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STUDIES ON USABILITY OF PHYTIC ACID DETERMINATION FOR ESTIMATION OF SOYBEAN PROTEIN CONTENT IN MEAT PRODUCTS

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Key words: phytic acid, soybean protein preparation, meat products, phytic P

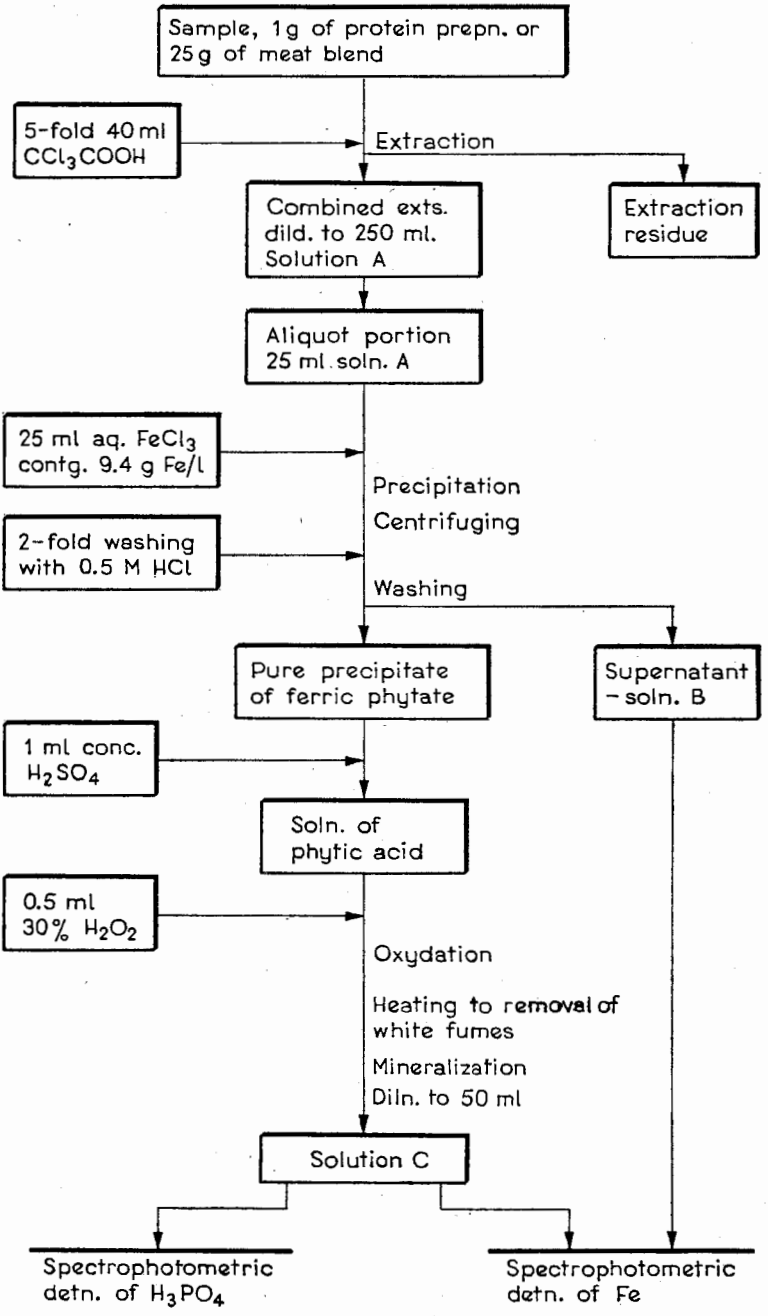
The usability of determining phytic acid for analytical control of soybean proteins in meat products was investigated. It has been found that the content of phytic phosphorus in soybean preparation of isolate and concentrate types depend evidently of the content of proteins. Beef meat blends containing 2, 4 and 6% on soybean isolates and concentrates were prepared and analysed. Phytic P determined in these blends was proportional to the amount of substitute added. No correlation was found between total P and soybean protein added.

INTRODUCTION

In recent years there has been a steadily increasing use of vegetable proteins as additives to meat products. The most widely applied substitute material is soybean meal as well as protein concentrates and isolates. The content of vegetable proteins in some meat products reaches 30% [7]. These facts claim for the necessity of a quantitative control of the level of the substitute material.

At least several methods have been proposed and developed for analytical control and determination of vegetable proteins in meat blends, yet none of them has been generally accepted. There are methods based e.g. on determination of hemicellulose [2], on electrophoretic fractionation followed by chromatographic or electrochromatographic determination of proteins characteristic for soybean products [1, 2, 7], etc.

Our attention has been called to phytates, which are a common component of vegetable materials and do not occur in meat. Our idea of using phytic acid as a measure of vegetable proteins content in meat blends


Sample, 1 g of protein prepn. or 25 g of meat blend
5-fold 40 ml CCl_3COOH
Extraction
Combined exts. dild. to 250 ml. Solution A
Extraction residue
Aliquot portion 25 ml soln. A
25 ml aq. $FeCl_3$ contg. 9.4 g Fe/l
Precipitation
Centrifuging
2-fold washing with 0.5 M HCl
Washing
Pure precipitate of ferric phytate
Supernatant – soln. B
1 ml conc. H_2SO_4
Soln. of phytic acid
0.5 ml 30% H_2O_2
Oxydation
Heating to removal of white fumes
Mineralization
Diln. to 50 ml
Solution C
Spectrophotometric detn. of H_3PO_4
Spectrophotometric detn. of Fe

arose from the fact that in plant materials phytates are firmly bound with proteins, from which they do not separate during the commonly used methods of processing.

Literature data show [6] that the contents of phytates in vegetable protein materials varies considerably. For this reason any method for evaluating the content of vegetable proteins added to meat products, based on determination of phytates, may be applicable only in cases where the substitute materials used in meat blends originate from the same known biological source, as is the case with soybean.

Quantitative determination of phytic acid in plant materials consists in a) solubilization of the phytates and their extraction by means of an appropriate solvent, b) precipitation of phytic acid from the extract in the form of a sparingly soluble salt, and c) decomposition of the salt and estimation of phytic acid from the amount of phosphoric acid or equivalent amount of the metal ions liberated during the decomposition. This general procedure is applied in several modifications, differing mainly by the kind of chemicals and analytical methods involved.

The aim of the present work was to check the usability of determining phytic acid for an analytical control of the amount of soybean proteins in meat products.

EXPERIMENTAL

Phytic P was determined in pure soybean concentrates and isolates supplied by Central Soya Co., USA, as well as in blends of those materials with meat. The blends were prepared by mixing grinded beef with a concentrate or an isolate contained 2, 4 or 6% of the dry vegetable protein material with respect to the total blend weight.

The analytical procedure applied was is based on the method proposed initially by Samotus and Schwimmer [9], modified in some details of extraction, precipitation and final analytical treatment [3, 8]. The content of water and total protein were determined by the generally known methods, and total P was determined according to Harris and Popot [4]. The detailed scheme of operations is given in Fig. 1. From each material three samples were analysed and average results were calculated.

RESULTS AND DISCUSSION

The results of analyses of pure substitute materials are given in Table 1. Significant differences in the content of proteins and phytates have been found between the concentrates and the isolates. The diffe-

rences among individual products within each group are much less pronounced. It may be seen that the concentrates, which contain smaller amounts of proteins, contain also lesser amounts of phytates. The differences vanish when the ratio of phytic P: protein is compared (see column 7). As the content of total P was almost identical in all the materials tested, the ratio of P_{phyt}:P_{total} was proportional to the contents of phytic P in those materials.

An identical procedure was also applied in determining the content of phytic acid in ground meat blends with 2, 4 and 6% additions of the two kinds of vegetable protein preparations. The results are collected in Table 2. As may easily be seen, the content of phytic P increases with increasing amount of vegetable protein added, whereas no correlation has been found between total P and substitute material added. Therefore it seems unadvisable to use total P level as a measure of the content of vegetable proteins in meat products.

Table 1. Determination of phytic phosphorus in vegetable proteins

Preparation	Water %	Proteins Nx6.25 %	Phytic P mg/g sample	Total P mg/g	P_{hyt} P_{total}	Phytic P mg/g protein
Concentrates						
Promosoy 100	8.14	66.93	4.08	7.28	56.1	6.1
Promosoy 20/60	8.82	64.05	4.02	7.62	52.8	6.3
Isolates						
Promine D	6.20	90.71	6.14	7.32	83.9	6.8
Promine F	5.99	89.96	5.69	7.81	72.9	6.3
Promine K	5.39	87.96	5.90	7.90	74.7	6.7
Promine R	5.62	91.03	5.96	7.73	77.2	6.5

Table 2. Determination of phytic and total phosphorus in meat blends with vegetable protein preparations

No.	Preparation	Amount of dry prepn. added, %	Phytic P in mg/100 g blend	Total P in mg/100 g blend
1.	Promine D	2	10.2	235.3
2.	Promine D	4	24.6	246.6
3.	Promine D	6	38.9	243.2
4.	Promosoy	2	9.3	238.8
5.	Promosoy	4	19.4	243.9
6.	Promosoy	6	27.3	240.7
7.	Beef meat	0	0.0	226.8

CONCLUSION

1. The content of phytic acid in soybean protein preparation depends on the type of preparation and is roughly proportional to the content of protein in it. The amount of phytic P as expressed in mg P per 1 g of

soybean protein is practically independent of the kind of preparation (see Table 1 column 7). This fact may be accounted for by strong bonds existing between phytates and proteins in vegetable materials.

2. The content of phytic P in meat blends depends on the amount of soybean protein preparation added. Further investigations are aimed at improving the precision of the method so as to enable its application in analytical control.

3. The content of total P in meat blends with soybean protein preparations has no effect on the determination of phytic P in the blends.

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BADANIA NAD PRZYDATNOŚCIĄ OZNACZANIA KWASU FITYNOWEGO DO OKREŚLANIA ZAWARTOŚCI BIAŁKA SOJOWEGO W PRODUKTACH MIĘSNYCH

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Streszczenie

W pracy zaproponowano i sprawdzono metodę ilościowego oznaczania dodatku białka sojowego do produktów mięsnych, opartą na oznaczaniu zawartości fosforu fitynianowego. Wykonano oznaczenia P_{fit} w wielu preparatach białka sojowego typu koncentratu i izolatu. Stwierdzono, że zawartość fosforu fitynianowego w tych produktach jest proporcjonalna do zawartości białka i nie zależy od rodzaju produktu. Sporządzono farsze mięsa wołowego z dodatkiem 2, 4 i 6% izolatów i koncentratów białka sojowego. Oznaczenia wykazały wzrost zawartości fosforu fitynianowego proporcjonalny do ilości wprowadzonego substytutu. Nie stwierdzono istnienia korelacji między zawartością fosforu całkowitego a wielkością dodatku białka sojowego.