Effect of High Pressure on pea protein digestibility

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Abstract

In the context of increasing global interest in plant-based diets, pea protein represents a promising alternative to animal protein due to its relatively high protein content and balanced amino acid profile (Amat, 2023). While plant proteins are often limited in essential amino acids, peas can provide a complete amino acid profile especially when combined with cereals. However, their digestibility remains a key limitation. This study examines the nutritional potential and digestibility of pea protein, with a particular focus on the effects of High Pressure (HP) processing.

To carry out the experiment, pea protein powder (85% protein) and fresh green pea (5% protein) were used. Samples of pea protein powder suspensions were introduced in PA/PE bags and underwent a vacuumization. Then, they were treated by High Pressure (15°C, 5 min, 200 MPa, 400 MPa or 600 MPa). Protein digestibility was assessed as described by Gatellier & Santé-Lhoutellier (2009). Analysis of proteins and peptides was conducted using SDS-PAGE electrophoresis in denaturing conditions according to Laemmli (1970). Determination of total amino-acids in samples was performed according to Guyon (2018).

Above all, the *in vitro* digestibility of pea protein powder and green peas using pepsin digestion are compared. Results show that green peas are digested more rapidly in the early stages, whereas pea protein powder is initially less accessible to enzymatic action. However, over time, pea protein powder reaches a higher overall digestibility, suggesting structural differences that influence enzyme accessibility. Despite this, both forms exhibit relatively low digestibility compared to theoretical expectations, highlighting the need for improvement strategies.

High Pressure processing is investigated as a method to enhance digestibility. This non-thermal technology, commonly used in the food industry, can modify protein structure without significantly affecting other nutrients. The results demonstrate that HP treatment significantly improves pea protein digestibility. At pressure between 200 and 400 MPa, digestibility increases moderately, while at 600 MPa, a substantial improvement is observed, with more than half of the protein being digested. This effect is attributed to partial protein denaturation, which exposes new enzymatic cleavage sites and facilitates peptide release.

Electrophoresis analysis reveals that HP treatment does not destroy protein fractions but likely alters their conformation. After digestion, new low-molecular-weight peptides appear, especially at higher pressure, confirming enhanced enzymatic activity and protein breakdown. These findings support the hypothesis that HP improves enzyme accessibility rather than changing protein composition.

Amino acid analysis shows that pea protein is rich in key amino acids such as glutamic acid, lysine, leucine, and aspartic acid. Importantly, HP treatment does not alter the overall amino acid profile of undigested samples. However, after digestion, higher pressure increase the release of certain essential amino acids, particularly lysine and valine. This suggests that HP processing enhances not only digestibility but also the nutritional availability of important amino acids.

In conclusion, pea protein is a valuable plant-based protein source with a favorable amino acid composition but limited digestibility. High Pressure processing significantly improves its digestibility and promotes the release of nutritionally beneficial peptides and amino acids. These findings highlight the potential of HP technology to enhance the nutritional quality of plant proteins and support their use as sustainable alternatives to animal protein.

References:
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