EFFECT OF HEATING ON FUNCTIONAL PROPERTIES OF RAPESEED PROTEIN ISOLATES

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Introduction

Heat treatment at high temperature /above 100°C/ is more and more frequently used method in manufacture of protein products and preparations. It causes, however, denaturation of proteins, to smaller or greater degree. It results in changes of physicochemical and functional properties of preparations, affecting their applications. The extent and run of these changes are dependent not only on the applied parameters of heat treatment but also on the properties and susceptibility of the raw material itself to the denaturation changes.

Since degree of heat denaturation plays an important role in the functionality and subsequent application of protein preparations, this study was undertaken to provide information on heat treated rapeseed protein in relation to better known changes in soy protein.

Material and Methods

In the experiments, dehulled and ground soybean seeds were extracted with hexane in order to remove oil. The procedure with rapeseed was the same but removal

of hulls was only partial. The obtained meals were then reground to 0.2 mm. From the defatted rapeseed and soybean flours protein isolates were obtained by the method of acid precipitation. The extraction and coagulation of nitrogen substances of rapeseed were conducted at pH 9.7 and 3.8, respectively, and that one of soybean - at pH 8.5 and 4.5. The precipitated protein sediments were washed and then neutralized to pH 6.8. The protein suspensions /about 12% DM/ were divided into 4 batches of about 500 g each. One batch was used as the experimental control and the other three were heated in autoclave at 105, 120 and 145°C for 20 minutes and all samples were then freeze-dried.

The studies upon the functional properties of the obtained isolates covered the following determinations: NSI, water absorption capacity /WAC/, fat absorption capacity /FAC/, emulsifying capacity /EC/, emulsion activity /EA/ and emulsion stability /ES/, foam expansion /FE/ and foam stability /FS/, viscosity and gelation according to the methods used in our laboratory /1/ .

Results and Discussion

The obtained protein preparations from rapeseed and soybean contained about 82 and 87% protein, respectively. The solubility of nitrogen substances in the control /non-heated/ sample of rapeseed isolate amounted to 24.3% /Table 1/. This low value, in comparison with analogical sample of soy isolate may be explained by the small solubility of rapeseed globulins under the conditions of NSI determination - temperature 45°C, pH = 6.7 /2/. Heating of the samples of isolates in

Table 1. Some functional properties of heat treated rapeseed and soybean protein isolates

Sample	NSI /%/	WAC [gH_2O/g] met.I	WAC [gH_2O/g] met.II	EC /%OP/	Gelation /%/	Gelation /0-5/
Rapeseed protein isolate						
control	24.3±1.1	2.6±0.1	3.2±0.1	49.3±1.0	60±4	1
105°C	11.8±1.3	3.5±0.1	4.2±0.1	44.0±0.6	80±4	2
120°C	10.5±1.6	3.4±0.2	4.0±0.2	48.1±0.2	100±0	3
145°C	10.3±1.2	3.6±0.1	4.2±0.2	46.6±0.7	100±0	3
Soybean protein isolate						
control	89.3±4.7	5.1±0.1	7.4±0.3	78.4±0.2	100±0	4
105°C	42.5±4.5	7.5±0.3	8.5±0.5	54.8±0.3	100±0	3.5
120°C	39.3±4.1	7.7±0.5	7.8±0.5	61.8±0.5	100±0	3.5
145°C	76.6±5.2	2.2±0.2	4.3±0.2	70.8±0.2	0±0	0

the range of temperatures 105 - 145°C caused decrease in solubility. However, no repeated rise of NSI value for the sample heated at 145°C was stated as it was found in the case of the soy isolate /Table 1/.
The subsequent increase in nitrogen solubility of soy isolate heated at 145°C may be explained by the dissociation and degradation of proteins to low molecular weight substances /3/. It is also revealed by the considerable decreasing in viscosity, water absorption capacity, emulsion stability and especially gelation behavior of this sample /Table 1, Fig. 1/.

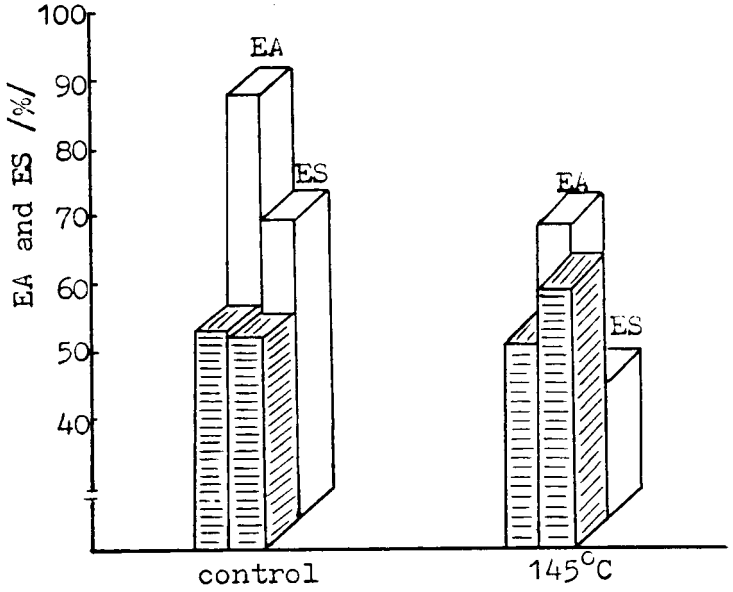

Fig. 1. Effect of heating at 145°C on emulsion activity /EA/ and emulsion stability /ES/ of rapeseed ▥ and soybean isolates □

The marked decreasing of water absorption capacity was also demonstrated by the second method /Table 1/, i.e.

the method applied in the case of easily soluble preparations. For the sample of soy isolate heated at 145°C, only the emulsifying capacity and foam expansion were maintained on the high level. It closely correlates with the nitrogen solubility data. The results obtained for soy isolates indicate that only heating at lower temperatures e.g. 105°C may favourably improve some functional properties such as water absorption capacity /by 50%/, emulsion stability /by 27%/ and especially viscosity /50-times/.

The changes of functional properties of rapeseed isolates due to heat treatment were different. Heating at high temperatures /120 and 145°C/ has not diminished their functional properties, on the contrary, it has enhanced some of them or maintained at the same level compared to unheated rapeseed preparations. Gelation properties were significantly improved. It was demonstrated for 10% slurries of the preparations both in neutral /Table 1/ and in alkali pH /8.5/.
The rapeseed preparations heated in the range 105-145°C were characterized by the somewhat better water and fat absorption capacities. Besides it, in comparison with soy proteins, rapeseed preparation heated at 145°C showed good properties of water-protein-oil emulsion formation, especially its stabilization /Fig.1/.

The present results as well as those obtained earlier for heat treated protein preparations of rapeseed and soybean show the different extent of denaturation changes in these proteins. Simultaneously, discussed results suggest higher heat stability of rapeseed proteins in comparison to soy proteins in the range of

temperatures 105-145°C. It may be due to different native properties of rapeseed and soybean proteins and/or by the influence of relatively high level of non-protein substances /e.g. phenolic compounds, phytates/, associated with rapeseed globulins. The presence of non-protein components, as it was reported /4/ has an influence on the heat stability of vegetable proteins.

References

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