A participatory research on NCGS: are bread and pasta produced by farmers and manufacturers different?

Marie-Françoise Samson, Grégori Akermann, Yuna Chiffoleau, Paul Coeurquetin, Dominique Desclaux, Kristel Moinet

A participatory research on NCGS: are bread and pasta produced by farmers and manufacturers different?

Samson, M.F.[1], Akermann, G.[2], Chiffoleau, Y. [2], Cœurquetin, P.[2], Desclaux, D.[3], Moinet, K.[4]

1 IATE, Univ Montpellier, INRAE, L'institut Agro, Montpellier, France
2 Innovation, Univ Montpellier, CIRAD, INRAE, L'Institut Agro, Montpellier, France
3 DiaScope, INRAE, Montpellier, France
4 Biocivam 11, Trèbes, France

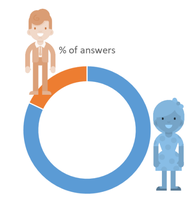
Introduction

The number of people suffering from non coeliac gluten sensitivity (NCGS) has increased over the past forty years. About 10% of French people claim to have troubles when eating wheat products and tend to avoid them. Besides that, some people suffering from NCGS are able to re-eat wheat products when they buy them from farmers or from local markets. An analysis of farmers' practices pointed out common similarities between them. They use "ancient" or local varieties, grown in organic conditions, stone milled and transformed with sourdough for bread and in mild conditions for pasta. Based on this information, we designed a project ("*Gluten : mythe ou réalité ?*") built on different approaches (sociological and technical), conducted in a participatory mode, to understand which differences exist between farmers' and manufacturers' practices can be linked to NCGS.

A participatory research project: key figures

15 farmers, producers, trainers, facilitators
10 researchers from several sectors (genetic, agronomy, food science, biochemistry, microbiology, sociology)
17 sessions for producing samples: flours, bread and pasta (13 with craftsmen and 4 in a research unit)
8,500 kg of wheat harvested in experimental fields
235 bread samples produced and analysed
62 pasta samples produced and analysed
25 sourdoughs collected in bakeries and characterised
503 hypersensitive people who answered a survey
38 hypersensitive people who participated in an interview
13,000 raw data from laboratory analyses
Many meetings

Who are people suffering from NCGS in France?



Survey	Individual interviews
Sent: 503 Answers: 324 Gluten sensitive: 285	n=38 11 auto diagnosis 26 diagnosed by health system
82% women	
26–55 years (75%) Urban Higher education	13/38 strictly avoid cereal products
Median duration before diagnosis: 3 years 2.3 doctors seen	26/38 tried farmers' products 18/38 regularly eat farmers' products
68% avoid gluten consumption without any diagnosis	

Methodology to compare farmers' and manufacturers' cereal products

Bread and pasta were first obtained at farm, in bakeries and supermarkets, and compared on the basis of their gluten protein solubility and *in vitro* protein digestibility. Protein were recovered from freeze-dried and ground bread crumb and from cooked pasta after sequential extraction (first with phosphate buffer containing SDS, then with the same buffer containing a S-S bond reducer -DTE-), and quantified by Size-Exclusion Chromatography. Three types of protein fractions were retained: protein easily soluble in SDS-phosphate buffer, protein not very easily soluble in the buffer and needed DTE to be extracted and finally protein not extracted (by comparison with the total protein content of the freeze-dried product). *In vitro* protein digestibility was measured with chemicals enclosed in Megazyme test kit PDCAAS and proteolysis rate was assessed on the basis of protein remaining in the solid residue after incubation with enzymes.

In a second approach, bread and pasta made in controlled conditions varying in terms of variety (modern *vs* landrace), milling process (stone milling *vs* roller milling) and 2nd transformation type (craft system *vs* industrial system) were compared.

Results

Bread crumb

Fig 1: extractability of proteins in different solvents and *in vitro* proteolysis rate for farmers' and industrial bread

Cooked pasta

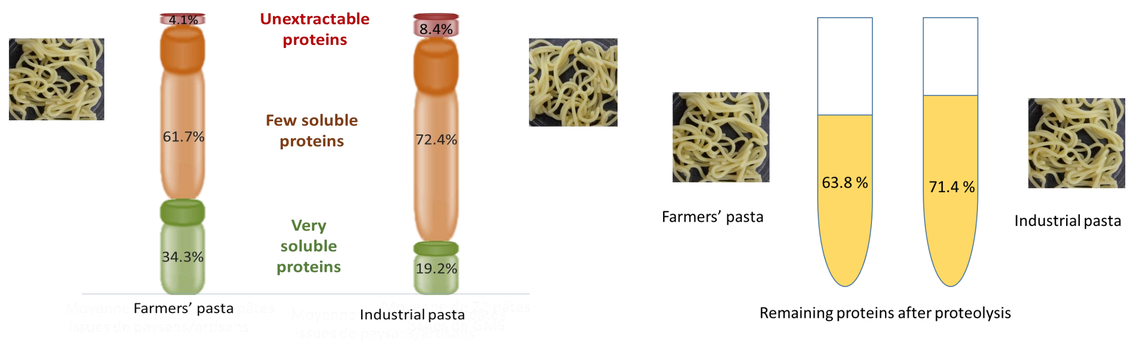


Fig 2: extractability of proteins in different solvents and *in vitro* proteolysis rate for farmers' and industrial pasta

Why important differences between production modes?
Which is responsible: the variety, the 1st transformation, the 2nd transformation?
Elements of answer for bread

- **2 distinct varieties**: Renan (recommended by industry); Barbu (used by farmers)
- **2 milling systems**: Roller milling (Bülher MLU 202); Stone milling (Astrié mill)
- **2 leavening agents**: Sourdough; Commercial baker's yeast
- **2 kneading types**: Manual; Mecanical (spiral mixer)
- **2 fermentation methods**: Direct; Cold proof
- **2 oven baking types**: Electric oven; Wood oven

An experiment with different factors
64 modalities tested

Breadmaking performed by

Les Compagnons du Devoir et du Tour de France

Breadmaking performed by a farmer

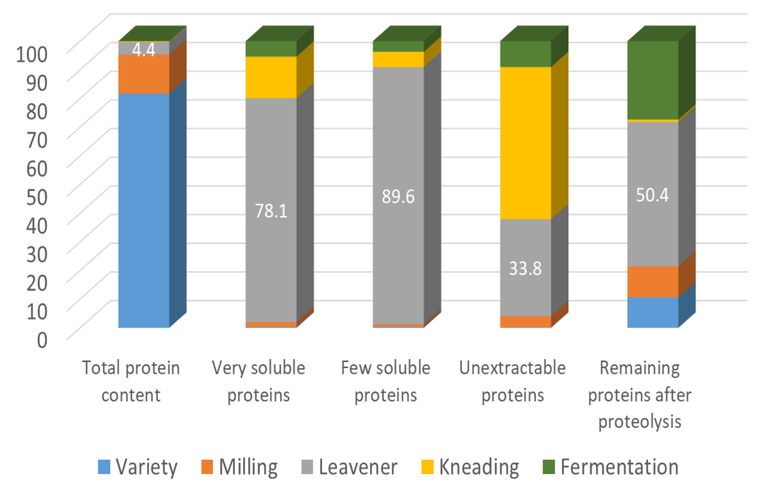


Fig 3: influence of different factors on protein content, on protein extractability in different solvents and on *in vitro* proteolysis rate for bread

Great impact of leavener on protein solubility. More protein easily soluble with sourdough

More protein remaining after proteolysis with roller milling, commercial yeast, manual kneading, short fermentation and electric oven baking

Conclusion

Trends have been found and farmers' products appear different from industrial products: more easily extractable proteins, and less proteins remaining after proteolysis. Similar trends were found for protein solubility with craft bread and pasta made with einkorn flours but surprisingly, einkorn products exhibited a higher content of proteins remaining after proteolysis (*ActivaBlé* project 2019-2022). From that, new studies are necessary to go further and to assess einkorn behavior (varieties, composition, transformation processes). This will be done in a new participatory project: DIVINFOOD (2022-2027).

Acknowledgments: the authors want to thank all the participants and partners involved in the projects ("*Gluten : mythe ou réalité ?* " and *ActivaBlé*). A special thank is addressed to S. Marrou, G. Chirat, F. Caizergues, E. Blaque, V. Tourenq, A. Gainon, A. Marcodini, E. Canaguier, A. Boury-Esnault, E. Menguy, L. Mietton, D. Sicard, V. Avit, G. Jard, L. Belahcen and D. Clair for their huge contribution to the projects. The "*Gluten : Mythe ou réalité ?*" project was funded by *Fondation de France, Fondation Edouard et Geneviève Buffard* and *Fondation Daniel et Nina Carasso*, with the support of *Occitanie* region. *ActivaBlé* project was funded by *Occitanie* region.