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## Legume-enriched Pasta

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Montpellier SupAgro INRA ASSISTANCE PUBLIQUE HÔPITALX DE PARIS NECKER-ENFANTS MALADES PANZANI

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

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### Interest of Mixing Durum Wheat and Legume in pasta

Inspired by The Mediterranean diet and its health benefits

Wheat & Legume Well represented  
But  
Legume consumption decreased

Nutritional complementarities

Legumes: **Fibres + Proteins ++ Rich in Lysine Poor in sulphur Aa**

Wheat: **Fibres Proteins Poor in Lysine Rich in sulphur Aa**

STRUCTURE: Starch digestibility Protein digestibility and allergenicity

### Durum wheat pasta structure

Macroscopic: Durum wheat + water

Microscopic: Gluten network, Starch granules + fibres (3%)

Supramolecular: Gluten (~13%), Starch (~75%), Gliadins + Glutenins, Amylopectin + Amylose, S-S bonds

### Structure/ Nutrition: what is known on durum wheat pasta

Durum wheat pasta: a low glycaemic index (GI) food

Cereal products	GI
Glucose	100
95	
65	
53	

*Foster-Powell, 2002*

GI =  $\frac{\text{Area A (tested food)}}{\text{Area B (bread or glucose)}} \times 100$

Glycemia (g/L) vs Time (h)

Main hypothesis

- Pasta compactness (Fardet et al., 1998; Granfeldt et al., 1991)
- Encapsulation of starch by proteins (Colonna et al., 1990; Fardet et al., 1998)
- Physical structure of starch (Akerberg, 1998; Englyst et al., 1992; Holm et al., 1988)

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

COMPOSITION: 100% Durum wheat (CONTROL), 35% Split pea, LT-dried

STRUCTURE: Porosity, Protein network, Microscopic, Supramolecular

PROCESSING: Freeze-drying, LT (55°C) (CONTROL), VHTLM (90°C)

Starch and Protein Digestibilities, Allergenicity

### Methodology

PASTA STRUCTURE: Macroscopic (Porosity, Rheology), Microscopic (Starch, Proteins, Fibres), Supramolecular (Protein interactions)

GLYCEMIC INDEX: *in vitro* starch digestibility, Englyst et al., 1996,  $r = 0.76$ , RAG (% available carbohydrates)

PROTEIN HYDROLYSIS: Gastric: 30 min pepsin, pH2; Intestinal = Gastric + 3h pancreatine, pH7

ALLERGENICITY: Presence of IgE-Reactive Fragments in digestion juices: inhibition ELISA, pools of sera from allergic patients to wheat or to pea

### Impact of legume flour addition

100% Durum wheat pasta (control) DW } LT drying  
35% Split pea pasta SP }

Pasta composition

Pasta	Proteins (% db)	Starch (% db)	Fibres (% db)	
			Insolubles	Solubles
100% Durum wheat	13.3	77.6	2.4	0.7
35% Split pea	16.1	67.0	6.2	0.8

35% legume fortified pasta: higher protein and fibre contents

### Macroscopic structure of dry and cooked pasta

- Porosity (Hg porosimeter):

	Total porosity (%)
100% Durum wheat	5.9
35% Split pea	5.6

No effect

- Rheology (TAXTplus):

Compression test: TPA Hardness (Nmm<sup>-1</sup>)

	TPA Hardness (Nmm <sup>-1</sup> )
100% DW	~0.04
35% SP	~0.055

Tension test: Breaking energy (c 10<sup>6</sup>) (Jm<sup>-2</sup>)

	Breaking energy (c 10 <sup>6</sup> ) (Jm <sup>-2</sup> )
100% DW	~4
35% SP	~1

Legume effect: higher hardness and lower breaking energy

### Microscopic structure of cooked pasta

100% Durum wheat: Starch (Polarised light), Fibres (Fluorescence), Proteins (CLSM + image analysis)

35% Split pea: Protein, Starch

Legume fortified pasta: Some partially gelatinised starch granules, Increase in fibre content, No major impact



