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# Pasta and Gluten: Facts and Fakes

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*This presentation was prepared at the initiative of the French Pasta Manufacturers Association (SIFPAF) but the content of this presentation is on the sole responsibility of the authors*



# How Traditional Pasta are made ?

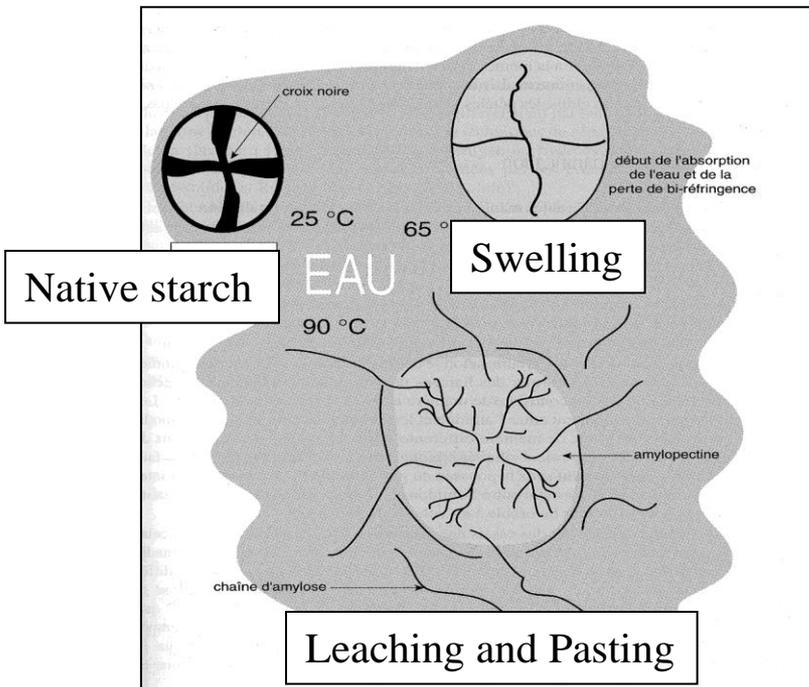
- Only one raw material: Durum wheat
- Primary processing : Extraction of the starchy endosperm in form of semolina
- Pasta processing :
  - Hydration
  - Mixing
  - Forming: sheeting or cold extrusion ( $< 55^{\circ}\text{C}$ )
  - Drying
- Sensorial attributes
  - Yellow color
  - High capacity to hold water during cooking with low amount of solid losses
  - Texture : firm and elastic
  - Surface condition : no stickiness, no disintegration



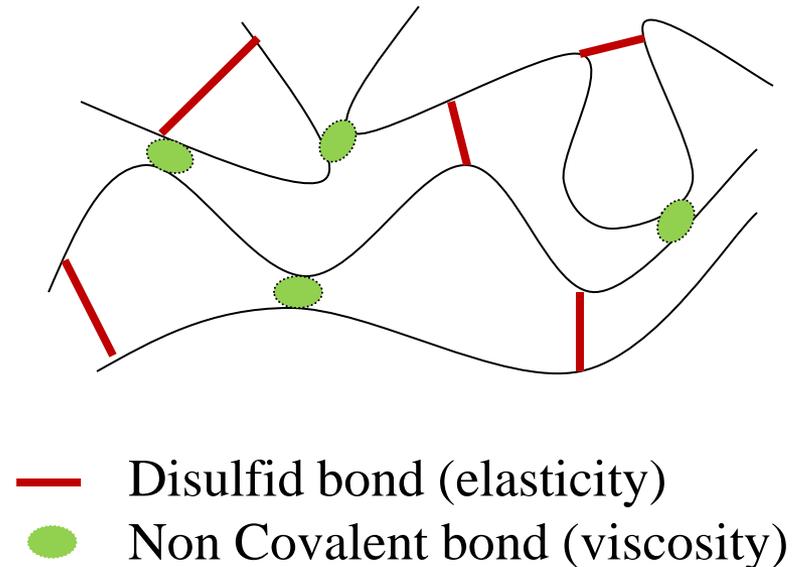
# Physicochemical Basis of Pasta Quality

Pasta processing consists in developing a protein network able to entrap starch granules during cooking

- **Starch Swelling and Gelatinisation**



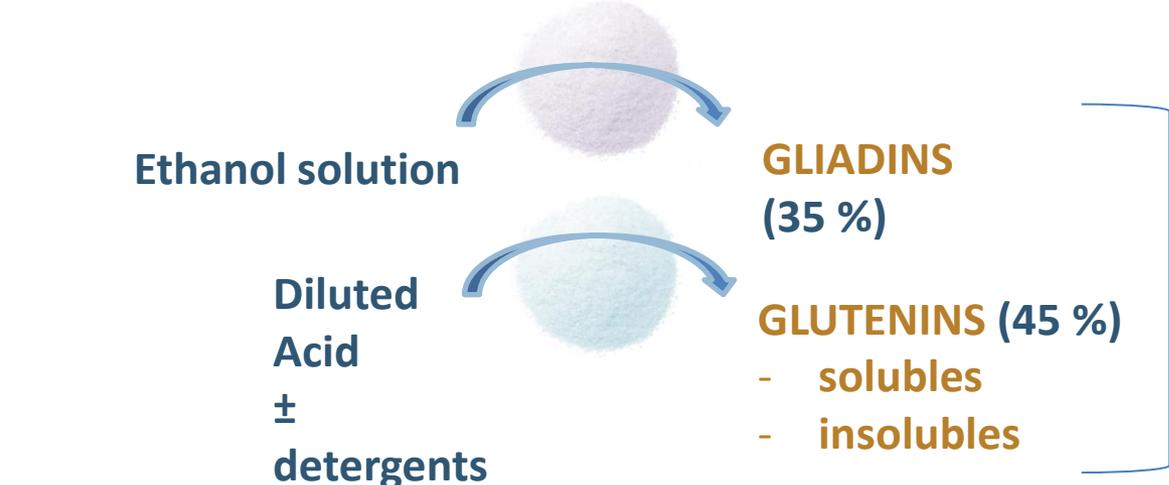
- **Protein Network forming and denaturation**



# Proteins and Gluten



Cytoplasmic or metabolic proteins



*Viscosity*

**GLUTEN**

*Elasticity*

*QUALITY*

# Gluten (wheat) Related Pathogenesis

## Autoimmunes

Coeliac disease

Dermatitis herpetiformis

Gluten ataxia

- Genetic background: HLA DQ2 and DQ8
- Atrophy of duodenal villi
- Anti-transglutaminase 2 Ac
- Anti-class A endomysium Ac
- Anti deamidated gliadin IgG

Dermatological form

Neurological form

## Allergic

Wheat allergy

- Mediated by anti- $\omega$  gliadin IgE
- Respiratory symptoms (baker asthma)
  - Induced by physical effort
  - Skin and digestive symptoms

Non autoimmune  
Non allergic

non coeliac gluten sensitivity NCGS

- Gluten intolerance (?) with :
- No serological markers
  - No IgE
  - No atrophy of intestinal mucosis

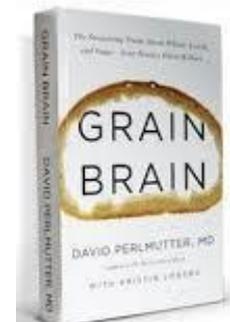
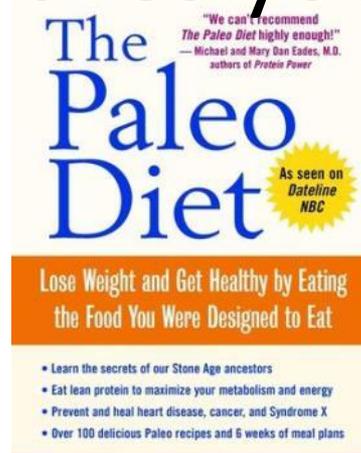
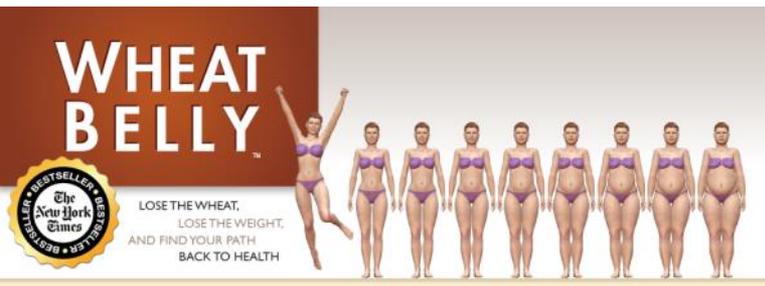
1. Abdominal pains (68 %)
2. Epigastric burns (15 %)
3. Nausea and vomiting (15 %)
4. Borborygmus (10 %)
5. Bloating, flatulences (25 %)
6. Constipation (20 %)
7. Diarrohea (33 %)
8. Eczema /erythema(40 %)
9. Headache (35 %)
10. Disturbance in attention(34 %)
11. Chronic tiredness (35 %)
12. Neuromuscular troubles
13. Comportemental troubles

**Prevalence: 0.7-1.5%**

**< 1%**

**6-8%**

# Global Social Media Hype : Eating wheat makes you fat and sick



**GRAIN  
BRAIN**  
*The Surprising Truth About  
Wheat, Carbs, and Sugar - Your  
Brain's Silent Killers*



**Gluten-Free is healthy !**

# How to Prepare Gluten Free Pasta ?

- Gluten Free pasta should have the same sensorial attributes as traditional pasta :
  - Color
  - Cooking Quality
- Mixing different raw material: Flour and/or starch products without gluten content
- Adding or not additives for color
- Adapting pasta processing
  - Modifying starch properties
  - Additives for cooking quality

# How to Replace Gluten Functionality ?

Modifying the starch components in order to :

1. Create a new organised structure to give a form to pasta during extrusion (binding properties)
  - Heat-treated flours and starches
  - Extrusion cooking
2. Limit starch swelling and solubilisation during cooking
  - High-amylose content (starch)
  - Additives to complex amylose : Emulsifiers (mono and diglycerides)
  - Other texturing ingredients : hydrocolloids (guar, Xanthan, CMC, etc.)

# Commercial GF Pasta Ingredients

Starch sources	Protein sources	Additives
Rice (flours and starches)	Protein isolates from pea or lupin	Hydrocolloids and gums <ul style="list-style-type: none"><li>• Xanthan</li><li>• Guar</li><li>• ...</li></ul>
Corn (flours and starches)		
Pseudocereals : (flours) <ul style="list-style-type: none"><li>• Buckwheat,</li><li>• Quinoa</li><li>• ...</li></ul>	Egg	Emulsifiers <ul style="list-style-type: none"><li>• Mono-glycerides</li><li>• Di-glycerides</li></ul>
Potato and tubers (starch)	Whey	Inulin
	Legume (flour)	Aroma, cane sugar syrup, salt

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## Sources:

*Mariotti et al. (2011) J. Cereal Sci.53: 319-327*

*Marti and Pagani (2013) Trends Food Sci. Technol. 31: 63-71*

*web sites of different French supermarkets and health food stores*

# Some Examples of GF Pasta



Rice pasta



Lentil Pasta



Durum Pasta



Buckwheat Pasta



Quinoa Pasta

# Macronutrients of Traditional and GF Pasta

Pasta	Protein (%)	Total Carbohydrates (%)	Total Lipids (%)	Fiber (%)
GF pasta	11.2	80.8	5.5	2.4
Durum pasta	13.8	78.4	2.6	5.3

Sources: Miranda et al. (2014) *Plant Foods Hum. Nutr.* 69: 182–187  
Means based on 15 GF products and 38 non GF pasta

# Micronutrients of Traditional and GF Pasta

## Minerals

Products	Minerals (mg/100 g)						
	Ca	Fe	Mg	P	K	Na	Zn
GF pasta	19	1.46	77	224	197	326	1.44
Durum pasta	25	2.46	90	266	328	6	2.19

Source: <http://ndb.nal.usda.gov/ndb/foods>

# Micronutrients of Traditional and GF Pasta

## Vitamins

Products	Vitamins (mg/100 g)					Folate (µg/100 g)
	Thiamin	Riboflavin	Niacin	B6	E	
GF pasta	0.25	0.08	1.99	0.16	0.11	30
Durum pasta	0.25	0.14	5.19	0.21	0.28	43

Source: <http://ndb.nal.usda.gov/ndb/foods>

# Sensorial Properties of GF Pasta

Composition	Colour		Cooking Quality		
	Brightness	Yellowness	Losses	Firmness	Stickiness
Rice Flour	↗	↘↘	↗↗	→	↗↗↗
Yellow Corn Flour	↘	↗	↗↗	→	↗
Corn Starch	↘	→	↗↗	→	↗↗
Rice + Corn flours + additives	→	→	↗↗	→	↗

Sources: Mariotti et al. (2011) *J. Cereal. Sci.* 53: 319-327 and Lucisano et al. (2012) *J. Cereal. Sci.* 56: 667-675

# Glycemic Index of Traditional and GF Pasta

Pasta content	GI	Sources
Durum wheat	48	Foster-Powell et al. (2002) Am. J. Clin. Nutr. 76:5-56.
Whole wheat	46	
Corn	64	- Bacchetti et al. (2014) Food Funct. 5:3014-3017
Rice	79	- Berti et al. Eur J Nutr (2004) 43 : 198–204
Rice and corn	76	- Foster-Powell et al. (2002) Am. J. Clin. Nutr. 76:5-56.
Corn/rice/other ingredients (pea, millet, protein isolates...)	55	- Packer et al. (2000) Diabet. Med. 17:657-660

# Price Differential between GF and Traditional Pasta

Country	Year	Price differential	Sources
Australia	2000-2009	x 4.9	Lambert and Ficken (2015) Nutr. Diet. DOI: 10.1111/1747-0080.12171
UK	2005-2010	x 2.7	Singh and Whelan (2011) J. Hum. Nutr. Diet. 24: 479–486
USA	2000-2005	x 2.2	Lee et al. (2007) J. Hum. Nutr. Diet. 20: 423–430
France	2015	x 5.0	prices recorded on web sites of different French supermarkets and health food shops (based on 36 durum wheat pasta formats and 36 GF equivalent products + 1 pasta made with legumes)

# Conclusions

1. Durum wheat remains the most suited raw material to reach pasta quality attributes expected by consumer with a very high reliability.
2. GF pasta can be elaborated from a large diversity of raw materials. It results as a “non well-defined” product exhibiting large variability.
3. Except celiac patients and other gluten proven pathologies, eviction of gluten in pasta is not justified neither for sensorial properties nor for nutritional aspects.
4. For non-celiac sensitivity, not only gluten has to be considered but other hypothesese should be explored (fodmaps, ATI, etc). It is suggested to organise a vast study through an international consortium.
5. In a longer term vision, pasta stakeholders should be able to separate trends from fads with the aim not to demonize traditional pasta which is a pillar of the Mediterranean diet.