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PREPARATION OF FABA BEAN (*Vicia faba L.minor*) PRODUCTS. PART V. EFFECT OF HYDROTHERMAL TREATMENT OF FABA BEAN AND PEAS ON THE QUALITY OF PROTEIN ISOLATES

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From hydrothermally treated cotyledons of faba bean and pea there were obtained protein isolates characterized by inreased protein content, trace activity of trypsin inhibitors, lowered content of bonded and residual fat, and better taste compared to isolate obtained from non-treated material. This significant improvement of quality was obtained at the cost of 20% yield decrease.

INRODUCTION

During steaming of faba bean seeds for a short period a considerable attenuation of the intense flavour typical for raw seeds can be observed, as well as a decrease of antitrypsin activity [6]. Given this we decided to evaluate protein isolates obtained from steamed seeds of faba bean and pea.

EXPERIMENTAL

Seeds of the Fribo faba bean variety and the Koral pea variety were investigated. After dehulling, cotyledons were devided into two parts, one of which was grineded in a Ascobloc Feuma grinder and sieved with a 0.15 mm mesh size sieve, and the other steamed in a device of our own construction in a fluid bed fro 2 min at 110°C. The seeds were then dried for 24 h at 30°C, and then grinded and sieved like nontreated seeds. Protein isolates obtained from hydrothermally treated and, for comparison, from non-treated cotyledons were prepared as follows: 500 g faba bean or pea flour were extracted with water to pH 8.5 (faba bean) and pH9,0 (pea) using 2N NaOH at 1 : 5 flour-to-solvent ratio. Extraction was conducted for 30 min at 20°C with continuous stirring. Sediment was separated in a Janetzki centrifuge (type K-70), at 3,000 r.p.m. for 15 min. Protein coagulation was conducted at the isoelectric point of most proteins, i.e. at pH 4.0

for faba bean proteins and pH 4.5 for pea proteins. The pH was adjusted with 2N HCl. The coagulum was centrifugated at 3,00 r.p.m. for 15 min and then rinsed twice with water of pH 4.0 or 4.5. The separated coagulum was neutralized and freeze-dried.

ANALITYCAL METHODS

The following determinations were made: total protein content [7], soluble nitrogen content and nitrogen solubility index (NSI) [12], residual fat with Soxhlets's method [7] and total fat content with the Weibull-Stoldt metod [11], bonded fat content calculated from the difference between total and residual fat content, trypsin inhibitor activity (TIA) according to Kakade et al. [4], colour of flours and isolates by measuring the percent of reflected light at 610 nm applying magnesium white as a standard, organoleptic estimation in a 5-point scale [1], and the yield of extraction and protein isolation [13].

RESULTS AND DISCUSSION

MATERIAL

The chemical composition of flours obtained from non-treated (A) and treated (B) faba bean and pea seeds is shown in Table 1. Faba bean flour (A) contained ca. 6% more total protein and ca. 10% more soluble protein than pea flour (A), which was confirmed by our earlier investigations [5]. The determined

Table 1. Chemical composition of flours used for obtaining isolates

Flours	Protein		NSI %	Antitrypsin activity	
	total % dm	soluble % dm		TUI/mg dm	TUI/mg protein
Faba bean					
A*)	34.2	26.5	77.6	4.4	11.7
B**)	34.3	16.9	49.4	2.6	6.0
Pea					
A	27.7	15.7	56.8	4.1	12.7
B	27.3	14.7	53.8	1.8	5.3

*) Non-steamed cotyledons
**) Steamed cotyledons

TIA value was similar in both flours. The same TIA for the Thüringer faba bean variety, i.e. 4.5 TUI/mg d.m., was reported by Olsen [9]. The result of cotyledons hydrothermal treatment was diminished nitrogen solubility and lowered TIA in flours. The observed changes of pea nitrogen substances solubility were very

small (ca. 3%) compared to those in faba beans (ca. 28%). This is most probably due to differences in physical-chemical properties of legumins and vicilins in both kinds of seeds. Pea legumins, for example, occur mainly in combination with sugars and glucosamin, which is reported among others by Bash and Beevers and by Garvey and Dudman/quoted in [8], as opposed to faba bean legumins in which most subunits are not glycoproteins, which may be the reason for their greater resistance to hydrothermal treatment. The determinedloss of TIA resulting from hydrothermal treatment and caused by denaturation of proteins of this kind was similar in cotyledons of both faba and pea, namely 51% and 49% respectively (Tabl. 1).

ISOLATES EVALUATION

Protein isolates obtained from hydrothermally treated cotyledons (B) contained more total protein than those obtained from non-treated material (A). There was 1.3% more total protein in faba bean isolate, and 6.9% more in pea isolate (Fig. 1). It can be assumed that proteins which have not undergone

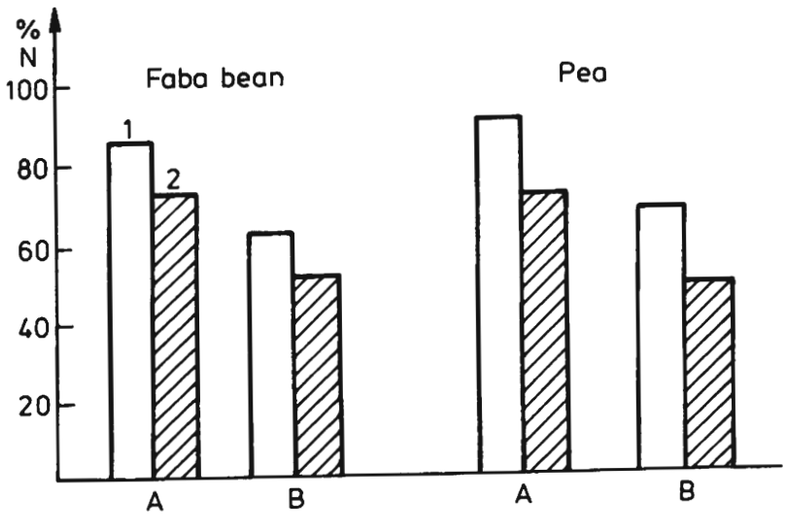

Fig.1 Characteristics of nitrogen substances of isolates obtained from non-steamed (A) and steamed (B) cotyledons; 1 — total protein, 2 — soluble, 3 — NSI

denaturation during hydrothermal treatment show less affinity to form complexes with the compoends which usually accompany them in the seeds, such as phytic acid, fats, pigments. etc. Consequently, this may lead to a greater concentration of thes compounds in isolates. Proteins of isolates obtained from treated cotyledons were also more soluble. The NSI for these isolates was higher by 16,2% and 12.3% for faba bean and pea preparations, respectively (Fig. 1). as for TIA, the initial treatment of cotyledons was observed to affect it in a very advantageous way (Fig. 2). The treated faba bean isolate was characterized by very small antitrypsin activity, while the treated pea isolates activity was ca. 1.5 TUI/mg d.m. greater. It is noteworthy that such a low activity in faba bean isolates has not been obtained so far, even for modified parameters of protein extraction and coagulation, either by us or by other authors [3].

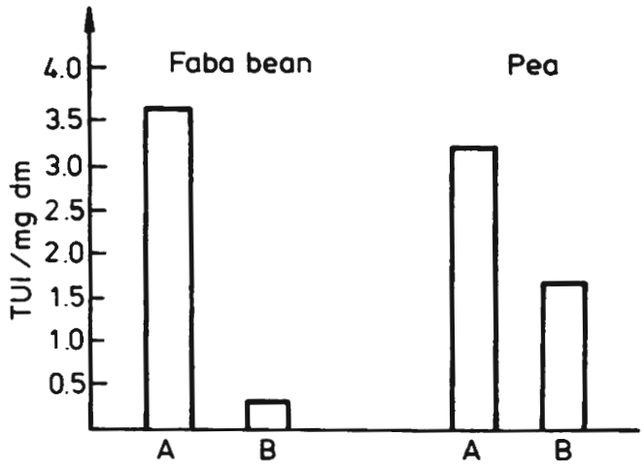

Fig.2 Antitrypsin activity of faba bean and pea isolates obtained from non-steamed (A) and steamed (B) cotyledons

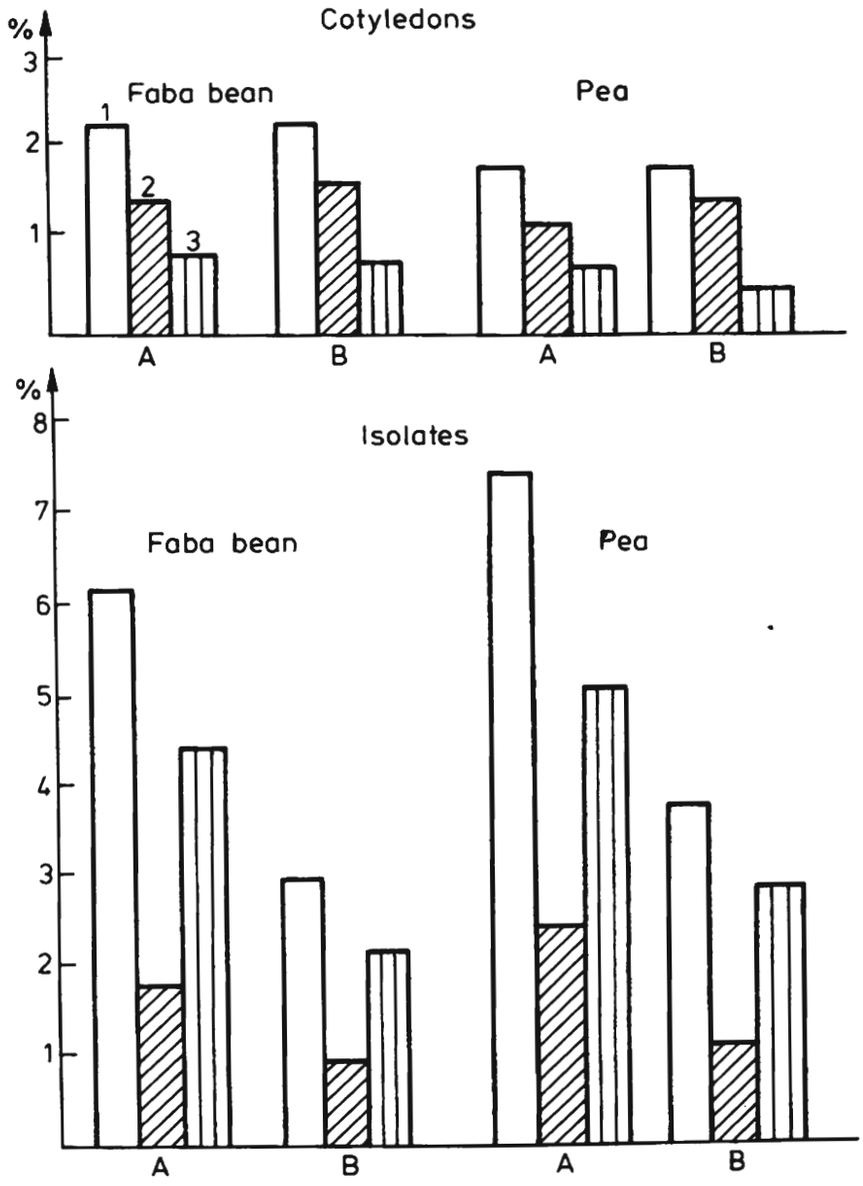

Fig.3 Fat content in non-steamed (A) and steamed (B) cotyledons and isolates; 1 — total fat, 2 — residual fat, 3 — bonded fat

Hydrothermal treatment of cotyledons resulted in a decrease of bonded fat content in raw material without affecting total fat content (Fig.3). Protein isolation process caused the decrease of fat concentration in these preparations, but still an advantageous lowering of both free and bonded fat was observed after

hydrothermal treatment (Fig. 3). The available literature data [10, 14] point to possibilities of creating protein-fat complexes during the technological process of isolates obtaining. Such complexes coagulate along with other proteins, thus raising the content of fat forms in the product. Smaller amouts of residual and bonded fat found in isolates obtained from treated cotyledons may indicate that some protein fractions denaturated during the treatment are no longer able to form such complexes, which results in a lower fat content in preparations.

ORGANOLEPTIC ASSESSMENT

Flours and isolates obtained from treated and non-treated cotyledons differed as to some organoleptic qualities. Hydrothermal treatment of cotyledons caused only a small difference in the colour of flours and isolates (a change from straw colour to light beige), perceptible only visually, since the colorimetric measurements failed to show it (Tab. 2). There was a noticeable improvement of taste and smell of flours and isolates obtained from treated cotyledons.

Table 2. Organoleptic assessment of faba bean and pea isolates

Sample	Colour	% of reflected light at 610 nm	Taste		Odour	
			points	description	points	description
Isolates:						
Faba bean						
A*)	straw-grey	89	3.0	leguminous	3.5	leguminous
B**)	light-beige	89	4.5	very slightly leguminous	4.5	very slightly leguminous
Pea						
A	beige	89	2.5	slightly leguminous	3.0	slightly leguminous
B	light-beige	89	4.0	very slightly leguminous	4.0	very slightly leguminous

*) **) — as in Table 1.

Preparations were devoided of the characteristic, bitterish, leguminous flavour. The improvement of organoleptic quality of flours and isolates can be assumed to be the result of removing from cotyledons the compounds responsible for undesirable properties during hydrothermal treatment. Yet it cannot be excluded that these compounds become flavour-neutral during the treatment. The undesirable organoleptic properties in flours of leguminous plants and their products are attributed by some autors to hydroperoxides resulting from lipoxygenase activity [10]. Hence, it may be assumed that the conditions of hydrothermal treatment could have caused inactivation of this enzyme, thus preventing undesirable convertions of fat compounds.

PROCESS YIELD

As could have been predicted, the yield of protein isolation process was lowered by the initial hydrothermal treatment of seeds. This was caused by partial denaturation of soluble proteins. Both in pea and faba bean extraction, the yield expressed as NSI in the extraction conditions, dropped By over 20% (Fig. 4).

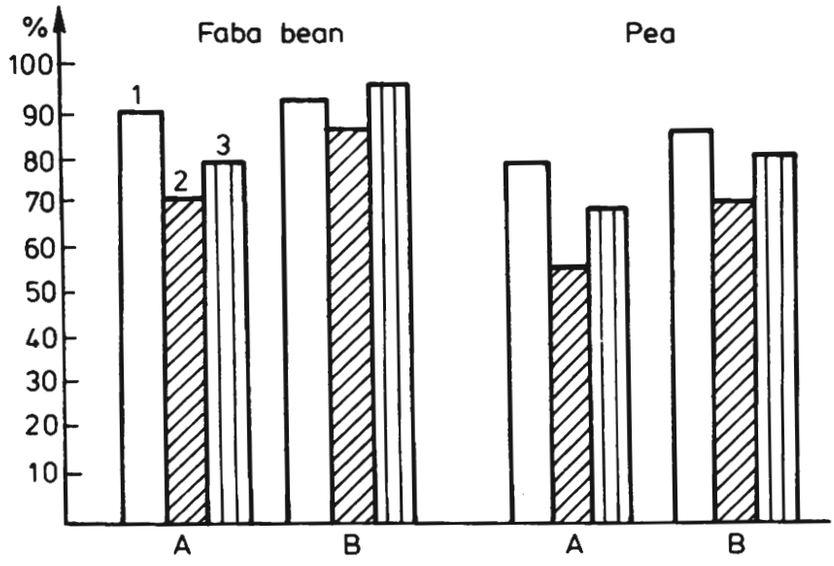

Fig.4 Solubility of nitrogen substances in flours and isolation yield from steamed (A) and non-steamed (B) cotyledons; 1 — N solubility, 2 — isolation yield

Taking this into account, the calculated protein isolation yield was ca. 20% less for faba bean and for pea compared with the yield of isolates obtained from non-treated cotyledons. This is the cost of a considerable improvement of the chemical composition of isolates and of their taste.

CONCLUSIONS

Isolates obtained from faba bean and pea cotyledons treated hydrothermally differed from isolates obtained from non-treated ones by:

— considerably lowered TIA, lower content of total, bonded and residual fat, and greater protein content;

— more neutral taste and odour,

— lower protein isolation yield.

These results encourage further investigation of hydrothermal treatment optimization.

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OTRZYMYWANIE PRODUKTÓW Z BOBIKU (*Vicia faba L.minor*), cz. V. WPŁYW OBRÓBKI HYDROTERMICZNEJ BOBIKU I GROCHU NA JAKOŚĆ IZOLATÓW BIAŁKOWYCH

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Streszczenie

W celu poprawienia jakości izolatów, szczególnie smaku z liścieni bobiku i grochu po obróbce hydrotermicznej — parowaniu (110°C, 2min) otrzymano izolaty, które poddano ocenie chemicznej i organoleptycznej. Izolaty z parowanych liścieni w porównaniu z nieparowanymi charakteryzowały się większą zawartością białka o lepszej rozpuszczalności oraz miały znacznie obniżoną aktywność antytrypsynową, szczególnie preparat bobikowy, w którym była ona śladowa.

Uwzględniając trwałość otrzymanych izolatów i ich cechy organoleptyczne, przeprowadzono analizę zawartości tłuszczu całkowitego, resztkowego i związanego. Jakkolwiek wszystkie izolaty zawierały więcej tłuszczu całkowitego aniżeli mąki, to izolaty otrzymane z liścieni parowanych zawierały go o ok. 3% mniej niż izolaty z nasion kontrolnych. Mniejsza była również zawartość tłuszczu związanego.

Najbardziej istotną zaletą wstępnej obróbki hydrotermicznej liścieni była zdecydowana poprawa cech organoleptycznych. Izolaty te były pozbawione charakterystycznego, lekko gorzkawego i strączkowego posmaku i zapachu. Ujemną natomiast stroną było, zresztą spodziewane obniżenie o 20% wydajności procesu otrzymania izolatów.