PEA PROTEIN: IMPROVEMENT OF FUNCTIONAL PROPERTIES RELEVANT FOR MEAT SYSTEMS.

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Background

In the manufacture of emulsion-type meat products protein preparations are used increasingly as filler, binder and/or for its specific functional properties. This results in the production of more stable meat products with better textural and -in some cases- nutritional properties. For non-meat proteins the most important functional properties in meat processing are: formation and stabilization of the meat emulsion, gelation and water- and fatbinding (Zorba et al, 1995; Parks and Carpenter, 1987). In meat systems soy proteins are being used because of their good water and fat binding properties. Next tot this they may emulsify fat as well as improve cooking yields and over-all quality through interaction with meat proteins (Dabrowski et al, 1991).
Pea proteins resemble soy proteins with respect to both biochemical and functional properties (Owusu-Ansah and McCurdy, 1991). To compete with the well established and versatile soy proteins, which dominate the food protein ingredients market, functional properties of pea proteins have to be improved. This improvement can be achieved by chemical, enzymatic and physical modifications. Emphasis in this paper is on enzymatic modification, especially proteolysis.

Objectives

The potential use of pea protein in comminuted meat is linked to their functional properties. These functional properties can be improved by enzymatic hydrolysis, yielding products which are better suited to compete with soy proteins. In this study a commercial pea protein isolate was hydrolysed to various degrees with the commercial protease preparation Protamex. Relevant functional properties have been investigated in relation to the extent of enzymatic hydrolysis.

Methods

Pea protein isolate was provided by DPS (Tiel, The Netherlands). Protamex was obtained from Novo Nordisk (Bagsvaerd, Denmark). The conditions for hydrolysis were: 7% substrate dispersion (77% protein), 45°C, pH 7, enzyme/protein ratio 0.5%. The degree of hydrolysis (DH) was calculated from the base consumption during hydrolysis (Adler-Nissen, 1986). The enzyme was inactivated by heating the solution at 90°C for 10 minutes. Then, the hydrolysate was freeze dried. Protein was determined by Kjeldahl analysis or by the method of Lowry et al (1951). Fat binding capacity and emulsifying activity were determined according to the methods described by Lin et al (1974) and Pearce and Kinsella (1978). As reference material, a commercial soy protein hydrolysate was used.

Results and discussion

During the hydrolysis the increase in DH was highest in the first 20 minutes (DH 1.8). Thereafter, the DH increased more slowly upto a DH of 5.1 in 2 hours of hydrolysis.
The solubility of pea protein and some of its hydrolysates as a function of pH is shown in figure 1. Hydrolysis increases the solubility of pea protein, especially near the isoelectric pH. At this pH the solubility of the hydrolysate having a DH of 5.1 is ten times higher than that of the unmodified protein (54 versus 5% resp.). At increasing DH the solubility becomes nearly independent of pH. This is already found at the low DH of 1.8. However, even at high DH values (5.1) only about 60% of the protein becomes soluble. At the pH at which comminuted meat is commonly processed (pH 5.5), the solubilities of the soy hydrolysate and the pea hydrolysates are about the same.
The emulsifying activity (taken as the absorbance of the diluted emulsion at 500 nm) and the fat binding capacity are presented in table 1. As can be seen from this table, the emulsifying activity (EA) can be improved by hydrolysis to a substantial extent. The EA first increases with increasing DH to a maximal value. Upon further hydrolysis the EA decreases. The optimum of the emulsifying activity at pH7 is found at a DH between 3.2 and 3.7. This optimal emulsifying activity is comparable to that of the soy hydrolysate. Figure 2 shows the pH dependency of the emulsifying activity. In the tested pH range, the emulsifying activity increases with increasing pH. Furthermore, the optimal DH for emulsifying activity is dependent on the pH: at pH 5 the optimal DH is around 2.6 and at pH 7 it is around 3.7. This implies that the performance of the hydrolysates can be adjusted towards a given application by adjustment of the DH.
The fat binding capacity (FBC), a very important parameter for meat applications, can also be improved by hydrolysis. It increases from 1.3 to about 5 g fat/g protein upon hydrolysis and then decreases slightly. The optimal DH value is broader than that for emulsifying activity. The FBC of the pea hydrolysates is better than that of the soy hydrolysate, which has a FBC of 2.3 g fat/g protein.
The pea protein isolate formed a weak gel after heating dispersions (18 to 20% of protein) for 10 minutes at 90°C and subsequent cooling to 4°C. As was expected, preliminary experiments indicated that the gelling properties of pea proteins declined upon hydrolysis. The soy hydrolysate also had only poor gelling properties: it formed weak gels at high concentrations.

Conclusions

Enzymatic hydrolysis can effectively enhance the applicability of pea proteins in meat systems. Relevant important functional properties such as solubility, emulsifying activity and fat binding capacity are substantially improved by proteolysis. The improvements are depending on the DH of the hydrolysates. So by controlling the hydrolysis parameters carefully tailor made pea protein products can be produced which can replace soy protein products.

Pertinent literature

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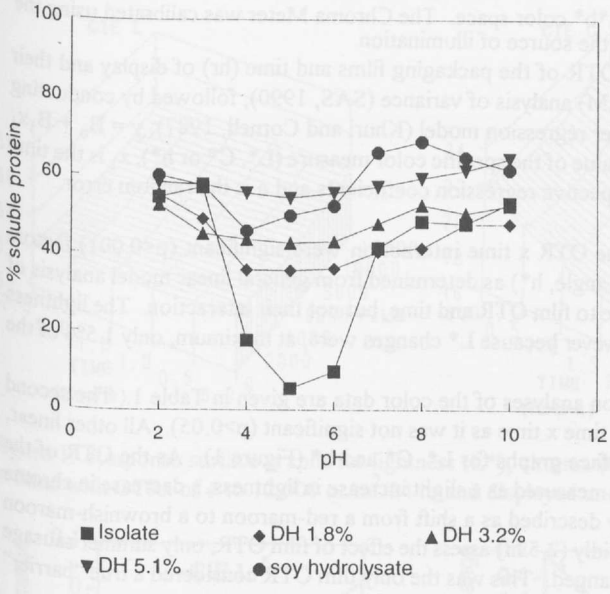

Figure 1: Solubility profile of the pea isolate and its hydrolysates and of the soy hydrolysate.

Table 1: Emulsifying activity (EA; absorbance at 500 nm) and Fat binding capacity (FBC; g fat/g protein) of pea protein isolate and its hydrolysates and of a soy hydrolysate.

DH	EA	FBC
0	0.32	1.2
1.8	0.49	4.0
2.6	0.60	5.5
3.2	0.70	5.1
3.7	0.71	5.1
4.5	0.60	5.9
5.1	0.46	4.1
soy hydr.	0.71	2.3

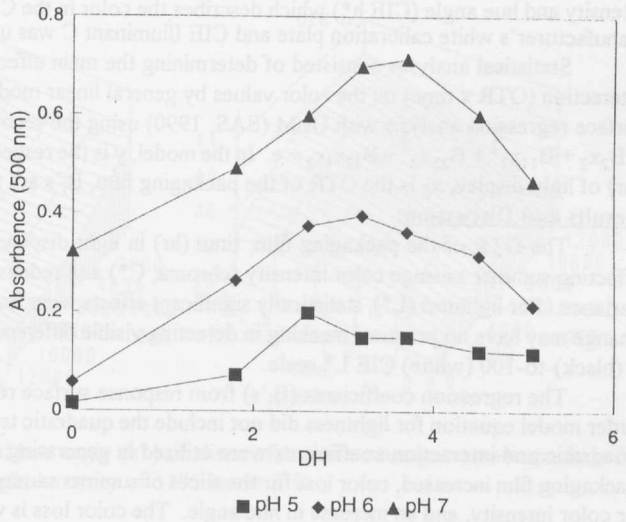

Figure 2: pH dependency of the emulsifying activity of the pea isolate and its hydrolysates.