Legume-enriched Pasta
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Legume-enriched Pasta: how structure impacts starch and protein digestibilities and protein allergenicity


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Interest of Mixing Durum Wheat and Legumes in pasta

Inspired by The Mediterranean diet and its health benefits

Nutritional complementarities

Macroscopic structure of dry and cooked pasta

Impact of legume flour addition

Pasta composition

Microscopic structure of cooked pasta

Durum wheat pasta structure

Methodology

PASTA STRUCTURE

GLYCEMIC INDEX

GLYCEMIC INDEX

in vivo starch digestibility

Processing

Macrosopic

Microscopic

Supramolecular

Structural/ Nutritional: what is known on durum wheat pasta

Pasta structure and nutritional properties: impact of Legume addition and changes in process

Porosity

STRAIN

Compression test

Toa test

Breaking energy (* 10^-3)
Supramolecular structure of cooked pasta

SE-HPLC after protein extraction

Non covalent bonds
Covalent bonds
Other covalent bonds

Legume pasta: non covalent bonds - covalent bonds - weaker protein network

Covalent (others)
Non covalent
Covalent (S-S)

% of total protein content

Durum wheat
35% Split pea

Pasta samples

Rapidly available glucose: RAG value

% Available carbohydrates

In vitro starch digestibility of cooked pasta

Rapidly available glucose: RAG value

Pasta samples

100% Durum wheat
56.8 ± 2.5

100% Split pea
47.2 ± 1.1

No effect of structural modifications made by pasta fortification with 35% of legume flour on the RAG value

No change in the in vitro starch digestibility (RAG)

In vitro Protein digestibility and allergenicity

Degree of Proteine hydrolysis (%)

Pasta samples

No significant difference

In vitro Protein digestibility and allergenicity

Degree of Proteine hydrolysis (%)

Pasta samples

No significant difference

Impact of drying treatments

35% Split pea

Freeze-drying:
LT (55°C) CONTROL
VHT LM (90°C)

Macroscopic structure of dry and cooked pasta

Total porosity (%)

Freeze-drying
LT VHT LM

Rheology

Compression test

Tension test

Microscopic structure of cooked pasta

Starch
Proteins

VHT LM: Strengthened pasta structure

Effet of drying No major impact

In vitro starch digestibility of cooked pasta

Rapidly available glucose: RAG value

Freeze-drying
LT VHT LM

Higher porosity could increase accessibility to amylases

Stronger protein network at a supramolecular level

Degree of Proteine hydrolysis (%)

Freeze-drying
LT VHT LM

No significant difference

Stronger protein network at a supramolecular level

In vitro Protein digestibility of cooked pasta

Degree of Proteine hydrolysis (%)

Freeze-drying
LT VHT LM

No significant difference

Stronger protein network at a supramolecular level

Degree of Proteine hydrolysis (%)

Freeze-drying
LT VHT LM

No significant difference

Stronger protein network at a supramolecular level
**In vitro allergenicity of digestion juices of cooked pasta**

**ELISA inhibition with allergic sera:** presence of IgE-reactive fragments (IgE-RF)

**Freeze-drying:** no significant difference

**VHT.LM** Changes concerned wheat proteins

**γ-gliadins, LTP...**

**Gastric juices**

![Graph showing percentages of inhibition](image)

**Conclusions (1):**

- **COMPOSITION**
  - More fibres
  - Non-gelatinised starch at the core

- **PROCESSES**
  - Freeze-drying:
    - Stronger protein network (Covalent links)
  - VHT.LM:
    - Same RAG value
    - Change DH and IgE-RF

**Process:**

- Freeze-dried LT
- VHT.LM
- Pasta

**Intestinal juices**

![Graph showing percentages of inhibition](image)

**Conclusions (2):**

- **Pasta porosity:** YES
- **Protein network thickness:** No changes
- **Nature & quantity of interactions between proteins:** YES

- **Hypothesis:** A highly aggregated protein network would be more resistant to protein hydrolysis, which could delay hydrolysis of starch by amylases

**Conclusions (3):**

- **Structural elements involved in protein digestibility and allergenicity**
  - Pasta porosity: NO
  - Protein network thickness: No changes
  - Nature & quantity of interactions between proteins: YES

- **A highly aggregated protein network would be more resistant to protein hydrolysis, which could delay hydrolysis, change released fragments and impact their allergenicity response**