Legume-enriched Pasta
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Interest of Mixing Durum Wheat and Legume in pasta

Inspired by The Mediterranean diet and its health benefits

Macroscopic structure of dry and cooked pasta

Microscopic structure of cooked pasta

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

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

Methodology

Main hypothesis:

- Pasta compactness (Foulad et al., 2008; Grauch et al., 1998)
- Enzymatic production of starch/biopolymers (Gallina et al., 2008; Foulad et al., 2008)
- Physical structure of starch (Chenier, 2000; Englyst et al., 1992; M. H. Morel et al., 1990)

Impact of legume flour addition

100% Durum wheat pasta (control) D9
35% Split pea pasta

Pasta composition

<table>
<thead>
<tr>
<th>Protein</th>
<th>Starch</th>
<th>Fibres (% db)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.3</td>
<td>77.6</td>
<td>2.4</td>
</tr>
<tr>
<td>16.1</td>
<td>47.9</td>
<td>6.2</td>
</tr>
</tbody>
</table>

35% legume fortified pasta: higher protein and fibre contents

Macroscopic structure of dry and cooked pasta

Microscopic structure of cooked pasta

Durum wheat pasta structure

Structure/Nutrition: what is known on durum wheat pasta

Pasta composition

<table>
<thead>
<tr>
<th>Protein</th>
<th>Starch</th>
<th>Fibres (% db)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>70</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>50</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Glucose (~15%)

Amylose

Amylopectin

S-S bonds

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

Glycemic Index

Different test conditions include

- Inglyst et al., 1996
- Foster-Powell, 2002

Structure/ Nutrition: what is known on durum wheat pasta

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Rheology

RAG

Allergenicity

Presence of wheat (bio-enzymes fragments in digestion phase) additively, ILA, sera of mice from allergic patients to wheat or pea
Supramolecular structure of cooked pasta

Impact of drying treatments

In vitro starch digestibility of cooked pasta

Macromolecular structure of dry and cooked pasta

Microscopic structure of cooked pasta

Supramolecular structure of cooked pasta

In vitro starch digestibility of cooked pasta

In vitro Protein digestibility and allergenicity

Degree of Protein hydrolysis (% of the total released fragments)
**Conclusions (1)**

- **COMPOSITION**
  - Freeze-drying: no significant difference
  - VHT.LM: Changes concerned wheat proteins
  - Presence of IgE-RF from some wheat proteins (γ gliadins, LTP…)

- **PROCESSING**
  - Freeze-drying:
    - More fibres
    - Non-gelatinised starch at the core
  - VHT.LM:
    - Stronger protein network (Covalent links)
    - No effect

**Conclusions (2)**

- **Structural elements involved in starch digestibility**
  - 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**