



OWC 2020 Paper Submission - Science Forum

Topic 2 - Product and process quality in Organic Agriculture: methods and challenges

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THE DIVERSITY OF FOOD PROCESSES IN ORGANIC SHORT CHAINS

THE CASE OF ARTISANAL PASTA

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Abstract: To provide local and healthy food, an increasing number of French farmers make the choice to not only produce cereals but also process them into flour or semolina, then pasta and sell them on farm or through local food networks. Less or no gluten sensitivity have been reported by some consumers of these handmade products. A current participatory project proposes to inventory such initiatives in Occitanie region, to describe their farming systems and to evaluate the quality of pasta. The first results showed that on-farm processing and marketing are mostly the fact of small-scale organic farms growing landraces durum wheat varieties and other orphan Triticum species. Stone-milling is mainly used instead of roller-milling and the pasta process is soft, simpler but longer than the industrial one. The raw materials and the final products were analyzed in order to understand how the process influences the final quality of pasta, particularly the gluten and organoleptic quality.

Introduction: The durum wheat chain in France illustrates the agro-industrial model initially structured around high yielding varieties bred and registered for their adaptation to high input-intensive farming systems and to standardized processes. Three French main companies dominate the semolina and pasta market and impose to breeders and farmers a large number of technological quality criteria (e.g. protein, vitreous grain, specks and yellow index) (Sissons, *et al.*, 2012). They aim to offer homogeneous products in quantity, accessible to all (Rastoin & Ghersi, 2010).

Wishing to break with this locked system and to offer "local" and "healthy" products, some farmers have decided not only to produce cereals but also to process them into semolina or flour and then pasta and sell them on farms or through local food networks (CREAB Midi-Pyrénées, 2013). The term "peasant pasta-maker", that appeared in the early 2000s, as that of "peasant-baker", demonstrates the possible alternatives to meet the growing demand of consumers, mainly in terms of food safety.

The new trend to reduce gluten content encourages a flourishing market around "gluten-free" industrial products. It is also translated into growing consumer interest in artisanal bread and pasta, supposed to have "less gluten".

The Latin term *Gluten*, meaning "Glue", refers to insoluble proteins called gliadins and glutenins in wheat. They are of interest for the agri-food industry conferring to the dough its properties of cohesion, elasticity, tenacity and gas retention capacity. Industrial bakeries often add pure dry gluten to flour to give the dough its "swelling" properties.

Three types of pathologies have been related to gluten ingestion: (1) Celiac disease, an immune-mediated enteropathy, (2) Wheat allergy, an Ig E mediated pathology and (3) Non-Cœeliac Gluten Sensitivity (NCGS) for which no biological markers are available to establish a diagnosis. Only a strict gluten-free diet allows the identification of this pathology.

Cereals have been consumed for about 8500 years and still cover more than 20% of the necessary protein intake (Reynolds, 2010). However, an increasing number of persons are suffering from one of these pathologies, four times more today than 50 years ago (Rubio-Tapia, *et al.*, 2009). Consumers are worried, 3% of French people have already removed gluten from their diet and sales of gluten-free products are exploding (+30 to 50% per year since 2009 (Ziegler, 2016)), even if other motivations, of a more sociological nature, can be found.

A current on-going participatory project proposes to inventory and characterize the on-farm processes, to evaluate the quality of the pasta and to deeper study the motivation of a gluten diet. Both surveys and laboratory analyses were implemented to assess the processes during the main steps from the seeds production until the final product (pasta) (fig.1).

Material and methods:

More than fifty persons (farmers, small-scale processors, pasta-makers...) were interviewed about their production practices and samples of pasta (durum wheat and einkorn pasta) were collected. Among them, twelve (seven durum wheat pasta and five einkorn pasta) were submitted to two organoleptic tests, involving more than hundred artisanal pasta consumers. The first test, Pivot method (Thuillier, *et al.*, 2015) permitted to describe the sensorial attributes of pasta. Data resulted from the tasting of the fifteen panelists were analyzed thanks to Tastel software. Sensorial data were correlated with process parameters collecting from the previous step of diagnosis. The second test allowed establishing a rank of preference using an hedonic method (Stone & Sidel, 2004). The sociological study was conducted using online self-administered survey among 324 gluten-free and -restricted persons.

Results: Diagnosis on grain production

The farms, covered by the survey, are of three types: those producing cereals and selling them to a miller, those producing and milling on farm and selling the flour or semolina, and finally those managing all the steps from grains to pasta production. These farms are of medium to high size from 10 to 125 ha when the region average is about 45 ha of arable lands (UAA) (Chambre d'agriculture d'Occitanie, CERFRANCE d'Occitanie, 2017), they practice organic agriculture (99%) based on crop rotation, including no/low tillage (in a shallow area); with green and animal manure fertilization and mechanical weeding (never chemical). In France in 2017, Occitanie region was the first one for organic cereal production with around 15% of organic producers (Agreste, 2019) (DRAAF, 2020). It is also the major durum wheat production area (FranceAgriMer, 2018), with 10 to 25% of the total regional agricultural area dedicated to this specie. In the same order of magnitude, around 10% of the agricultural area of the farms included in the survey, are dedicated to cereals production. The used varieties are very few those registered in the national catalog but rather those developed by farmers in participatory plant breeding approaches (*LA1823 cultivar*) or some "old varieties" or landraces (*Bidi 17, Senatore Cappelli, Montferrier, Blé Galère*). Their yield ranged from 1 to 2.5 t/ha, whereas the regional wheat yield mean was usually around 5t/ha (FranceAgriMer, 2018). Durum wheat is part of the rotation with about ten other

Triticum species (*Triticum aestivum*, *Triticum monococcum*, *Triticum spelta*, *Triticum turgidum*, *Triticum turanicum* etc.).

The grains storage is done in cells (ventilated or not), and without any treatment.

Diagnosis on milling process

Flour and semolina are produced by using only stone-milling, instead of roller-milling generally used in industrial process. Different mills were used on-farm: Astrié, Tyrol, SAMAP Ecosystem or self-made mills. The average flour/semolina yield is about 50 to 60%, less than the industrial yield around 75 to 80% (Bourson, 2009). The particles sizes range from 470 µm to 1000 µm, whereas industrial semolina is from 250 µm to 500 µm. Purifier and flour reel are often used after the stone-milling process to refine products. Farmers recycle mill by-products (brans) for animal feeding.

Diagnosis on pasta making

Artisanal and industrial processes diagrams were compared (fig.2). The first one is simpler but longer than the second one. Among the artisanal processes, the most important variations mainly concern the hydration level of the raw materials (20 to 30 %wb), the mixing time (from 5 to 30 min), the extrusion pressure (20 to 200 bars), the extrusion rate (10 to 100 kg/h), the extrusion temperature (25 to 70°C, being 40°C the optimal), the mold type (Bronze, Teflon), the drying mode (open-air or ventilated chamber), the drying time (10 to 72 hours), the drying temperature (30 to 80°C), and the final moisture content (10 to 12%).

Product diagnosis: a first sensory description

Thanks to the Pivot method, some descriptors were highlighted to characterize pasta in terms of texture (firm, melting, sticky, crumbly, floury, etc.), then visually (colored, dark, clear) and with taste criteria (egg taste, tasteless, etc.). Based on similarity, a map was created to cluster pasta samples. The descriptors were correlated to the process parameters. For example, the flour used to make pasta depends on mineral content and milling technics and therefore influences the taste and the color of pasta. Data resulted from Hedonic test gave relevant information about consumer's preferences. The nutritional compositions of these products and of their raw materials are under analyzes.

Consumer's diagnosis

In the survey on NCGS, the panel of respondents declared to be "gluten sensitive". The types of symptoms and the proportion of women (86%) are roughly the same as in the international literature (Biesiekierski, *et al.*, 2014) (Aziz, *et al.*, 2014). However, nearly half were self-diagnosed and almost none have followed a gluten diet prescribed by a doctor. Even 80% of sensitives have completely stopped eating gluten, others are wheat consumers and stated they can eat artisanal products without experiencing disorders previously associated with wheat ingestion. These products frequently include pasta and sourdough bread made from semolina or flour issued from local wheat varieties and/or landraces, grown in organic farming, stone-milled and processed without additives.

Discussion:

The process to make pasta is very simple: only semolina/flour and water mixing then extrude. But this first survey among artisanal pasta producers revealed that their know-how are very diverse and differ significantly from those of the industry. The main differences concern the raw material (elite vs landraces), type of mills (roller vs stone), process (fast and hard vs slow and soft).

Perspectives:

Farmers, millers, pasta-makers from industrial, artisanal and peasant sectors, advisors, researchers, physicians, consumers and people suffering from NCGS are currently collaborating in a research project to identify possible genetic, agronomic, technological and sociological determinants of this hypersensitivity.

The final objective of the running project is to produce robust scientific data on cereal-based products made from these processes, to confirm, or nuance empirical judgments. The perspective is to promote quality wheat-based products that do not generate food intolerance and to develop new cereal food supply chains based on a strong reconnection between agriculture and food, environment and health.

If you are NCGS and interested to participate in this participatory research, please send an email to gluten@inra.fr.

References:

- Agreste. (2019). *Mémento de la statistique agricole région Occitanie*. Available on : http://draaf.occitanie.agriculture.gouv.fr/IMG/pdf/memento2019_light_cle01d79d.pdf
- Aziz, I., Lewis, NR., Hadjivassiliou, M., Winfield, SN., Rugg, N., Kelsall, A., Newrick, L., Sanders, DS. (2014). *European Journal of Gastroenterology & Hepatology* 26, 33-39. DOI 10.1097/01.meg.0000435546.87251.f7.
- Biesiekierski, JR., Newnham, ED., Shepherd, SJ., Muir, JG., Gibson, PR. (2014). *Nutrition in Clinical Practice* 29, 504-509. DOI 10.1177/0884533614529163
- Bourson, Y. (2009). *Mouture du blé tendre et techniques d'obtention de la farine*. Ed. Technique Ingénieur.
- Chambre d'agriculture d'Occitanie, CERFRANCE d'Occitanie. (2017). *Agri'scopie*, 6 - 8.
- CREAB Midi-Pyrénées. (2013). *Résultats de l'essai Variétés de blé pour une utilisation en pâtes alimentaires Campagne 2012-2013*. Available on : <https://www.creabio.org/sites/default/files/vari%C3%A9t%C3%A9s%20p%C3%A2tes%20alim%202013.pdf>
- DRAAF, Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Occitanie. (2020, Février). *Agriculture Biologique*. Available on : <http://draaf.occitanie.agriculture.gouv.fr/Agriculture-Biologique.36>
- FranceAgriMer. (2018). *Céréales Chiffres-clés 2016/17 Occitanie*. Available on : <https://www.franceagrimer.fr/filiere-grandes-cultures/Cultures-textiles/Publications?page=2>
- Rastoin, JL., Ghersi, G. (2010). *Le système alimentaire mondial : Concepts et méthodes, analyses et dynamiques*. Quæ.
- Reynolds, MP., ed. (2010). *Climate change and crop production* 1. CABI.
- Rubio-Tapia, A., Kyle, RA., Kaplan, EL., Johnson, DR., Page, W., Erdtmann, F., Brantner, TL., Kim, WR., Phelps, TK., Lahr, BD., Zinsmeister, AR., Melton, LJ., Murray, JA. (2009). Increased Prevalence and Mortality in Undiagnosed Celiac Disease. *Gastroenterology* 137, 88-93. DOI 10.1053/j.gastro.2009.03.059
- Sissons, M., Abecassis, J., Marchylo, B., Cubadda, R. (2012). Methods Used to Assess and Predict Quality of Durum Wheat, Semolina, and Pasta. In : M. Sissons, J. Abecassis, B. Marchylo, C. Marina. *Durum Wheat Chemistry and Technology*. éd. 2e. Minnesota : AACCI International, 470-518.
- Stone, H., Sidel, JL. (2004). *Sensory Evaluation Practices 3rd ed*. Food Science and Technology.
- Thuillier, B., Valentin, D., Marchal, R., Dacremont, C. (2015). Pivot profile: A new descriptive method based on free description. *Food Quality and Preference* 42, 66-77. DOI 10.1016/j.foodqual.2015.01.012
- Ziegler, M., (2016). Le sans-gluten poursuit son envolée. LSA. Available on : <https://www.lsa-conso.fr/le-sans-gluten-poursuit-son-envolee.228987>

Figure n°1 :

Diagnosis Phases

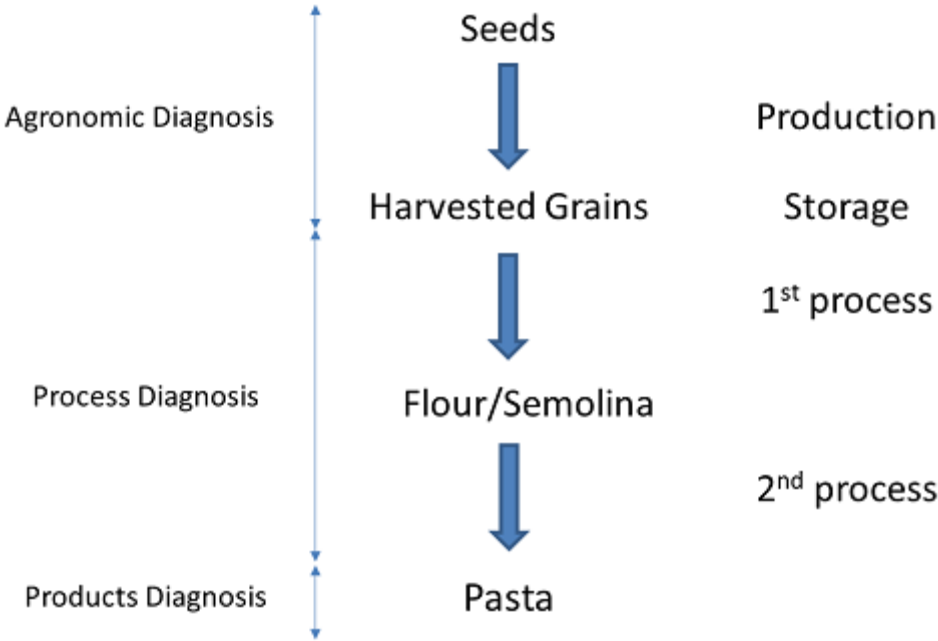
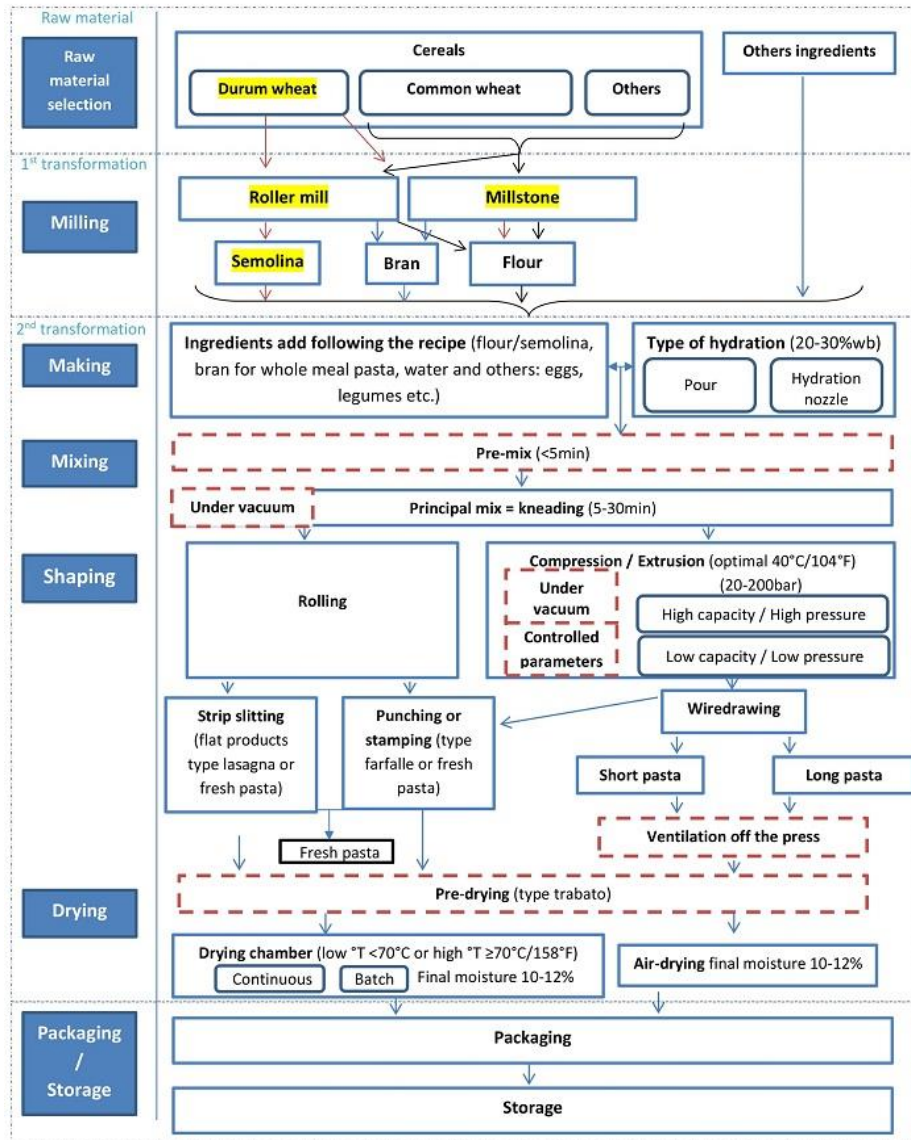


Figure n°2 :

Production process of pasta



Legend

- Main step
- Optional step
- Final product
- Process choice

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Disclosure of Interest: None Declared