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The in-vitro digestibility of plant- vs milk-based powder protein supplements

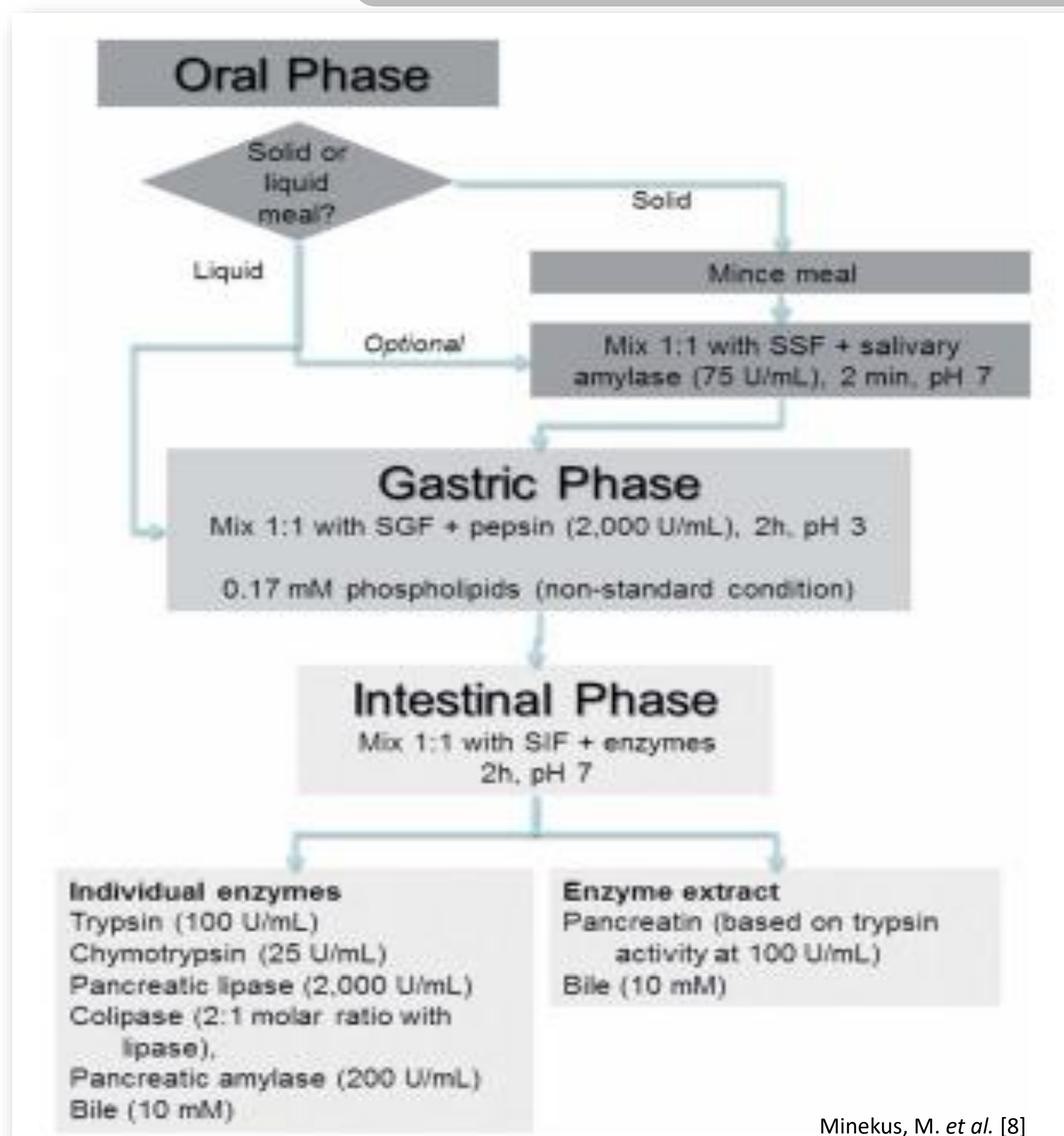
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INTRODUCTION

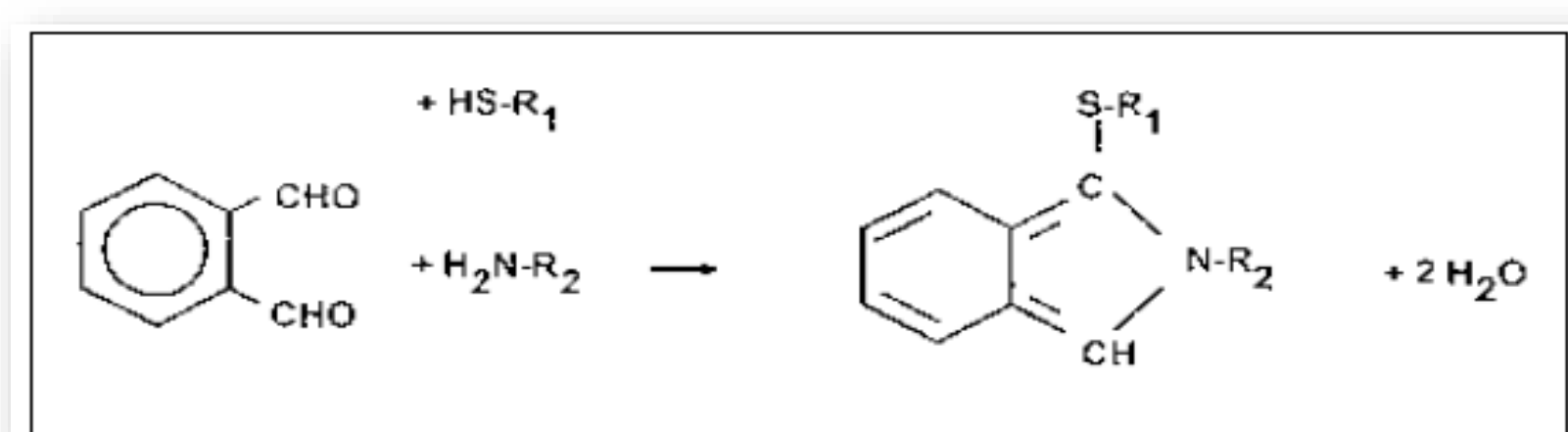
- Proteins are nitrogen-containing substances that are composed of amino acids. Proteins serve as the major structural component of muscle, tissues, hormones and enzymes in the body.
- Fecal digestibility is used to determine protein digestibility, it is the difference between nitrogen ingested and excreted in the feces in an animal model (rat)[1,2].
- The fecal digestibility of whey protein has been documented as 99 %.[3], for soy protein 95 % [4], for hemp protein between 84.1-86.2 % [5], while of rice 87% [6]
In vitro trials suggest a digestibility of 67% for pumpkin protein[7]
- Based on the fecal digestibility, there is a significant difference between the digestibility of plant-based proteins compared to milk-based protein.
- It is not clear whether this difference remains when comparing commercially manufactured protein sources (powder form).
- This study aims to examine and compare the digestibility difference between plant- and milk-based protein supplements; whey, hemp, pumpkin, and rice. The study hypothesis is that plant-based powder protein supplements (hemp, pumpkin, soy and rice) will have a lower digestibility compared to powder milk-based protein supplements (whey).

METHODS



- Commercial protein powder supplements were purchased from local grocery stores.
- Digestibility of protein powder supplements was determined by the in-vitro simulated gastrointestinal digestion method according to standardized method[8].
- This in-vitro digestion attempts to mimic the physiological conditions of human digestion during the oral phase, gastric phase and intestinal phase of digestion.
- The SDS-PAGE is a method separating proteins by electrophoresis. The displacement of the different proteins indicates the peptides' chain length.

- The percentage of degree of hydrolysis (DH) is the percentage of peptide bonds hydrolysed in each protein sample. This value gives an indication of the proportion of cleaved peptide bonds in a protein hydrolysate, thus an indication of the protein digestibility.
- The digesta was analysed at each stage of the digestion (oral, gastric and intestinal) using the O-phthalaldehyde OPA assay to determine the degree of hydrolysis.
- The O-phthalaldehyde OPA assay was performed according to the method of Nielsen P [9].



- The data was statistically analysed using IBM SPSS V.24

RESULTS

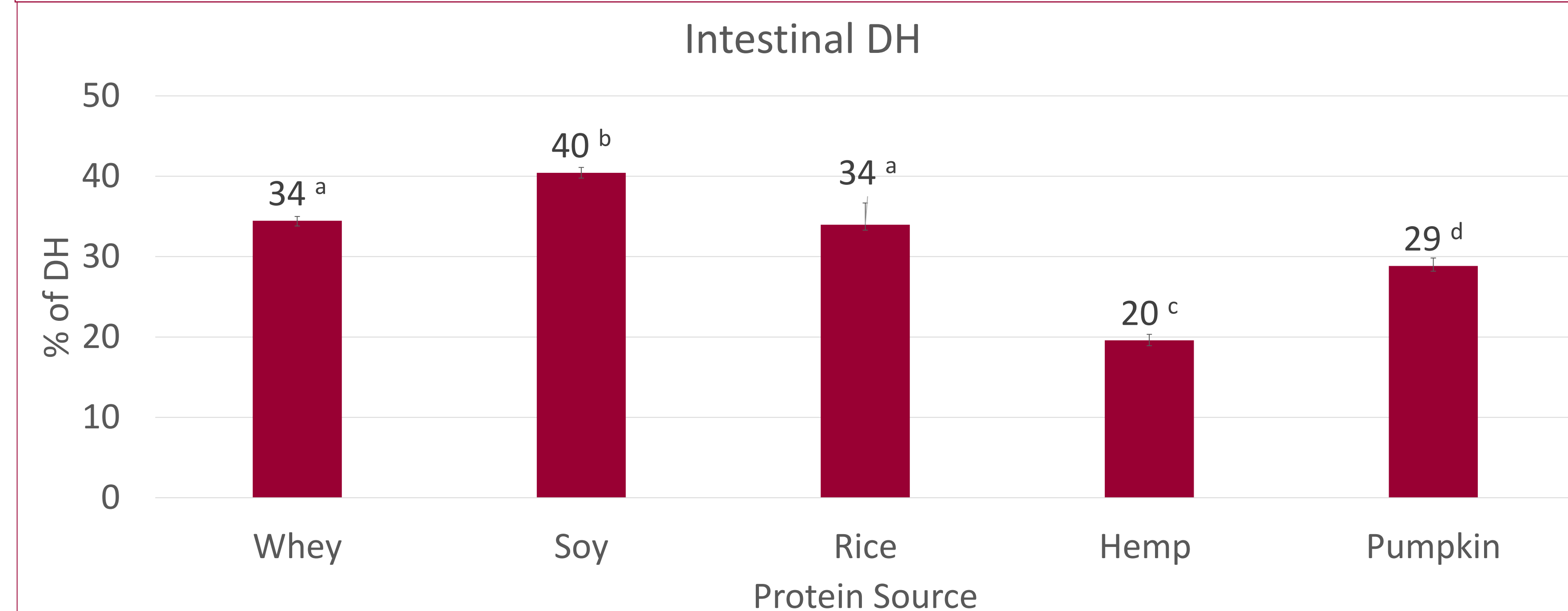
Figure 1. The SDS-PAGE gel of digested whey protein.

The SDS-PAGE gel showing the separation of proteins of varying peptide length at each stage of the in-vitro digestion of whey protein. The gel shows fading in the spots representing alpha and beta lactalbumins.



- Reference protein
- Native protein
- Oral phase of whey protein
- Gastric phase of whey protein
- Intestinal phase of whey protein

Figure 2. Intestinal degree of hydrolysis (%) of the various protein powder supplements.



Values are mean with standard deviation. There is a significant overall difference (p<0.001) among groups by ANOVA. Values with different letters are significantly different by post-hoc Tukey HSD test (p<0.001).

Conclusion

- The in-vitro digestion process was effective in hydrolysing whey protein as demonstrated by the SDS-PAGE.
- Contrary to the hypothesis, soy protein appears to have the highest %DH followed by whey protein and rice protein in second place, pumpkin in third place and finally hemp protein with the lowest %DH.
- Further study is needed to replicate these findings with a larger number of commercially available supplements and also to verify the effect of manufacturing processes on protein digestibility.

Acknowledgment

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