato byproducts

N° Nutr-P39 - New approaches for microbial risk – nutritional benefits assessment in the case of heat processed vegetables

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Food industries frequently need to adjust processing to find the best compromise between conflicting requirements. For some heat processed vegetables, preserving vitamins C and folates is an important aspect of the nutritional benefit for consumers. However, increasing this benefit might come into conflict with the need to maintain a high level of safety by reducing the risk caused by microbiological hazard. For heat processed vegetables, the most relevant microbiological hazards are spore forming bacteria. The project RIBENUT proposes to develop an original statistical approach to assess the compromise between risk and benefit in the case of heat processed vegetables. The project will be focused on processing and storage, from raw materials to the end product at consumption. In addition to this innovative and generic approach, the project will develop a user friendly software, providing food industries with a decision support tool to determine the compromise between risk and benefits.
To achieve these objectives, RIBENUT will use existing knowledge on behaviour of vitamins and spore forming bacteria during processing and storage. The project will also generate new knowledge to fill data gaps. It will integrate the following aspects : (1) An investigation on real processing lines in food industries to identify critical steps and parameters during processing and storage, (2) The determination, or improvement, of kinetic constants for vitamins losses (diffusion, heat combined with oxygen and pH, ….), (3) The determination of spore forming bacteria inactivation and growth parameters under conditions of combined low oxygen and low temperatures, (4) The development of a stochastic (probabilistic) model to assess the balance between risk and benefits, integrating all the steps along processing and storage, (5) The development of a user friendly, probabilistic software, combining several modules, each describing vitamin losses, pathogen inactivation and pathogen growth, over processing and storage.The project will be focussed on processed vegetables due to the importance of vegetables for vitamins in consumers diet, but the risk-benefit approach will be generic in nature and applicable to other foodstuffs and to other compromises in food processing.
This project received funds from the Agence Nationale de la Recherche under the reference ANR-09-ALIA-014

Keywords
vegetables, folates, vitamine C, spore forming bacteria

N° Nutr-P40 - Determination of antioxidants contents from some dried fruits and evaluation of their antioxidant activities

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Context: Free-radicals can produce pathologies through their capacity to damage some biological molecules. Dried fruits such as prunes, apricot, grape and fig contain a lot of antioxidants and the consumption of these fruits is very important in Algeria. The aims of this study were the quantification of some antioxidants (total polyphenols, carotenoids, anthocyanins, flavonoids, flavonols and proanthocyanidins) by using colorometric assays and the determination of antioxidants activities by three methods (reducing power, antiradical activity (DPPH), phosphomolybdenum method).
Materials and methods: Extraction of carotenoids was done by using the mixture of hexane/acetone/ethanol (2/1/1) and the absorbance of the upper phase was determined at 450 nm. Three solvents (water, methanol 50 % and ethanol 50 %) were used in order to extract the phenolic compounds and each sample was mixed with 20 ml of each solvent. After centrifugation, the mixture is centrifuged then filtered. Total phenolic contents were estimated by using Folin-Ciocalteu reagent. The amounts of flavonoids and flavonols were determined by the methods of Djeridane etl al. (2006) and Adedapo et al. (2008), respectively. Concentrations of proanthocyanidins were estimated according to the method of Maksimovic et al. (2005). The quantification of anthocyanins was realized according to the method of differential pH.
Results: From the obtained results, apricot (10.65 mg EβC/100g) and fig (5.91 mgEC3G/100g) had the highest level of carotenoids and anthocyanins. Grape was the richest fruit in total phenols (1183.45 mgEAG/100g) and proanthocyanidins (17.53 mgEC/100g). Also, fig (105.63 mgEQ/100g) and prune (485.91 mgEQ/100g) had the highest level of flavonoids and flavonols. Apricot and grape possessed the major reducing capacity, while agen prunes showed significant antioxidant activity to the phosphomolybdate. There were significant correlation between total phenols and antiradical activity (r=0.89) and reducing power (r=0.80). Moreover, a significant correlation was found between proanthocyanidins and antiradical activity (r=0.72).
Conclusion: The results obtained for antioxidants and antioxidant activities of dried fruits varied from fruit to another according to several parameters such as the type of antioxidant, the variety of fruit and storage conditions. It is very interesting to identify and quantify these antioxidants by HPLC/MS and to do other biological properties.

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Keywords
free-radicals, dried fruits, antioxidants, antioxidant activities.

N° Nutr-P43 - Polyphenol oxidase activity in fresh-cut sweet peppers of cultivars 'California wonder' and 'Quadrato d'Asti'

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Fresh cut sweet peppers represent a growing sector of 'minimally processed' vegetables market, whose quality may be injured by enzymatic activities under certain technological conditions. Among these, polyphenol oxidase (PPO, EC 1.14.18.1) catalyzes the hydroxylation of monophenols to *o*-diphenols and the oxidation of *o*-diphenols to *o*-chinons, which represent the main reaction products. All *o*-chinons molecules are highly reactive and may react with other phenols, producing substances whichdetermine fruit browning.
This research aimed at assessing the changes in PPO activity throughout a 30 days period (T_0, T_1, T_2, T_3, T_4 = after 0, 7, 14, 21 and 30 days, respectively) in green (cv. California Wonder), yellow and red (cv. Quadrato d'Asti) sweet peppers washed, cut, packaged in polyethylene terephthalate(PET) trays covered by anti-fog film with a 25 µm double-barrier, with an oxygen permeability lower than 2 cm^3 m^{-2} 24 h^{-1}, immediately refrigerated (4.0°C, 95% UR).
At T_0(9.91 e 7.05 mg/g d.w., respectively). At T yellow fruits had the highest ascorbic acid content (30.10 mg/g d.w.), followed by the red (21.64 mg/g d.w.) and green ones (14.96 mg/g d.w.). However, in red and yellow fruits, ascorbic acid content steeply declined already during the 1st week of storage, whilst in those green it increased during the same period and then it started to decline slowly. PPO was active in red and yellow fruits but not in those green, where in occurred at T_3. In particular, yellow peppers exhibited the maximum oxidative activity earlier (T_2) as compared to those red (T_3). When PPO reached its maximum activity, it peaked in red fruits, followed by those yellow and green (2.77, 2.50 and 1.82 U/g d.w., respectively). At the end of the storage period (T_4), PPO activity was 1.36 (yellow peppers), 0.94 (red peppers) and 0.61 (green peppers) U/g d.w. Total phenols content (GAE, gallic acid equivalent) was higher in green peppers, followed by those red and yellow. In green fruits total phenols increased until T_3 (11.05 mg/g d.w.), decreasing afterwards, whilst in red and yellow fruits phenols content progressively declined after T_2
Yellow peppers, for their greater susceptibility to PPO activity which negatively affects visual quality of the fruits, are less suitable to this use, at least when packaged under ordinary atmosphere. Green peppers, with the highest phenols content, exhibited the lowest PPO activity and the latest expression of it, as red fruits. However, PPO activity in red peppers was higher than that of the green ones, and this was probably due to a greater enzyme affinity for specific phenols in those fruits. Everything confirms that green peppers 'California Wonder' are more suitable to be "minimally processed" than yellow and red fruits analysed.

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Keywords
fresh-cut vegetables, sweet peppers, storage, ordinary atmosphere packaging, polyphenol oxidase, total phenols, ascorbic acid

N° Nutr-P44 - Fermentation of a commercial fiber product to release phenolic compounds

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Background and motivation: One of the major waste streams in nature consists of fibers, still a difficult degradable, but highly valuable biomass. Fibers are composed of different molecules i.e lignin, cellulose, hemicelluloses and pectin. Within these fibers, phenolic compounds can be complexed and bound to the lignin and hemicellulose fractions. Release of the phenolic compounds from this waste-stream could be a way to valorize the fibers.
In this study, the aim was to investigate if fermentation by *Lactobacillus plantarum*, either or not combined with enzymatic pretreatment, could be a tool to release phenolic compounds from a commercial beetroot fiber product.
Materials and Methods: The fiber matrix used in the incubations was a commercial product Fibrex, made from beetroot (FIBREX, Telco Foods BV), containing 73 % fibers, of which 22 % of pectin, 29 % of hemicelluloses, 18 % of cellulose and 4 % of lignin (according to the supplier). In a first experiment, only a bacterial treatment was performed. Fermentation flasks containing minimal medium with 3 % Fibrex were inoculated at 1% with *L. plantarum* (LMG6907). The experiment was conducted at 30°C for 14 days. In a second experiment, minimal medium with 3 % fibrex was treated with only cellulase (isolated from *Trichoderma reesei*), with a combination of versatile peroxidase (isolated from *Bjerkandera adusta*) and laccase (isolated from *Trametes versicolor*), and with the three enzymes together, creating three different enzymatic treatments, for 24 hours at 40°C. Enzymatic activity was stopped by heating at 80 °C for 5 minutes. Then inoculation was done at 1% with *L. plantarum*. In both experiments, samples were taken during fermentation at regular time points to follow growth of *L. plantarum* (CFU/ml, pH) and to measure release or conversion of the phenolic compounds by LC. Further identification of the phenolic compounds was performed by UPLC-HDMS-Q-TOF.
Results: During the fermentation experiment, without enzymatic treatment, a pH drop from 6.25 to 5.1 was observed, indicating that *L. plantarum* was growing by converting the free sugars, present in the Fibrex, to organic acids. No phenolic compounds were observed on the LC chromatograms, indicating that no phenolic compounds were released from the matrix using *L. plantarum* fermentation.
In the second experiment using the enzymes followed by bacterial fermentation, it became clear that when cellulase was used, lower pH values and higher growth was monitored. This could be the result of liberation of extra sugars from the matrix occurred compared to the first experiment. Also, on the LC chromatograms, a peak was observed showing maximal absorption at 261 nm. This peak was metabolized during fermentation with *L. plantarum*. Further identification of this peak by UPLC-HDMS-Q-TOF is in progress. Enzymatic treatment with only laccase and versatile peroxidase did not have any effect on the fiber matrix under the conditions used.

Keywords
fermentation, fibers, laccase, versatile peroxidase, lignin, lactic acid bacteria

N°Nutr-P45 - Proximate composition of raw and cooked sicilian chickpea seeds

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Chickpea is one of the oldest and widest cultivated pulses in the world on the basis of total grain production, after soybean, peanut, bean and pea. Its seeds are a good source of proteins, carbohydrates and dietary fiber, as well as of vitamins (mainly those of B-group) and mineral elements such as K, Zn, Ca and Mg. One of the main drawbacks that limit the domestic use of chickpea and other grain legumes, is the long cooking time required. Cooking time is a heritable characteristic for many pulses that is influenced by environmental conditions during seed development, seed composition and seed storage duration and conditions, and it differs widely among genotypes. Seed coat permeability, seed hardness and water absorption are, in fact, strongly affected by both environmental and genetic factors and their interactions.
The objective of this study was to assess the effects of cooking upon proximate composition in three Sicilian chickpeas ('12 CL", 'Etna' and 'Calia'). Genotypes were grown in a hilly site of inland Sicily (South Italy) and the same agronomic techniques were adopted in the field in order to obtain homogeneous material for assessment in the laboratory. Samples of harvested seeds were cooked in distilled water for two hours, in order to reach an adequate softening level in all chickpeas, according to their size. Raw and cooked seeds were analyzed for moisture, nitrogen, starch, ash, fat, tannins, crude fiber, magnesium, calcium and iron content, following the official methods AOAC. In addition, the caloric value was calculated using the Atwater factor method and the cooking water was analyzed for conductivity.
When compared to raw seeds, the ash, tannins, starch, magnesium and calcium contents of chickpeas significantly decreased after cooking. The tannins content decreased dramatically 20 g 100 g^{-1} due to the thermal treatment of seeds as cooked. Cooking decreased the starch content from 46.2 g 100 g^{-1} to 31.7 g 100 g^{-1}. In opposite, a significant increase in the level of crude protein, crude fiber and lipids occurred in all genotypes. Protein value was 24.5 g 100 g^{-1} for raw grains and 27.1 g 100 g^{-1} for cooked grains, without any significant difference among genotypes. from 480 mg 100 g^{-1} of uncooked chickpea to
This result highlights the great protein retention after cooking in all genotypes tested. Both the caloric value (393 kcal 100 g^{-1} d.w., on average) and the conductivity of cooking water (ranged between 3.5 and 4.1 mS/cm) did not vary in relation to genotypes. Among genotypes, cooked seeds of 'Calia' showed the highest losses of tannins (97%, on average), whilst seeds of 'Etna' accounted for the highest minerals retention (Fe and Ca, in particular) after cooking process.

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Keywords
chickpea, cooking, tannins, protein content, mineral content, energy value

N° Nutr-P46 - Fruit Carotenoids affect the bioaccessibility but not intestinal cell uptake of β-carotene from orange fleshed sweet potato

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Context and aim of the work: To fight against vitamin A deficiency in developing countries, consumption of orange fleshed sweet potato (OFSP) which contains high concentrations of beta-carotene (provitamin A) is currently promoted. Indeed, clinical studies showed that the vitamin A status was increased in children fed with OFSP (1). However, information on bioaccessibility and intestinal cell uptake of provitamin A carotenoids are lacking.
Bioaccessibility of carotenoids depends on various factors including food matrix, food processing and cooking, presence of fiber and dietary fat or other microconstituants in foods, etc… (2). The objective of this study was to assess the effect of carotenoids from fruit juices on the bioaccessibility and cellular uptake of beta-carotene (BC) from OFSP by using the *in vitro* digestion coupled with Caco-2 cell culture model.
*Material and methods***:** To simulate gastric and small intestinal phases of digestion, boiled OFSP (5g) mixed with different fruit juice samples (30 ml) taken into saline solution were first incubated at 37 °C (pH 4.0, pepsin, 30 minutes). Then, the pH was adjusted to 6.0, bile extract and pancreatin were added and incubated for 30 minutes. Micelles were collected in aqueous fraction after centrifugation and filtration (0.22µm). A micellarisation test without food matrix was also investigated (equimolar quantity of carotenoids, 5 ml of 100 mg/ml bile, 17h, 37 °C). Diluted digestats from *in vitro* digestions were incubated (1h30) on Caco-2 clone TC7 cells cultivated 21 days on wells to study the uptake by intestinal cells. Extraction and HPLC analysis of carotenoids from micelles and cellular samples were carried out according to a previous study (3).
*Results***:** Pink grapefruit juice diminished BC micellarization whereas kiwi and clementine juices increased *all-trans* BC, but decreased *13-cis* BC micellarization. When fruit juice carotenoids were replaced by pure carotenoids (lycopene, beta-cryptoxanthine and lutein) during *in vitro* digestions, some carotenoid interactions were confirmed particularly in the case of lycopene. Micellarization test showed that OFSP BC micellarization was decreased by lycopene while increased by beta-cryptoxanthine. Cellular uptake of BC isomers from digested OFSP was also investigated in presence of fruit juices.
Conclusion: This study suggests that carotenoids from fruit juices modify the bioaccessibility and cellular uptake of BC from OFSP. However, further investigations are needed to identify other components responsible for interactions in order to improve the use of OFSP to maintain vitamin A status.

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Keywords
beta-carotene, orange fleshed sweet potato, interaction, fruit carotenoids, bioaccessibility, cellular uptake

N° Nutr-P47 - In vitro bioavailability of isoflavones in a fruit juice - soymilk beverage

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Background and motivations: Isoflavones have been associated to health benefits related to age, menopausal symptoms, cardiovascular diseases and osteoporosis. The major sources of isoflavones in the diet are soybeans and soy derivatives. However, soy products have a "beany" flavors and chalky mouth feel. New soy products, such as soy beverages containing soymilk and fruit juices, have been developed to improve their sensorial characteristics, as well as their nutritional properties. Although studies about the bioavailability of isoflavones from different sources such as pure compounds, soy protein isolate and soybeans exist, little information is available about the *in vitro* digestion of isoflavones from soy-based beverages. The purpose of this work was to evaluate the *in vitro* bioavailability of isoflavones in a fruit juice-soymilk beverage.
Methodology: The gastrointestinal *in vitro* digestion method was carried out in two phases. The first one contained pepsine to simulate gastric digestion, whereas the second one used pancreatin and bile salts to simulate a duodenal digestion. In both phases, the temperature was maintained at 37 ºC during 2 h. After duodenal digestion, dialyzed and non-dialyzed fractions were obtained. The major isoflavones (Daidzein, genistein, daidzin and genistin) were determined in each phase by HPLC.
Results: Initial concentration of isoflavones in non-digested fruit juice-soymilk beverages were: 1,81 (Da = daidzein), 5,97 (Din = daidzin), 3,0 (Ge = genistein), 15,72 (Gin = genistin) mg/100 mL. A significant effect of the gastric digestion ($p < 0,05$) was found on the concentration of each isoflavone, compared with the initial. Ge and Gin had the highest recovery in gastric phase, corresponding to 89 and 87% respectivetly, whereas Din had the lowest (44%). A great recovery of isoflavones was obtained in non-dialyzed fractions (between 65 and 75 % of Da, Ge and Gin), except of Din that was less than 30%. On the other hand, in dialyzed fractions Din was not detected, whereas the recovery of Ge, Da and Gin was 37%, 23% and 18%, respectively, which indicates that they were available to be absorbed by intestinal epithelium. These results are in agreement with other reported investigations that had determined Da and Ge in aqueous soy extracts after *in vitro* digestion.
Conclusion: Most of the isoflavones contained in a fruit juice-soymilk beverages showed to be stable after *in vitro* gastrointestinal digestion, with exception of Din that was not recovered in dialyzed fraction. Therefore, this beverage could be an important source of bioavailable isoflavones.

Keywords
soy beverages, *in vitro* digestion, isoflavones, bioavailability

N° Nutr-P48 - A systematic survey of polyphenol losses during food processing based on the analysis of the scientific literature

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Background/aims: Polyphenols are natural antioxidants present in plant foods which may contribute to the prevention of several major chronic diseases. Food processing (storage, industrial treatment, domestic cooking) often results in important losses in polyphenol. These effects can be characterized by retention factors used to correct values in food composition tables. This information is particularly important for epidemiological studies aiming at better understanding the role of polyphenols in the prevention of diseases. Until now, no table of retention factors exists for polyphenols in processed and cooked foods. Our objective was to create a comprehensive database on polyphenol retention factors compiled from the scientific literature.
Methods: A systematic literature search was performed using Food Science and Technology Abstracts to identify articles containing content values for polyphenols in raw and processed foods. Polyphenol content values were inserted in a Microsoft Access® database, together with publication reference, description of the phenolic compound, analytical method used for quantification, food and food process, process description and classification. Data were evaluated for quality according to sample description, analytical methods, expression of results, and disclosure of experimental details. Only those data meeting specified minimum requirements were selected for the creation of the retention factor table. Retention factors were calculated taking into account yield factors for each individual process and aggregated to produce mean values characteristic of each polyphenol in a given food treated by a given process.
Results: Four hundred twenty retention factor values extracted from 250 publications were collected and 320 data were selected for aggregation, to provide average retention factors values for 54 phenolic compounds in 62 foods belonging to the following groups: vegetables, cereals, pulses, fruits and nuts. Foods were transformed by 12 different processes defined according to the Langual thesaurus (Boiled, Steeamed, Roasted, Fried, Pressure cooked, Microwaved, Soaking, Blanching, Peeled, Stewed, and Grilled). Retention factors were found to vary widely according the process and the nature of the polyphenol considered, with as an exemple values of 0.45 and 0.95 for cyanidin 3-O-glucoside in cabbage when respectively boiled and microwaved.
Conclusion: This polyphenol retention factors database is the first of its kind developed for polyphenols in foods and should significantly contribute to improving our knowledge of the effect of food processing on the content of various polyphenols. This information should help epidemiologists and nutritionists to evaluate more accurately the polyphenol content of prepared dishes and diets.

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Keywords
polyphenols, food content, storage, processing, cooking, losses, retention factors

N° Nutr-P49 - Phenolic contents and quality changes of different sweet cherry cultivars from Norway stored in modified atmosphere packing (MAP) bags

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Background: Norway (Hardanger area) is known for its production of sweet cherries. Fruits in Norway are there exposed to different growth conditions regarding water availability, temperature and sun compared to other, southern countries. Cherries are known to be non-climacteric fruits, characterised by short post-harvest life, shortened by water and firmness loss, colour changes and rot occurrence. Modified packing is an alternative to control atmosphere (CA), but connected with lower costs, since the only thing you need are special PE bags and cold place. The aim of our study was to evaluate the phenolics and colour changes, firmness, weight loss and rot development during 4 weeks of cold storage in normal atmosphere (NA) and in MAP bags at 1 °C.
Materials and Methods: All fruits of Van, Lapins and Sunburst cherry cultivars (*Prunus avium* L.) were harvested in Lofthus area (Norway) in 2010, stored at 4 °C for 24 hours after harvest and than packed in MAP bags (6 x 0,8 kg). Cherries were evaluated for their skin colour (CIE *L, a*, b** colour space), weight, rot development, firmness, total phenol (mg gallic acid/kg fresh weight) and total anthocyanin contents (mg of cyanidin-3-glucoside/kg of fresh weight) on a weekly basis for 4 weeks. Data from different experiments were compared with ANOVA and LSD tests ($P < 0.05$).
Results and discussion: The results have shown that MAP storage could retard skin colour changes during cold (1 °C) 4 week storage of Van and Sunburst cherries, as noticed by *L* and *a** values decrease over time, but not for Lapins cherries. After 4 weeks was the rot development the highest in Sunburst cherries, which are characterised by thin skin and therefore easily damaged during harvest and post-harvest handling, but the rot development was not suppressed by MAP storage for any of the cultivars tested. MAP seemed to benefit the firmness of all cherry fruits, stem freshness and overall appearance as seen by eye. At the same time no impact of storage treatment on the changes of total phenol and total anthocyanin content could be observed. Total phenol and anthocyanin contents in general showed the trend of increasing in all three cultivars of sweet cherries until the 3rd week of storage followed by a decrease in the 4th week.
Conclusions: Our results have shown that MAP could stop stem browning of three different cherry cultivars during cold storage and was beneficial for the firmness of the fruits and in some cultivars also retarded shiny red colour loss but had not impact on rot development and phenol variations in cherries during cold storage.

Keywords
sweet cherries, MAP, cold storage, phenolics, quality parameters

N° Nutr-P50 - Labels of commercial juices: are they really informative?

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Context and rationale: Under normal metabolism, the levels of oxidants and antioxidants in the body are balanced. Indeed, reactive oxygen species are usually well controlled by antioxidant enzymes (e.g., superoxide dismutase and catalase), thiol-containing peptides (e.g., glutathione), metabolites (e.g., uric acid), and dietary antioxidants (e.g., vitamin C, vitamin E, and polyphenols). Overproduction of oxidants and/or reduction of antioxidant defenses might cause an imbalance in redox state, leading to oxidative damage on critical sites of tissues and cells. The complex composition of fruits, which includes a mixture of different antioxidants with complementary mechanisms of action, seems to provide a greater protection against free radical injury than any single compound, which highlights the importance of the synergic action of the redox network (1).
In this perspective, food industry has been providing several options of juices prepared with different mixtures of fruits and claiming antioxidant properties. Some brands claim polyphenols content of the beverage. However, the information about its antioxidant properties is usually scarce.
Materials and Methods: The aim of this work was to analyse total phenolics content, total flavonoids and vitamin C levels (by colorimetric assays) of several commercial juice samples (n=10) and to evaluate their antioxidant activity (by DPPH assay) (2). Results were compared with label informations.
Results/Conclusion: In what concerns to the analysed parameters, a great variability was found between the samples, probably due to the different fruits used to prepare each commercial beverage. Moreover, juices without antioxidant claims presented similar values to those with it.

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Keywords
antioxidants, fruit juices, phenolics content, consumers, labels, information, claims

N° Nutr-P51 - Monitoring Quality of Fresh-Cut Baby Leaf Vegetables used for salads

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Context and rationale: Fresh-cut vegetables used in salads are lightly processed products that offer consumers a ready-to-eat food meal item. The minimal processing of these vegetables aims to ensure product freshness, without losing its nutritional quality, and providing a shelf-life feasible with the transportation procedure. They are prepared by using light combined methods such as washing, cutting and packing at chilling temperatures. These products are convenient, healthful, and in a fresh-like state.
After harvesting fresh vegetables continue to live and have the capacity to respond to minimal processing, increasing their metabolism that leads to quality losses.
The quality of fresh cut vegetables relies on a combination of several properties from each product. Producers are, usually, concerned with the appearance and safety of fresh-cut products. Nutritional quality is also an important aspect for consumers due to their demand for healthier fresh food.
Materials and Methods: Several quality physical and chemical traits were evaluated during the shelf-life of seven fresh cut baby leaf vegetables. Nutritional composition was also monitored during shelf life period (10 days). The vegetables evaluated were green and ruby red lettuce, wild rocket, Swiss chard, watercress, spinach and lamb_'s lettuce. All samples were fresh-cut baby leaf packed and stored at refrigeration temperatures (3 ± 1ºC) Quality was monitored through color evaluation (CIE Lab), pH, humidity, ºbrix, total acidity, protein, fat and ash content after packaging (day one) and at the end of shelf life (day 10).
Results: Packed baby leaf products kept their fresh appearance during the storage period, being color parameters maintained throughout the shelf-life. Humidity, pH, protein, fat and ash content were also stable during the 10 day period. However, ºbrix and/or total acidity suffer a slight variation in some products (green and ruby lettuce; wild rocket, spinach and lamb's lettuce).
Conclusion: Quality of these seven fresh-cut baby leaf vegetables was constant during the storage period under refrigeration temperatures. Further studies to establish micronutrient composition and evolution are ongoing
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Keywords
baby leaf vegetables, fresh-cut, quality

N° Nutr-P52 - Effect of probiotic cultures on the anthocyanins stability in blueberry yoghurts

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Background: An intensive red colour is one of the most important quality characteristics of berry yoghurts. The colour of the blueberry yoghurt depends on anthocyanins which also have positive consequences on the nutritional value of product. The stability of anthocyanin in berry yoghurt is affected by storage temperature and pH but also by properties of bacterial cultures used to milk fermentation i.e. the amount of produced hydrogen peroxide or enzymatic activity [Yüksekdag et *al*. 2004]. The objective of the study was to evaluate the influence of probiotic cultures on the changes of anthocyanin content during storage of blueberry yoghurts.
Material and methods: Fruit of highbush blueberries (*Vaccinium corymbosum* L), sugar and preparation of low methoxyl pectin were processed under vacuum conditions in order to obtain a blueberry preserve contained 600 g fruit kg^{-1} and final sucrose concentration of 40°Brix. Fruit preserve was incorporated into yoghurts containing yoghurt starter culture YC-X11 (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus)* and three different probiotic cultures (*Bifidobacterium animalis* subsp. *lactis* BB-12; *Lactobacillus acidophilus* La-5; *Lactobacillus paracasei* subsp. *paracasei* LCP). Total anthocyanin, monomeric pigment and colour of blueberry yoghurt were determined post-processing and after 2, 4, 6, 8 weeks of storage in darkness at 4°C. The individual anthocyanin compounds were identified and quantified using HPLC/ESI-MS technique and total anthocyanin analyses were performed by spectrophotometric method.
Results: The derivatives of malvidin were the predominant anthocyanins in blueberry yoghurts. There was no significant difference in total anthocyanin content in yoghurts analyzed directly after production (12.6 mg×100 g^{-1}). All yoghurt after production exhibited also similar value of L* and b* values, but small difference was observed in a* value. The highest a* value was found in yoghurt with addition of culture La-5 (12.8) and the lowest in non-probiotic yoghurt (12.1) and product with culture LCP (12.0). These products have also the highest Ph value among yoghurt tested. After 8 weeks of storage of non-probiotic yoghurt contained almost twice more anthocyanins content than yoghurt made with culture LCP. Moreover non-probiotic yoghurt and product with La-5 showed the highest a* value, which indicated that this products had the highest redness.
Conclusion: The culture of bacteria used in milk fermentation was important factor for degradation of the anthocyanins during storage. The antocyanins were the most stable in non-probiotic yoghurt (contained culture YC-X11 only) and in yoghurt with addition of culture La-5.
Acknowledgements: This work was supported by the State Committee for Scientific Research of Poland though the project N N312 125 339 (in the years 2010-2013).

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Keywords
anthocyanin, probiotic cultures, yoghurt, storage

N° Nutr-P53 - Antioxidant activity and total phenolics of commonly consumed edible mushrooms in Poland

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Nutritional and nutraceutical (health-promoting factors) aspects of foodstuffs are gaining increasing importance worldwide. Among the nutraceutical compounds, the demand for antioxidants has greatly increased. A study was conducted to determine the content of phenolic compounds and the antioxidative activity of four edible mushrooms commonly cultivated in Poland: *Agaricus bisporus*, *Pleurotus ostreatus*, *Lentinula edodes* and *Flammmulina velutipes*. Fresh and blanched fruit bodies of these mushrooms were liofilized. Thereafter, from lioflized fruit bodies were prepared water, methanolic (70%), ethanolic (70%) and acetone extracts (70%). Two different extraction techniques were used: ultrasonication and stirring by a rotary shaker at ambient temperature, at 50ºC and at boiling point for each solvent. Next, total phenolics by Folin-Ciocalteu method, antioxidant capacity (AOC) by ferric reducing antioxidant power (FRAP) assay and DPPH (2,2-Diphenyl-2-picrylhydrazyl hydrate) assay were analyzed in these extracts. In addition antioxidant activities of mushroom extracts were compared to standard antioxidants such as butylated hydroxyanisole (BHA) and trolox. It was observed that factors such as the heat processing and the kind of solvent had an impact on antioxidant activity and concentration of phenols in mushrooms extracts. All prepared extracts had an atioxidative activity analyzed by FRAP and DPPH assays. Results indicated that extract prepared from *Lentinula edodes* and *Agaricus bisporus* had the higher antioxidative activity compared with extracts from other mushrooms. Data shows that hot water was the best solvent to obtain extracts were characterized by high antioxidative activity and ultrasonication was better method compared with stirring. Numerous significant positive correlations were observed between total phenolic compounds and antioxidative potential. The total phenolic compounds were higher in the water extracts than in methanolic, ethanolic and acetone extracts of edible mushrooms. Due to these characteristics edible mushrooms could be considered as a complement in the diet for the health benefit they present. Also, the knowledge gained from this study is expected to be beneficial for producing the extraction of natural antioxidants from fruit bodies of edible mushrooms.

Keywords
edible mushrooms, extracts, phenols, antioxidant activity, FRAP, DPPH

N° Nutr-P54 - Comparison of the nutritional quality of sous vide and conventionally processed carrot and Brussels sprouts

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Background and motivations of the work: In the last years, the "sous-vide" technique is increasingly gaining interest in both catering trade and in gastronomy. In such system of processing, foodstuffs are heated in a vacuum-packed container followed by rapid chilling and storage at 0-3 °C. Therefore, the lack of exposure to exogenous water and oxygen would be expected to preserve losses of antioxidants of vegetables due to leaching and oxidation. As this heat treatment is mild, most research has concentrated on the safety aspects, whereas few studies have tried to confirm the suggested nutritional advantages.
Recent studies seem to defy the notion that processed vegetables have lower nutritional quality than the raw ones, especially when the antioxidant capacity and profile are considered. In addition, different heating processes have different effect on such parameters depending on the vegetable composition.
In the present study the influence of the sous-vide technique on the nutritional quality of two vegetables (carrot and Brussels sprout) is analyzed and compared to oven steaming, a cooking practice commonly used in catering operation.
Material and method: Freshly harvested carrots (*Daucus carota* L.) and Brussels sprouts (*Brassica oleracea* L. cv.*gemmifera*) of a single batch were purchased from a local market. Carrots, peeled before processing, were prepared by cutting off the top and bottom ends with a knife and extracting cylindrical specimens (diameter, 25 mm, height, 25 mm). Brussels sprouts were deprived of the external leaves. For sous-vide processing, a portion of each vegetable was evacuated in vacuum bags and cooked for 21 min in a steamer under steam at 98 °C, then the vegetables were chilled a rapid refrigerator and stored in a climatic chamber for up 10 days at 4 °C. At the 1st, 5th and 10th day of storage, the sous-vide processed vegetables were reheated for 20 min in a water bath at 60 °C and chilled immediately. For each analysis, fresh carrot and Brussels sprouts were conventionally steamed in a Combi-Steal SL oven at 100 °C under atmospheric pressure for 30 and 17 min, respectively.
Carotenoids, polyphenols and ascorbic acid content were determined by HPLC. Total antioxidant capacity (TAC) was analyzed by three assays (ie. TEAC, TRAP and FRAP), as previously described (1). One-way-analysis of variance (ANOVA) at a 95 % confidence level was performed on results expressed on dry weight basis.
Results: Preliminary results show that both heating procedures, sous-vide and steaming, had a positive effect on TAC and antioxidant profile values of carrot and Brussels sprouts, confirming previous results (1,2). However, during the storage of sous-vide vegetables analyzed a significant reduction of nutritional quality was observed.
Conclusion: Our preliminary results seem to not confirm the suggested nutritional advantages of this technique compared to steaming, even though a slight different behavior was observed between the two vegetables analyzed.

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Keywords
sous-vide, vegetables, oven steaming, total antioxidant capacity, polyphenols, carotenoids, ascorbic acid

N° Nutr-P55 - Antioxidant and anti-inflammatory activities of Ribes nigrum extracts

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Background and motivations of the work: Blackcurrant berries contain very high amounts of flavonoids with a number of health benefit attributed to the antioxidant potential. Recent studies indicate that blackcurrant flavonoids also exhibit anti-inflammatory properties. Leaves and buds actually used to produce food complement could also exhibit such interesting properties. Anti-inflammatory activity of flavonoids could be due to their antioxidative and radical scavenging activities, as well as to their capacity to regulate cellular activities of inflammation-related cells such as neutrophils.
Material and methods: In the literature, many methods are used to evaluate the antioxidant capacity of food compounds or biological systems, the main ones being the DPPH, TEAC, ORAC and ESR assays[1]. These methods are valid indicators of the antioxidant potential of dietary substances. However this type of assay does not provide evidence that a substance or a mixture of antioxidants has an *in viv*o antioxidant activity when consumed. To obtain more biologically relevant information, we used cell models of oxidative stress: the haemolysis assay and the Cellular Antioxidant Activity assay[2]. In the neutrophils, phagocytosis process involves NADPH oxidase activation but also release of hydrolytic and proteolytic enzymes, and myeloperoxidase (MPO) from cytoplasmic granules. An excessive stimulation of neutrophils leads to oxidative damage in neighbouring cells, tissues and molecules. Three experiments were used: the evaluation of ROS production and the release of MPO by activated neutrophils, and the activity of MPO by SIEFED[3]
Results: In the first part of this study, we observed that the choice of the method has a notable influence on the determination of the antioxidant potential. But blackcurrant leaves always showed the highest antioxidant potential, followed by buds and berries. On neutrophil experiments, blackcurrant extracts showed extra- and intracellular reactive oxygen species scavenging activity. MPO release did not seem to be reduced, but MPO activity was inhibited (SIEFED assay).
Conclusion: The effects of leaf and bud extracts on antioxidant and anti-inflammatory activities are better than those of berry extracts. Further works must be focused on the characterization of these extracts and on the study of additive and/or synergic interactions of the flavonoids in relationship with health outcomes like chronic diseases in human and horse.

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Keywords
antioxidant, cellular antioxidant capacity, myeloperoxidase, EAHy926, neutrophils, SIEFED

N° Nutri-P56 - Composition and nutritional aspects of the military diet in Slovenia

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Introduction: Basic military training generates high levels of the physical and mental stress. This study was designed to examine nutritional aspects of a military diet from Slovenia. The aim was to establish whether the energy values and contents of macro, micronutrients and antioxidant vitamines are in compliance with nutritional guidelines of the Slovene Armed Forces.
Material and methods: In May, October and November 2005 15 daily military menus were analyzed. They were prepared according to prescribed menus and sampled by the double basket method. Whole meal samples were collected at Vipava military barracks, each sample in three replicates. Samples were analyzed on energy, total fat, protein, dietary fiber, antioxidant vitamins C and E and fatty acids composition. Results were compared with the nutritional recommendations of the Slovene Armed Forces and DACH Reference Values for Nutrient Intake.
Results: Average daily intake of energy was 2900 kcal, which is under the lower limit of Slovene military guidelines, but still in accordance with DACH reference. Carbohydrates are with 53.1 % of total daily energy intake on the lower limit of recommendations. Average daily intake of dietary fiber is with 45.3 g/day on the upper limit of nutritional recommendations, daily intakes of proteins and fats are sufficient and in accordance with military standards. Total amount of vitamins C and E in daily menus is higher than military and DACH recommendations.
Average intake for vitamin C was 214 mg/day and for vitamin E 24 mg/day. High amounts of antioxidants are important for the neutralization of stress effects, induced by the high mental and physical activity during intensive military training.
Conclusion: To assess the nutritional quality of fatty acids in the military menus analyzed, the ratio between n-6/n-3 fatty acids, the index of trans fatty acids and aterogenic index were calculated. The ratio between n-6/n-3 was 10.8 which is far from ideal values ≤ 5 but still normal in comparison with non-military standards. Average concentrations of trans fatty acids in whole meals were 0.64 % of total amount of fatty acids, which is in compliance with general quality parameters (< 1%).

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Keywords
composition, nutrition, macronutrients, energy intake, antioxidant vitamins, military diet

N° Nutr-P58 - Composition of oil extracts obtained of seeds separated from industrial black currant pomaces or freeze-dried fruits grown in Poland

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Introduction: Black currant is an important material for obtaining juices, nectars and beverages in Poland and Europe. Poland in last decade with production over 100 KT per year was and still being a leader in black currant production. According to data of Polish Central Statistical Office around 90% of years production in Poland is used in food industry which is linked to production of a large amount of pomaces. At present pomaces are used as a fuel or being composted most of all. The alternative way of utilization of black currant pomace is production of polyphenolic extracts, fiber preparations and oils. Black currant pomaces are characterized by high concentration of phenolics especially in seedless part. The seed part of pomaces can be considered as a good source of raw material for production of oil extracts. The quality of final oil extracts obtained from seed part will depend on seed origin, fruit culitvar and conditions of fruit processing during the juice production. Therefore there is a need for characterization of seeds isolated from industrial black currant pomace (processed seeds) and freeze-dried fruit (non-processed seeds) and evaluation of their suitability for production oil extracts.
Materials and methods: Black currant pomaces were supplied by Alpex company – a modern factory of juices production. Fruits of three cultivars: 'Tiben', 'Tisel', 'Ben Lomond' were delivered by Research Institute of Pomology and Floriculture in Skierniewice. Fruits were freeze-dried and seeds were separated on rubbing machine. Oil extracts from pomace seeds were obtained at Fertilizers Research Institute in Puławy by supercritical fluid extraction (SFE) method in pilot plant scale. Oil extracts from freeze-dried seeds were obtained by Soxhlet method. Bioactive compounds in seeds and oil extracts were analyzed by HPLC and spectrophotometric methods. The basic nutrients of seeds were analyzed as well.
Results : It was shown that seed fraction separated from dried pomaces is sufficiently good raw material for the production of oil SFE extracts. Such products fulfill the requirements of minimally processed food, and are characterized by low acid value, low peroxide number, and high contribution of unsaturated fatty acids including α- and γ-linolenic acids. The concentration of tocopherols and carotenoids varied depending on the stage of SFE extraction. The average content of tocopherols and carotenoids in SFE oil extract was around 3200 mg/kg and 270 mg/l respectively.
Research showed that freeze-dried seeds separated from different cultivars of fruit had the different colour, shape and the content of basic nutrients. The diversification between seasons was also observed. Fatty acid contribution in oil extracts obtained by solvent extraction were also diversified especially in a content of γ-linolenic acid, which ranged between 13,2 – 18,2%, where the highest content of this acid was in 'Tisel' cultivar.
Conlusions: The research showed that black currant seeds separated from dried industrial pomaces are good raw material for obtaining of oil extracts maintaining the status of minimally processed food. The oil extracts obtained from seeds of 'Tisel' cultivar were characterized by particularly high content of γ-linolenic acid among three studied black currant cultivars.

Keywords
black currant, pomace, seed oil, linolenic acid,

N° Nutr-P59 - Evolution of flavonoids composition during fruit ripening of *Citrus medica* L. var. *corsican*

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Context and rational: The revival of the market for Corsican citron liqueur and new informations about the medicinal properties of citron essential oil [1] have led us to identify the flavonoids contained in fruit peel and to follow their evolution during fruit ripening. To our knowledge, little attention has been paid to assay the chemical variability of *Citrus medica* L. var. *corsican* [2] and no data are available on the flavonoid composition of alcoholic extracts. The study of influence of fruit maturity on polyphenolic composition could be used by commercial producers to select the most appropriate phytochemical traits and to improve the quality of citron alcoholic beverages (liqueur and eau-de-vie).
Materials and methods: 1500 fruits were selected at the bud stage on 100 trees cultivated in the same climatic and cultural conditions. From July to January, twenty fruits were monthly sampled, weighed and measured (height and width). In addition, the fruit maturity was established using the methodology reported by Ometto [3] and modified as follows. Devices were used to measure air temperature every 15 minutes throughout the fruit ripening. Changes in temperature during the day allowed to determine the accumulated growing degree-days (GDD), that were calculated using minimum air temperature (Tm) and maximum air temperature (TM), with a lower base temperature (Tb) of 12.8°C and an upper threshold temperature (TB) of 36°C.
Citron zests are macerated in alcohol during one week. Then, the alcoholic extract is analyzed (identification and quantification of compounds) by Liquid Chromatography coupled with a Mass Spectrometer (LC/MS).
Results: We identified twelve flavonoids in alcoholic extracts. Indeed, they are divided into five flavones (acacetin, luteolin, chrysoeriol, disometin and diosmin), four flavanones (hesperidin, didymin, eriocitrin and neoeriocitrin), two flavonols (rutin and quercetin) and one dihydroflavonol (taxifolin). With regard to their evolutions, the composition of peel extracts was qualitatively stable on all measures from July to January and from a quantitative point of view, the flavonoid concentration increased during maturation. In addition, concentrations of compounds increased in the same way. Thus, alcoholic extracts showed the same major components that were diosmin, hesperidin, didymin and rutin.
Conclusion: Throughout the ripening of fruits, we measured their phenotypic and chemical characteristics. This allowed us, firstly, to identify the flavonoids contained in citron peels and secondly, to follow their evolution during seven months. Thus, the data obtained will allow producers to optimize their harvest and therefore better meet the expectations of their customers.

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Keywords
Citrus medica, citron, flavonoids, alcoholic extract, maturation, LC/MS

N° Nutr-P60 - Vitamin C retention in different plant foods after cooking in an electric fryer

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Background and motivation of the work: There is strong scientific evidence that the intake of five or more servings of fruits and vegetables results in beneficial effects on health. Some nutritionists consider that they should be eaten raw to derive most benefit. However most vegetables and even some fruits are cooked before being consumed.
Getting good nutritional value from cooked food depends not only on the quality of the raw ingredients but also on achieving optimum control of the cooking process. For domestic cooking, the SEB group is developing new household implements which improve heat performance and tend to limit the vitamin losses.
Vitamin C (VitC) is one of the most important vitamins and antioxidants found in plant derived foods; it is also one of the most labile ones. We have therefore selected this micronutrient as a marker of the nutritional degradation to evaluate the performance of different new cooking instruments. The results presented in this symposium were obtained from cooking red peppers, zucchini, and nectarines in an electric fryer called Actifry.
Material and methods: The fresh fruits and vegetables were washed before cooking. Red Peppers were cut into squares of 2x2 cm, zucchini were cut into slices of 0.5 cm thickness and nectarines were cut in regular segments of 20 g. For each stir-frying procedure 650, 750 and 365 g of red peppers, zucchini, and nectarines were placed into the bowl of the fryer, respectively. Fourteen milliliters of oil was used for each recipe. Fifteen milliliters of water was also added to cook the vegetables, and 40 g of sucrose to the nectarines. The cooking time was set following sensorial analysis.
In order to get accurate measurements, VitC was extracted from high quantities of plant foods (> 150 g) mixed into metaphosphoric acid. The total VitC was measured according to the method of Tessier and al. (1995). Briefly this method is based on a specific reaction of dehydroascorbic acid with dimethyl-phenylenediamine to form a fluorescent derivative quantified by RP-HPLC.
To assess the true impact of cooking on VitC retention the evolution of dry matter was also measured.
Results: The red peppers stir-fried for 30 min lost only 24% of VitC, meaning that a raw portion of 100g of red peppers which contained 121.8 mg VitC retained 92.7 mg after cooking. The zucchini cooked for 28 min lost 98% of VitC, and the nectarines cooked in a sucrose syrup for 12 min lost 65% of VitC. One hundred grams of fresh nectarines containing 56.2 mg VitC were reduced to 87 g containing 19.7 mg VitC.
Conclusion: The retention of vitamin C is highly dependent on the type of plant food cooked. Even when the VitC retention is low cooked fruits and vegetables contain a significant amount of VitC, permitting the recommended allowance still to be achieved.

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Keywords
vitamin C, frying, fruits, red pepper, zucchini

N°Nutri-P61 - Fatty acid composition of alternative sources: case of small fruits and sweet cherries

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The fats represent an important part of human nutrition but are in practice often treated as a harmful component due to obesity syndrome. According to modern nutritional habits, the equilibrium of single fatty acids consumed nowadays is far from optimal. In this study 5 cultivars of gooseberry (*Ribes uva-crispa* L.), 10 cultivars of black currant (*Ribes nigrum* L.), 4 cultivars of red currant (*Ribes rubrum* L.), one cultivar of hybrid josta (*Ribes nidigrolaria* Bauer) and 13 cultivars of sweet cherry (*Prunus avium* L.) were evaluated for their oil content and fatty acid composition. In average the seeds of small fruits contain 18,61 % of total fats while cherry seeds contain 28 % of total fat. In average, the fat from the seeds of small fruits contain 39.09 % of linoleic, 18,45 % of α-linolenic, 12,81 % of oleic, 3,41 % of stearidonic acid and 9,97 % of γ-linolenic fatty acids. The highest ratio of linoleic (43,27 %) and γ-linolenic (12,33 %) fatty acid was found in the seeds of black currant while that of α-linolenic (28,01 %), palmitic (8,48 %) and stearidonic (5,45 %) fatty acids was found in the seeds of josta. On the average, the cherry seeds contain the following fatty acids: palmitic (8,05 %), stearic (2,6 %), oleic (36,5 %), linoleic (43,6 %), linolenic (0,18 %), a-eleostearic (8,4 %) arachidic (1.13 %). From the nutritional point of view, small fruits represent an important source of a and γ-linolenic acid as well as stearidonic acid. On the other hand, cherry seeds are rich in conjugated linolenic (a-eleostearic) acid. Above mentioned fatty acids have favourable nutritional properties their effects being anti-inflammatory, antithrombotic, anti-arrhythmic, hypolipidemic and vasodilatory. Conjugated fatty acids share the same biological effects and also have antitumor effects.

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Keywords

fatty acid composition, *Ribes uva-crispa* L., *Ribes nigrum* L., *Ribes rubrum* L., *Ribes nidigrolaria* Bauer

N° Nutr-P62 - Interactions between pectins and procyanidins: consequences of heat treatment

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Context and rationale: Procyanidins (condensed tanins) and pectins (polysaccharides) are located in distinct compartments in vivo: in vacuoles and cell walls respectively. When cells are ruptured, procyanidins and pectins bind and these associations limit bioavailability of polyphenols [1]. They are governed by H bonds and hydrophobic interactions [2]. The amounts of procyanidins bound increased with their initial concentration and degrees of polymerisation (DPn). These bindings depend on the nature and the structure of pectins as well as physico-chemical conditions such as temperature or ionic strength [2].
Within the European project Dream, we investigate mecanisms which govern diffusibility and bioavailability of polyphenols in cooked apples. We present here the results that motivated our focus on interactions between procyanidins and pectins.
Materials and Methods: Cell walls were isolated from fresh ripe apples (cv. Ariane) using the phenol : buffer method [1] (BP CWM). They were devoid of polyphenols and contained 3.2 mg/g of aminoacids. They were modified by boiling for 20 min in citrate/phosphate buffer pH 3.8 followed by two modes of drying, by solvent exchange or by freeze-drying, giving the two samples BP-S CWM 100°C (solvent exchange) and BP-F CWM 100°C (freeze-drying). Procyanidins were extracted from freeze-dried parenchyma of cider apple cultivar (cv. Marie Ménard) by water: acetone after methanol pretreatment and then purified by HPLC. For binding, procyanidins (5 g/L) were incubated for 1h with a cell wall suspension (20 g/L, in citrate/phosphate buffer pH 3.8) [1,2]. After incubation the solution and the cell wall-polyphenol complexes were separated by filtration under vacuum. The bindings isotherms were interpreted according to the Langmuir formula [2].Commercial apple pectin (1.5 mM) dissolved in malate buffer pH 3.8 was titrated with procyanidins (2.4 mM) in VP-ITC instrument.
Results: No significant differences were observed for sugar composition between BP CWM, BP-F CWM 100°C and BP-S CWM 100°C. Boiling caused a decrease of the surface area : the surface area (related to porosity) of BP CWM was four times that of BP-F CWM 100°C, and a decrease of the sugars characteristic of pectins (galacturonic acid, rhamnose, arabinose and galactose). The proportion of procyanidins which were retained by BP-F CWM 100°C and BP-S CWM 100°C were lower than those retained by BP CWM, and the saturation levels of the BP-F CWM 100°C and BP-S CWM 100°C were close to but higher than those determined with BP CWM. ITC of commercial pectins with procyanidins showed a low but definite affinity ($K = 8.13\ 10^3\ M^{-1}$).
Conclusion: The capacity of the cell wall to interact with procyanidins is related directly to their physical state and the presence of pectins. During preparation of cell wall materials, the supernatant containing free pectins are removed and the affinity with procyanidins decreased. Isothermal titration calorimetry (ITC) gave information on affinities and will be pursued, together with other physico-chemical methods to better probe the mecanisms and structure / reactivity relationships of these interactions.

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Keywords
pectins, procyanidins, heat treatment, ITC

N° Nutr-P63 - Study on the profile of volatile compounds of deep fried iodine-enriched and non-enriched potatoes

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Context and rationale: This work is part of a larger project that dealt with the characterization of iodine-enriched potatoes, obtained by agronomic biofortification (Zanirato, 2008), which included chemical composition, product properties and quality assessment after frying. These parameters were compared with those found in non-enriched potatoes.
In particular, the present study focused on the system frying oil-French fries, to understand whether iodine biofortified potatoes could be suitable or not for frying purposes. In fact, thermal processes induce physico-chemical modifications on both frying oil and potatoes; some of these give positive aspects to fried potatoes (like color, odor, flavor, crispiness), while others cause the formation of different compounds that can negatively affect consumers' health.
The profile of volatile compounds (VC) of iodine-enriched and common potatoes after deep frying in high-oleic sunflower oil (HOSO), was here assessed.
Materials and Methods: Iodine-enriched and common potatoes were separately fried in HOSO according to the following plan: 3 repeated 4-min frying cycles/day at 180°C, with a 30-min preheating step and a 15-min interval between frying cycles; this scheme was repeated for a total of 3 consecutive days. Oil and fried potatoes samples were collected at several frying times, and stored at -18°C until the analysis. VC were determined by headspace solid-phase microextraction coupled to gas chromatography-mass spectrometric detection (SPME-GC-MS), according to Vichi *et al.* (2003). VC were identified by comparing the mass spectra with those reported in literature and in the NIST05 GC-MS library. Data are reported as internal percent peak areas.
Results : About 50 VC were detected in fried potatoes. The major peaks belonged to the class of alkans (only hexane 24.5-47.0%), followed by cyclic compounds (25.7-47.6%), aldehydes (19.8-27.4%) and carboxylic acids (only isopropenilic acid 5.3-8.7%); the minor peaks were alcohols and ketons. Major cyclic compounds detected were benzene derivates (12-30%) and pyrazine derivates (4.4-24.7%), which were only found in potatoes and not in oil; these compounds might have been developed during Maillard reaction, thus providing the particular frying aroma. Some aldehydes here detected (octanal, nonanal, 2-decenal, 2-undecenal) derived from the oxidation of oleic acid, the major fatty acid of HOSO and potatoes. Compounds arising from linoleic acid oxidation (hexanal, 2,4-decadienal) were also found. Among them, 2,4-decadienal is, in fact, considered the major contributor to the deep-fried flavor (Nawar, 1998).
Conclusion: The profile of volatile compounds of deep-fried iodine-enriched and non-enriched potatoes, was quite similar; the slight differences that were found may be more related to the different oxidative status of the fresh frying oil rather than to the actual different raw materials.

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Zanirato, V. 2008. *International Patent n. PCT/EP2008/052455*

Keywords
iodine-enriched potatoes, biofortification, deep frying, SPME, volatile compounds.

N° Nutr-P64 - Antioxidant activity, phenolics and physicochemical composition of tropical fruits, and processed products

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Context and rationale: High intake of fruits and vegetables has been shown to be inversely related to incidence of several degenerative diseases. The objective of this study was to characterize diverse Costa Rican fruits. The physicochemical composition, antioxidant activity (AA), total phenolic content (TPC), and total carotenoid content of ten fruits were determined and expressed as fresh weight (FW). The fruits were: banana (*Musa AAA*), pineapple (*Ananas comosus)*, mango *(Mangifera indica)*, melon (*Cucumis melo)*, blackberry (*Rubus adenotrichus*), peach palm (*Bactris gasipaes*), fig (*Ficus carica)*, tree tomato (*Solanum betacea*), naranjilla (*Solanum quitoense* Lam.), papaya (*Carica papaya*) and quince *(Cydonia oblonga)*.

Results:

- Cooked peach palm pulp presents the highest carotenoid content (116±7 µg β-carotene/g), and a 100 g portion provides more than 50% of the provitamin A recommended daily intake (5000 UI).
- Blackberry (6,9 g/ 100 g), cooked peach palm pulp (5,1 g/ 100 g), fig (4,9 g/ 100 g) and tree tomato (4,2 g / 100 g) have important contents of dietary fiber and they may be considered as a fiber source.
- Blackberry presents the highest H-ORAC value (64 ± 4 µmol Trolox Equivalent (TE) / g) and TPC content (520 ± 20 Gallic Acid Equivalent (GAE)/ 100 g). Compared with blackberries grown in temperate climates, the tropical highland blackberry presents high antioxidant capacity and high content of ellagitannins, and it may be classified as a super fruit.
- Quince has a TPC of 297 ± 54 mg GAE / 100 g and H-ORAC value of 19 ± 6 µmol TE/ g. It has been considered an important source of phenolics and dietary fiber (5,7 ± 0,9 g/100 g). For this reason it has been used as raw material for production of marmalade, and preserves. Quince jam presents a TPC of 233 ± 14 mg GAE / 100 g), H-ORAC value (14 ± 2 µmol TE/ g) and dietary fiber content of 3,5 g/ 100 g.
- Pineapple cv. Gold presents the highest vitamin C content (45,6-67,5 mg/100 g).
- Papaya hybrid Pococí developed in Costa Rica, presents a total soluble solids content (14,5 ºBrix) higher than other varieties.
- During peach palm flour processing total carotenoid content diminishes, and 17 % of the total carotenoids present in the cooked pulp remains in the flour.

Food product development trends focus in bioactive compounds content. The use of tropical fruits is a way of promoting the development of health-beneficial products.

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Keywords

tropical fruits, antioxidant activity, phenolics, carotenoids

N° Nutr-P65 - Evidence of health benefits of polyphenols enriched foods: from *in vitro* studies to clinical trials performed at University-CHU of Liège, Belgium

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Oxidative stress results from a decrease of endogenous antioxidant capacities or an increase of reactive oxygen species (ROS) concentration in organisms. It can cause deleterious damages on cell constituents like DNA, proteins or lipids and finally, could induce several pathologies Phytochemicals of fruits and vegetables such as polyphenols have been considered of crucial nutritional importance in the prevention of chronic diseases such as cancer, cardiovascular and neurodegenerative diseases. This may be related to their antioxidant activity as well their ability to regulate cellular activities of inflammation-related cells.

A large number of methods and variations have been developed and applied for the measurement of *in vitro* antioxidant capacity and efficacy of food matrix. The most popular assay is the ORAC assay (Oxygen Radical Antioxidant Capacity) initially developed by the US Agriculture Minister and using 2,2'-azobis(2-aminopropane) dihydrochloride (AAPH) as free radical generator. However, our expertise shows that results are strongly dependent of experimental conditions so that comparison between laboratories is impossible (Food Chem 113, 1226-1233, 2009). It is therefore required to better standardize the method as we recently proposed it (ORAC®). Another problem is that ORAC values do not necessarily correlate with the concentration in polyphenols present in the food matrix but also with data getted from other tests used for evaluating the antioxidant capacity such as DPPH, ABTS or FRAP assays. Moreover, a weakness of all these methodologies is that they do not use physiological free radical generator. So, we proposed to integrate all these results as a global and comprehensive antioxidant scoring® including most physiological and cellular assays rather than used the sole ORAC test. Professionals in food industry have also to keep in mind the necessity to compare their products with comparable food but also with standardized matrix known for their standardized polyphenols content (e.g. gingko biloba extract).

The great challenge of the future will be the demonstration of nutritional and health assertions of polyphenols enriched food via conclusive clinical trials. Recently, Afssaps has, however, rejected the "antioxidant" assertion since no convincing data are available on the regulation of the *in vivo* oxidative stress due to a lack of sensitivity and specificity of used methodologies. This will be discussed in our presentation. Nevertheless polyphenols are well – known to contribute to largely increase the release of nitric oxide or NO (a free radical produced by endothelial cells) that is implicated in the regulation of the blood flow and, consequently, of the arterial blood pressure. As ROS conditions strongly react with NO, it could be speculated that polyphenols may also exert NO protection provided that their blood concentration at least reaches 10 µM. We are convinced that clinical trials on polyphenols must be therefore focused on the regulation of *in vivo* endothelial function (and thus blood pressure) in order to get a chance to evidence a health assertion linked to antioxidant properties. Intersting data both on aorta segments of rats or in humans have already been obtained with different polyphenols enriched foods (red wine, blackcurrant, gingko biloba extract, black chocolate). Nevertheless, this beforehand requires to evidence the *in vivo* biodisponibility of the active ingredient(s) that can be now achieved by the easier measurement of blood polyphenols concentration.

N° Nutr-P66 - Kinetics of thermal degradation of vitamin C in marula fruit (*Sclerocarya birrea* subsp. *caffra*) as compared to other selected tropical fruits

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Context and rationale: In this study, comparisons were made of the kinetics of vitamin C degradation in marula, mango and guava pulp at different temperatures between 80 and 150 °C. Marula fruit has very high content of vitamin C 70-403mg/100g, guava has between 72.2–300mg/100g while mango has between 60–77mg/100g as reported in literature. Temperature time treatments were used in this study to investigate the thermal degradation of vitamin C. High content and stability of vitamin C in marula makes it an excellent source for vitamin C both in the fresh fruit and in heat treated products.
Materials and methods: Marula fruits were obtained from the northern parts of Namibia with the help of Eudafano Women's Cooperative centre (EWC) Ondangwa. The other fruits were obtained from local super markets.The fruits for samples preparation were peeled and the edible part cut into small pieces. The edible parts were then frozen in liquid nitrogen and homogenised using a blender. To determine vitamin C content of marula, guava and mango fruit pulp, a high performance liquid chromatography (HPLC) was used. The homogenized fruit pulp was heated at temperatures of 80°C, 100°C, 125°C and 150°C. Different heating times were used to determine vitamin C stability and degradability. Kinetic modelling of the breakdown of vitamin C was done using two parallel 1st order models combined with an Arrhenius equation.
Results: Vitamin C content obtained from marula pulp for the study was within the reported range while for mango and guava; the vitamin C contents were lower than the reported figures. The results therefore, show that vitamin C content decreased with increasing heating time and temperature treatments. A standard first order model did not describe the degradation process well. A model with two parallel 1st order models described the vitamin C degradation well. The marula vitamin C results fitted the model the best, with a $K_{d1,\ 100}$ of $7.2*10^{-3}$ min^{-1} and $K_{d2,100}$ of $7.9*10^{-4}$ min^{-1} . The pulp of marula was the most stable when heated, followed by the guava and mango (not well fitted to the model). At temperatures lower than 125ºC, vitamin C content in marula was more than 15 times and more stable than in guava and mango fruits. After 4 hours of heating at 125°C, the lowest vitamin C content of marula pulp was 0.11mg/g. In the guava pulp, vitamin C degraded to 0.1mg/g at 150°C after only 12 minutes. Vitamin C content of both mango and guava pulp seemed to stabilise at around 0.14mg/g at heat treatments of 80°C and 100°C.
Conclusion: Vitamin C in marula is very stable as it had the lowest degradability in comparison to vitamin C in guava and mango. Vitamin C in marula showed high stability and the results confirm previous studies that after pasteurisation, marula jam retained up to 84% of its original vitamin C content.

Keywords
marula, vitamin C, degradation, thermal treatment, tropical fruits

N° Nutr-P67 - Nutritionnal properties of seaweeds

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In the Far East, there has been a long tradition of consuming seaweeds as sea vegetables, while in Western countries the principal use of seaweed is phycocolloides as sources of thickening and gelling agents. This technical usage is broadening to other major compounds of algae for various industrial applications, including food, cosmetic, agriculture and more recently green chemistry.

Marine algae are not considered as traditional food in France, and their use in food was only authorized in 1990 by the French government. Good quality seaweeds containing non toxic pollutants can be used as vegetables and condiments for human consumption. Nowadays the food industry include seaweed as raw or semi-processed materials in the formulation of seafood products as soups, drinks, cheeses, biscuits, and even for functional use as salt replacement.

Seaweeds are nutritionally valuable as fresh or dried vegetables, or as ingredients in a wide variety of prepared foods. Seaweeds contain high amounts of carbohydrates and minerals, and certain edible seaweeds contain significant quantities of protein, and vitamins. The beneficial effects of seaweeds on human health would appear to be due to the presence of 3 categories of constituents (fibres, proteins and minerals) and the presence of metabolites presenting antioxidant properties and antiradiculars such as the carotenoïds, polyphenols, vitamins or polyunsaturated fatty acids.

This poster will update the knowledge about seaweed composition and nutritional interest in a healthy diet.

N° Nutr-P68 - Carbohydrates and total phenolic contents of domestic cooked artichoke

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Background and motivations of the work: Artichokes have a health-promoting potential attributed to their high antioxidant activity because of their high phenolic content, and to the presence of inulin that has prebiotic properties. Through fermentation, inulin affects bowel functions and microbial enzymes activities. The products of the fermentation process are short chain fatty acids and gases such as carbon dioxide and hydrogen. The gas production can also provoke discomfort for some people and lead them to reduce artichoke consumption. The present work focused on the changes occurring in artichoke after some of the common household cooking treatments (pressure-cooking, steaming, microwaving, conventional boiling and the adding of ingredients to the boiling water) on the content of carbohydrates and total phenolic (TPC).
Material and methods : Artichoke heads (*Cynara scolymus* L.) of the variety 'Camus' were cooked by six different methods in triplicate. The cooking settings were chosen according to what is reported in traditional recipes. Cooking time were adjusted using sensory tests in oder to have the same cooking degrees. After all cooking experiments, samples were cooled rapidly on ice. The edible part of the bud (i.e. the receptacle) was immediately freeze-dried and stored at -20°C until analysis. Carbohydrates content were determined by anion exchange HPLC with pulsed amperometric detection, and TPC according to the Folin-Ciocalteu procedure. Total inulin content were determined by difference of soluble sugars before and after inulinase enzymatic treatment. Cooking water was also analysed.
Results : TPC was the highest in steamed and boiled artichokes. All cooking methods induced inulin concentration and DP changes. A decrease in the higher polymerized fractions (degree of polymerization, DP>40) with an increase in the less polymerized fractions (DP<10) was observed in cooked artichokes. The highest variation is shown after conventional boiling in acidic water, where the high-DP inulin amount dropped of 83% while low DP-inulin increased of 72%. When pressure cooked, artichoke lost about 13% of inulin, while the boiling cooking resulted in losses of 26%. The leaching of soluble sugars and inulin mainly occurred in boiling cooking. The pressure cooking exhibited the less deleterious effects in inulin when compared to other treatments. Addition of citric acid to the boiling method caused greater inulin loss than conventional boiling did in reducing the inulin content by half. This could be an appropriate cooking option to reduce negative side-effects for some people suffering from intestinal discomfort.

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Keywords
Cynara scolymus, inulin, total phenolic content, cooking treatments

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To be continued !