Functional properties of rapeseed protein concentrates produced via alcoholic processes

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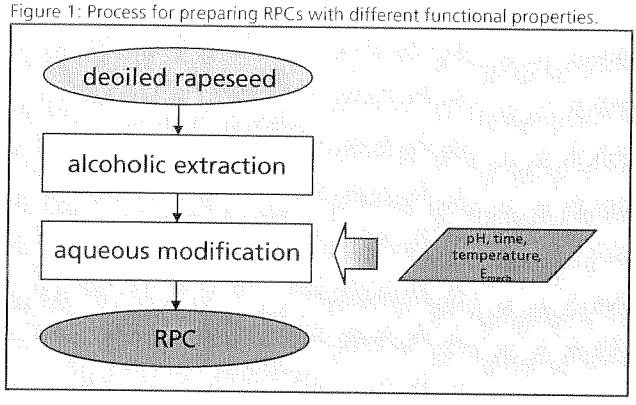
Introduction:

Plant protein products are of particular interest for food applications as functional ingredients, in order to improve properties such as texture, viscosity, mouth-feeling, appearance, aroma-stability as well as foods nutritional-physiological benefits.
it is necessary to de-hull and de-oil the seed to recover proteins from rapeseed. The de-oiled product is extracted via alcoholic or aqueous processes to obtain protein products (concentrates and isolates). Products obtained with aqueous extraction processes have a green colour and bitter taste. These products are unsuitable for use as food ingredients. The alcoholic extraction processes avoids these disadvantages. The products are suitable as food ingredients.
As result of the extraction with alcoholic solutions, protein structures in the rapeseed protein concentrate (RPCs) are coagulated [1]. Several methods describe strategies to modify protein ingredients [2]. Modifying protein ingredients from rapeseed is not known. The aim of this study is to improve the functional properties by different methods.

Material and Methods:

The RPCs were prepared from variety Express, dehulled and mild deoiled / desolventized, supplied by NPZ, Germany.
The deoiled rapeseed was extracted three times with 45%(w/w) 2-Propanol at a ratio of 1:5 (s:l). Each step included a centrifugation to separate the extracted components with the alcohol. The residue of the third extraction was suspended in demineralised water. The first method investigates the temperature influence of the slurry to improve the functional properties. Therefore the slurry was adjusted to pH 8.0 within 30min followed by heating up to 60°C-80°C for 10 or 30minutes.
The second method improves the functional properties by a mechanical energy input with a homogenisator (APV Schröder Typ LAB100-8) at 180bar. All products were spray dried.
The protein content and dry matter content (DM) of the samples were analysed (LMBG §35). To evaluate the functional properties emulsion capacity (EC, pH 5.0), emulsion stability (ES), protein solubility (pH 4.5-7.0), fat binding capacity (FBC), water binding capacity (WBC) of the samples were measured.

Figure 1: Process for preparing RPCs with different functional properties.



Results and discussion

The first results of the heat treatment experiments (not shown) show that best functional properties are obtained by heating 10min at max. temperature of 65°C.
There is a difference in the water and fat binding capacity between untreated and modificated RPCs after the alcoholic extraction. The advanced WBC of 4.9ml/g compared to 4.3ml/g from the temperature treated RPCs could be caused by a slight disintegration of the proteins and carbohydrates. Proteins are more denatured than proteins of the other RPC process conditions (s. figure 3). The sponge effect of big cells, which appears in RPC products, is reduced in homogenised RPCs as these products have smaller particle sizes. The WBC of the homogenised product is 0,8ml/g lower than of untreated RPCs. The results of the FBC show no significant influence of the treatments compared to untreated RPCs.
The emulsion capacity of the modified RPCs is lower than the untreated RPC with the exception of the homogenized RPC. This cannot be explained at present.

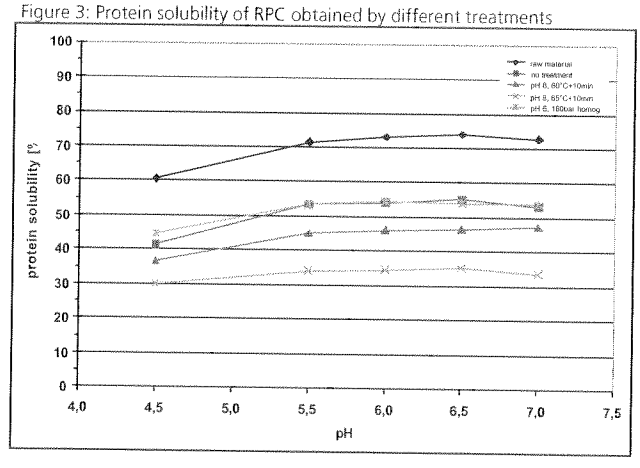
Figure 2: Functional Properties of RPC treated with different parameters

RPC (treatment after alc. extraction)	Protein content [%]	WBC* [ml/g]	FBC* [ml/g]	EC at pH 5 [ml/g]	ES* [%]
no treatment	63.6	4.3	1.9	335	56
pH 8	63.4	4.0	2.0	302	77
pH 8, 60°C+10min	63.7	4.9	1.8	234	93
pH 8, 65°C+10min	62.6	4.9	1.8	232	95
180bar homogenized*	65.7	3.5	1.7	357	83

*no pH setting

All modified RPCs have higher emulsion stabilities than the untreated RPC. At the modification conditions the proteins are negatively charged resulting in a higher repulsion of the oil droplets.
The interactions of the negatively charged proteins in the continuous phase induce a push off the oil droplets. The coalescence slows and the ES arise. The homogenized RPC shows an ES of 83%. This is 10% lower than of temperature treated products. One reason could be of the particle size discussed above. The smaller particles of the RPC results in a lower viscosity of the continuous phase in the emulsion. That results in a faster demixing of the aqueous and oil phase. Another reason could be the missed pH setting to pH 8 in the homogenised products. The outcome of this is a lower protein orientation caused by a lower protein solubility in the emulsion.

Figure 3: Protein solubility of RPC obtained by different treatments



Conclusion

Alcoholic extracted rapeseed protein concentrates are modified in aqueous systems at differend pH settings, temperatures and mechanical loads. The results show that it is possible to change the functional properties of RPCs. All modification steps lead to an Emulsion stability at min. 30% points better than the untreated RPC. The emulsion capacity is higher in products with mechanical treatments (approximately about 20ml/g) and drastically lower in products with temperature treatments (30-70ml/g). The results of water binding capacity show improvement by temperature treatment. In this ongoing project we plan application tests with the modified RPCs in sausages in order develpop protein ingredients with a maximum benefit as food ingredient.

Literature: [1] LUSAS, E.W. ET ALL: *IPA as an Extraction Solvent*, Inform. Vol 8, n°3, 1997, 290-306. [2] MATSUDOMI, N., SASAKI, T., KATO, A., KOBAYASHI, K.; *Conformational Changes and Functional Properties of Acid-modified Soy Protein*, Agric. Biol. Chem., 49, 1985, 1251-1256;

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