

Dietary protein degradation: protein hydrolysis kinetics in the stomach and small intestine of pigs using a two-step in vitro method

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1. Background

Recent studies have pointed out that the kinetics of protein hydrolysis along the gastrointestinal tract of pigs is important for the quantitative absorption of amino acids in time and their subsequent utilization in post-absorptive metabolism and for body protein deposition.

3. Material and Methods

Soybean meal (SBM), wheat gluten (WG) and rapeseed meal (RSM) were incubated with a modified procedure of Boisen and Fernández (1997) (Fig 1.). The nitrogen digestibility (%) was calculated as the amount of nitrogen in soluble fraction (SF) divided by the amount of nitrogen in the original sample. The molecular weight distribution of peptides in the soluble fraction (SF) was analysed using size-exclusion chromatography.

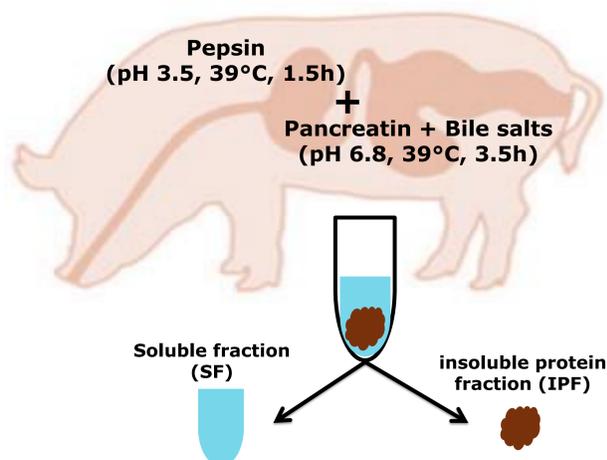


Figure 1. Simulation of enzymatic (pepsin+ pancreatin+ bile salts) digestion in the stomach and the small intestine. The samples after enzymatic digestion were fractionated into an insoluble protein fraction (IPF) and a soluble fraction (SF).

2. Objective

To evaluate the *in vitro* protein hydrolysis kinetics of three protein-containing feed ingredients in the stomach and small intestine of pigs using a two-step method.

4. Result

- At the end of gastric incubation, WG had a higher crude protein digestibility (82%) compared to SBM and RSM (22% and 35%) (Fig 2.).
- At the end of the incubation with pancreatin, WG and SBM had a higher crude protein digestibility (98% and 93%) compared to RSM (80%) (Fig 2.).
- Proteins were hydrolysed into peptides with small molecular weight (<1 KDa) mainly during the incubation with pancreatin (Fig 3.).

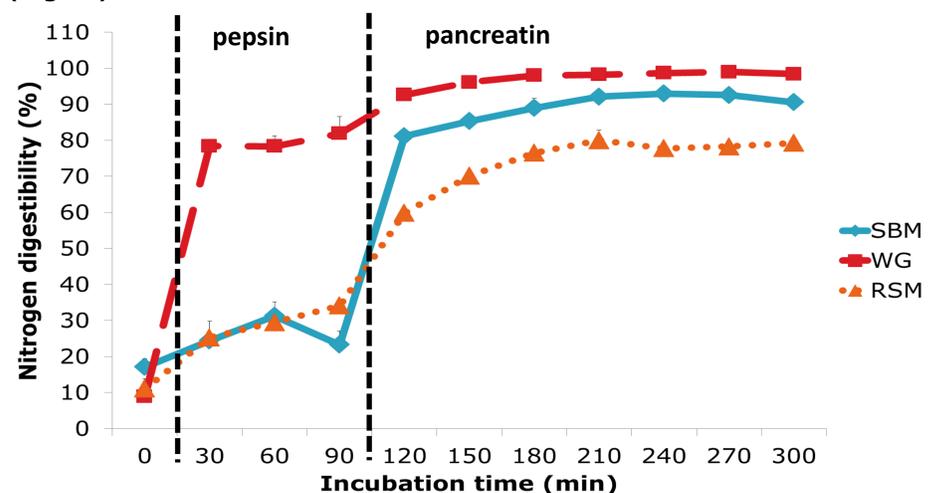


Figure 2. The nitrogen solubility (0 min) and digestibility (30-300 min) of soybean meal (SBM), wheat gluten (WG) and rapeseed meal (RSM) at different incubation time points.

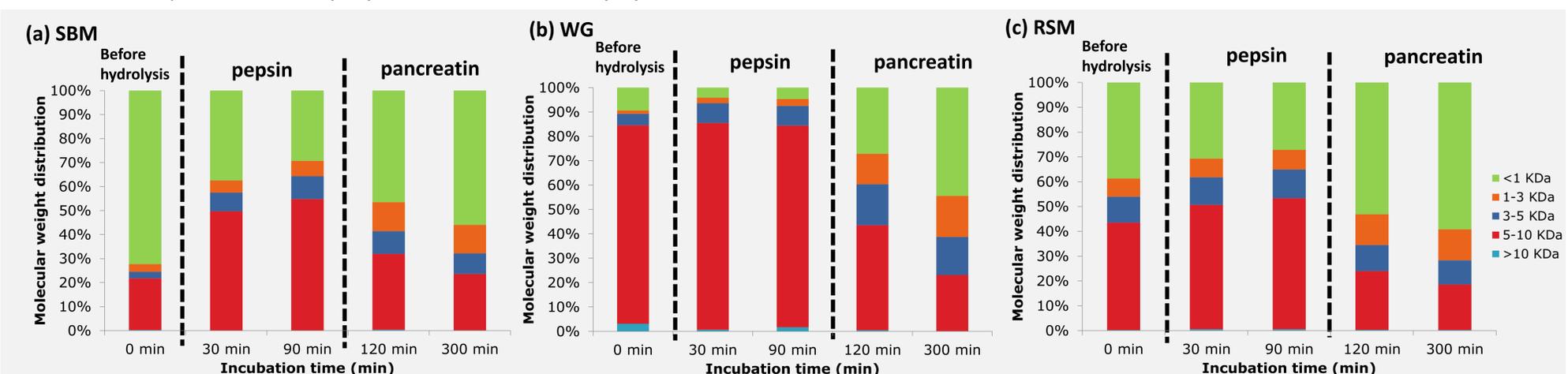


Figure 3. The peptide molecular weight distribution of the soluble fraction (SF) of soybean meal (SBM) (a), wheat gluten (WG) (b) and rapeseed meal (RSM) (c) at different incubation time points.

5. Conclusions

- Differences in protein hydrolysis kinetics were observed among SBM, WG and RSM. The crude protein fraction of SBM and RSM are mainly hydrolysed in the intestinal phase while the hydrolysis of the crude protein fraction of WG already starts in the stomach.
- For all ingredients, more intermediate and small peptides were produced in the intestinal phase compared to the gastric phase. The results indicate that pepsin aims for protein denaturation, which increases the accessibility for enzymes (i.e. pancreatin) in the intestinal phase.



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