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Digestion of protein and protein gels in simulated gastric environment

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Introduction

The investigation of food digestion from the perspective of process engineering has been increasingly concerned. With a thorough understanding of the digestion process, the functionality of food can be better defined and interpreted, which will lead to the rational design of food and food processing. This research is focusing on the digestion of protein and protein gels in simulated gastric environment. The behaviour of pepsin in structured proteins and the role of pepsin in the disintegration was also studied.

Methods

Whey protein isolate (WPI) and its heat-induced gel were digested in simulated gastric juice[1] in different systems, the free amino groups, the protein/peptide profile and the dry matter loss were analysed.

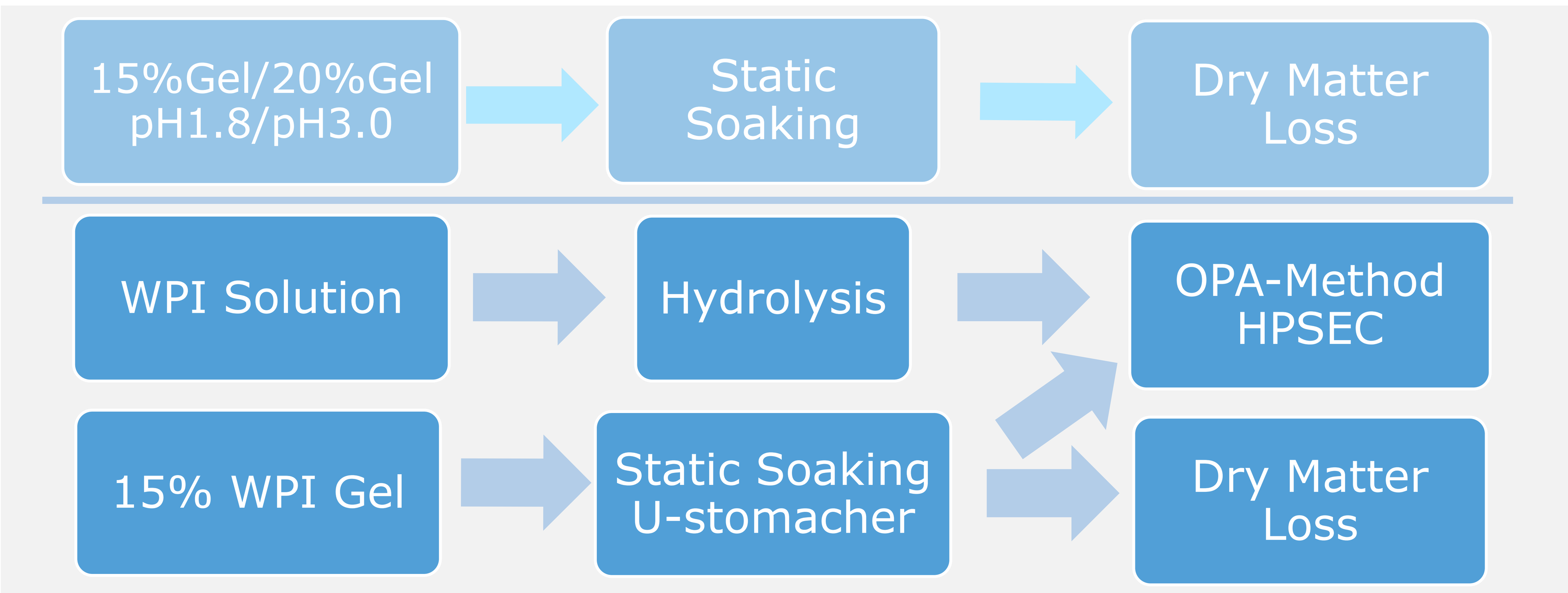

Figure 1. Flow chart of experiment set-up

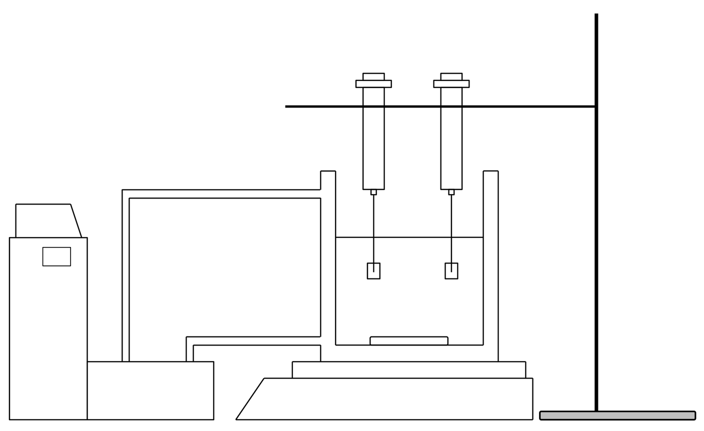

Figure 2. Water-jacketed glass vessel for static soaking, adjusted from Kong and Singh[1]. Temperature was kept at 37°C by a heat circulator.

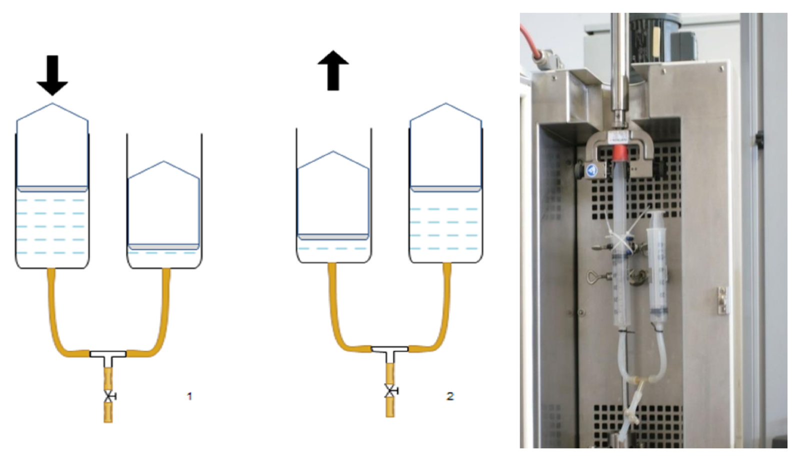

Figure 3. The schematic and the picture of the U-stomacher. Periodic mechanical force was supplied by texture analyser and the temperature was kept at 37°C by the environmental chamber.

Results

Effect of gel density and pH

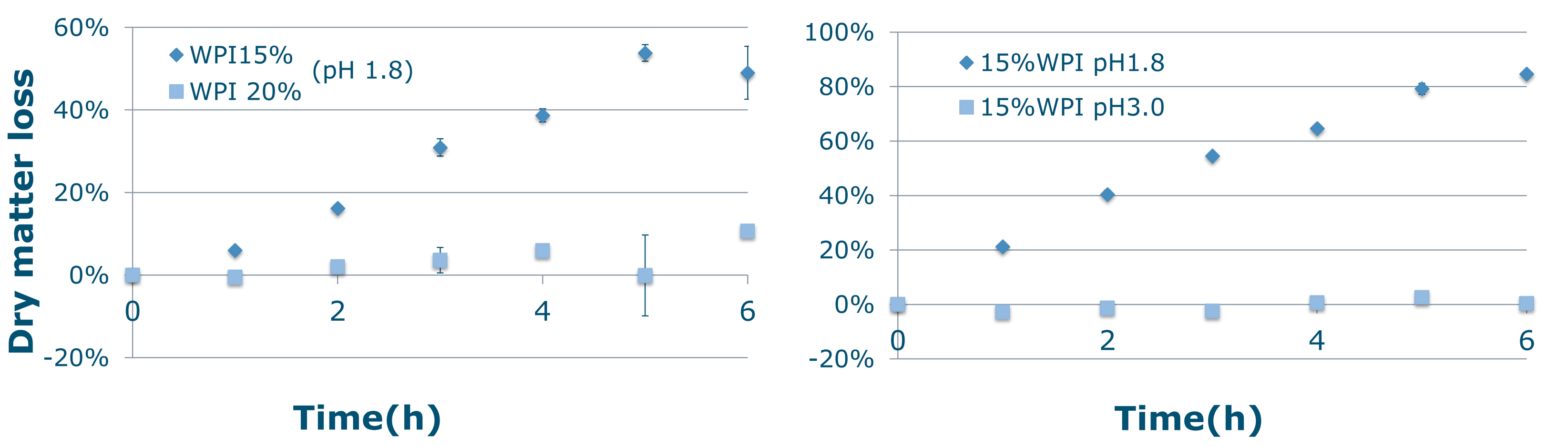

Figure 4. Dry matter loss of WPI gel in static soaking, mean of 4 trials with standard deviation as error bars.

Results

Dry matter loss of gels in digestion

	Without Pepsin	With Pepsin
Static Soaking	-3.6% (±1.3%)	33.2% (±4.6%)
U-stomacher Digestion	61.6% (±3.0%)	69.3% (±2.0%)

Hydrolysis analysis of WPI and WPI gel

- The increases of free amino acid of WPI and WPI gel followed different trend

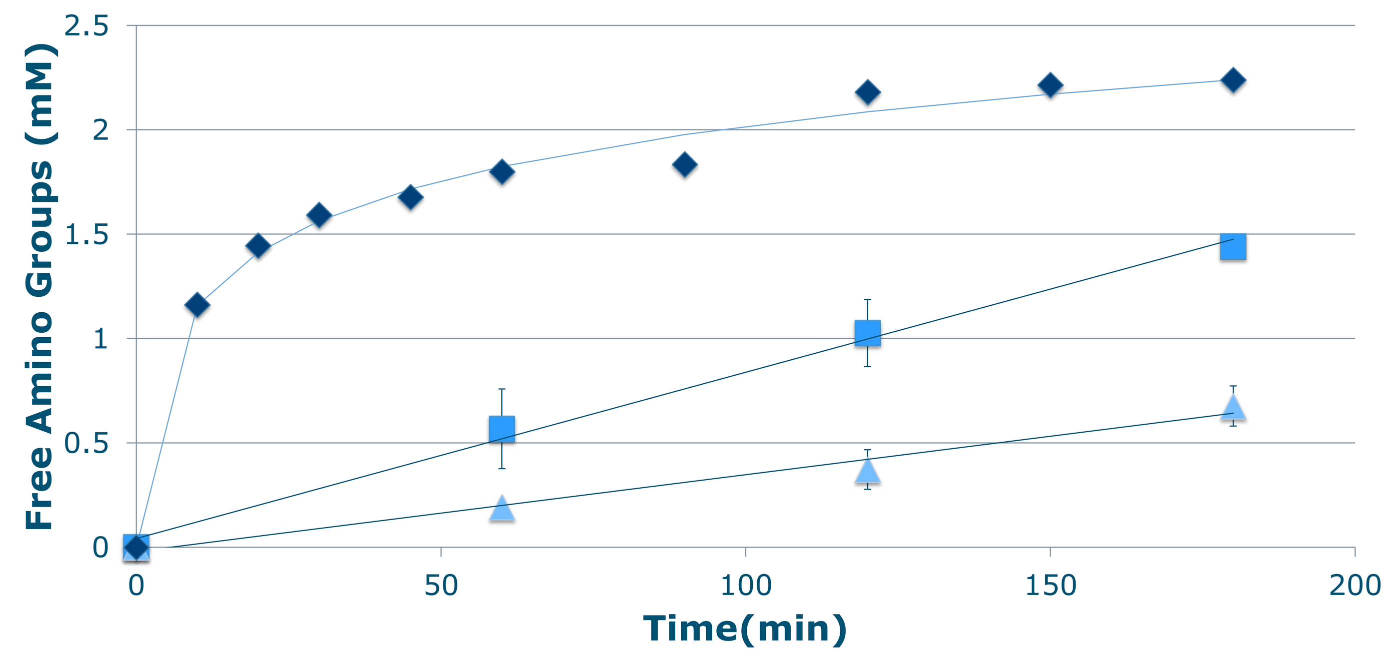

Figure 5. OPA result of WPI solution and gel digestion. ♦WPI solution ■WPI U-stomacher digestion ▲WPI static soaking, standard deviation as error bars.

- The quantity of big peptides (10kD-4kD, 4kD-2kD) was different between solution and gel at the same extent of hydrolysis

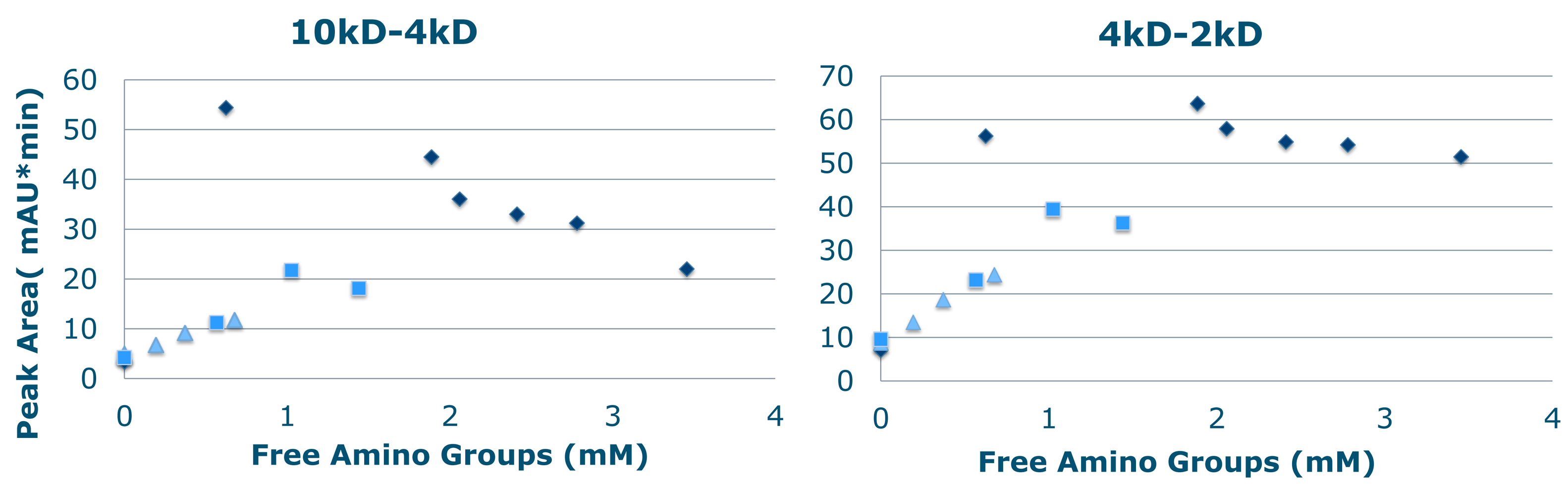

Figure 6. Free amino groups and peak area of peptides 10kD-4kD and 4kD-2kD in WPI digestion. ♦WPI solution ■WPI U-stomacher digestion ▲WPI static soaking

Conclusions

- The structural difference induced by the gel density and the higher pH have significant effects on the disintegration of protein gel.
- Pepsin played an important role in the disintegration of protein-based structure. The combination of pepsin with mechanical force produced the highest dry matter loss.
- The peptic hydrolysis in gel was not only slower than that in solution, but the enzymatic kinetics were shown to be different.

References

1. Kong, F., and Singh, R.P. (2008). A Model Stomach System to Investigate Disintegration Kinetics of Solid Foods during Gastric Digestion. J. Food Sci. 73, E202–E210

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