

An attempt to estimate the level of substitution of meat tissue by texturized soy protein
preparate in model comminuted sausage based on quantitative determination of the fiber

ZBIGNIEW DUDA, JAN MIELNIK, MIECZYSLAW STEC

Institute of Food Storage and Technology, Department of Animal Origin Food Products,
Agricultural Academy, Wrocław, Poland.

An attempt was made to adopt quantitative method of textured soy protein /TSP/ substitute estimation in processed meat products based upon determination of the amount of the fiber. Investigations were done on model comminuted sausages processed with 0,15;25 and 35% substitution of meat by TSP /Supro 50A, Ralston Purina Co./ .Elaboration of procedure aimed at fat saponification in ready product as well as the technics of filtration and fiber mat transferring were integral part of the present investigation.

The amount of fiber was determined in TSP and in ready product. An average quantity of fiber estimated in TSP was $2.86\% \pm 0.52$. On the basis of the amount of fiber determined in TSP and in model sausages with known level of substitution of meat by TSP a standard curve was prepared as well as appropriate regression equation was calculated: $y = 46,32x - 4,04$. Using one of them and having determined the quantity of fiber in product the estimation of the level of added TSP could be done with satisfactory precision. By adopted analytical procedure the recovery of fiber being introduced to sausage with TSP of known quantity of the fiber was in average 79,19% what has been taken under consideration in calculation of regression equation and drawing of the standard curve.

Versuch der Substitutionsgrössebestimmung von Fleischfasern durch strukturienten
Sojaiweißspräparat in Modellbrühwürsten anhand der Zellulose-Niveau-Bezeichnung.

ZBIGNIEW DUDA, JAN MIELNIK, MIECZYSLAW STEC

Institut für Lagerung und Lebensmitteltechnologie, Anstalt für Technologie der tierischen
Rohstoffe, der Akademie für Agrikultur, Wrocław, Polen.

Bei der Arbeit versuchte man in Anlehnung an die Zellulosegehaltbezeichnung die Mengenbestimmungsmethode von strukturienten Sojaiweißspräparat /substitut/ in Fleischverarbeitungen zu adoptieren. Die Untersuchungen wurden an Modellwürstwaren durchgeführt, die mit 0,15, 25, und 35% Substitution von Fleischfasern durch strukturienten Sojaiweiß /Supro 50A, Ralston Purina/ produziert wurden. Einen integralen Teil der Untersuchungen bildete die Bearbeitung der Fettverseifungsmethode in Würstwaren und auch das Filtrieren und Übertragen des Zelluloseinsatzes. Der Zellulosegehalt wurde im Eiweißspräparat und in den Modellwürsten bezeichnet. Der durchschnittliche Gehalt an Zellulose betrug im Präparat $2,86\% \pm 0,52$. In Anlehnung an die Ergebnisse der Zellulosebezeichnung im texturierten Sojaiweißspräparate und in den Modellwürsten deren Substitutionsniveau an Fleischfasern verschieden war, wurde eine Standardkurve und die entsprechende Regressgleichung: $y = 46,32x - 4,04$ bearbeitet, was in Anlehnung an die Zellulosegehaltbezeichnung ermöglicht, den Anteil des substitutionseiwisses im Fertigprodukt zu bestimmen. Die Angewandte Methode ermöglicht die Bezeichnung von durchschnittlich 79,17% der in die Rohstoffzusammenstellung der Modellwürste eingeführten Zellulosemenge samt strukturienten Sojaiweißspräparat, dessen Zellulosegehalt bekannt ist, was bei der Bearbeitung der Regressgleichung und der Standardkurve berücksichtigt wurde.

5.9

L'Essai d'indiquer la grandeur de la substitution du tissu musculaire avec la préparation texturée de la protéine de soya dans la charcuterie échaudée de modèle par la désignation du niveau de la cellulose.

ZBIGNIEW DUDA, JAN MIELNIK, MICZYSLAW STEC

Institut de Conservation et Technologie des Aliments, Laboratoire de Technologie des Matières Animales, Académie d'Agriculture, Wrocław, Pologne.

Das ces recherches on a fait un essai de l'adaptation d'une méthode de la désignation quantitative de la substitution texturée de protéine de soya dans la charcuterie grâce à la désignation du contenu de la cellulose. On a fait des recherches sur la charcuterie de modèle produite avec la substitution du tissu musculaire de 0,15, 25, et 35% et la protéine texturée de soya /Supro 50A, Ralston Purina Com./ C'est l'élaboration d'une méthode de savonner la graisse dans la charcuterie et celle de filtrer et transférer les précipités de la cellulose qui étaient la partie intégrale de nos recherches. On a indiqué le contenu de la cellulose dans la préparation de protéine de soya et dans la charcuterie de modèle. Le contenu moyen de la cellulose dans la préparation a démontré $2,86\% \pm 0,52$. En vertu des résultats d'indiquer, le contenu de la cellulose dans la protéine texturée de soya et dans la charcuterie de modèle produite avec le niveau différent de la substitution du tissu musculaire on a construit la courbe de standard et on a élaboré une équation convenable de régression : $y = 46,32x - 4,04$ ce qui permet grâce à la désignation du contenu de la cellulose d'indiquer la participation de la substitution de protéine dans la composition du produit tout fait. La méthode qu'on a appliquée permet d'indiquer en moyenne 79,17% de quantité de la cellulose introduite à l'assortiment de matière de la charcuterie de modèle avec la préparation de la protéine de soya dont le contenu de la cellulose est connu; ce qui a été pris en considération en élaborant l'équation de régression et la courbe de standard.

Попытка определения величины субституции мышечной ткани текстурированным соевым заменителем мяса в модельной вареной колбасе на основе определения клетчатки

ЗБИГНЕВ ДУДА, ЯН МЕЛЬНИК, МЕЧИСЛАВ СТЕЦ

Институт Хранения и Технологии Продовольственных Товаров, Отдел Технологии Продуктов Животного Происхождения, Сельскохозяйственная Академия, Вроцлав, Польша.

В работе сделано попытку применения метода количественного определения соевого текстурата в колбасных изделиях на основании определения содержания клетчатки. Исследования проведено на модельных колбасах произведенных с 0,15, 25 и 35% замещением мышечной ткани соевым текстуратом /Супро 50А, Ральстон Пурина Ком./. Успешному решению задачи сопоставления разработки условий омыления жира в колбасе, фильтрации мацерата и перемещения осадка клетчатки. Содержание клетчатки определено в заменителе белка мяса и в готовой колбасе. Среднее содержание клетчатки в соевом текстурате было на уровне $2,86 - 0,52$. На основании определения содержания клетчатки в соевом текстурате и в модельных колбасах выработанных с разным заменителем вычерчено стандартную кривую и вычислено соответствующее уравнение регрессии: $y = 46,32x - 4,04$. Пользуясь стандартной кривой или уравнением регрессии, после определения количества клетчатки, с достаточной достоверностью возможно определить количество волокнистого заменителя /с известным содержанием клетчатки/ в колбасных изделиях. Метод разрешает определить в среднем 79,17% клетчатки введенной в сыровый состав колбасы вместе с текстуратом, который подвергался исследованию что учтено при вычислении уравнения регрессии и вычерчиванию стандартной кривой.

An attempt to estimate the level of substitution of meat tissue by texturized soy protein
preparate in model comminuted sausage based on quantitative determination of crude fiber.

ZBIGNIEW DUDA, JAN MIELNIK, MIECZYSLAW STEC

Institute of Food Storage and Technology, Department of Animal Origin Food Technology,
Agricultural Academy, Wrocław, Poland.

Introduction

Utilization of soybean protein in various processed meat products has been increasing markedly over last years. However, foreign protein may be included in meat products as a replacement of meat tissue only to a limited amounts i.e. from a few percent up to 25-30% in selected products for example sausages. Numerous methods have been developed for determination of the meat extenders in meat products which are based on: electrophoretic separation of animal and plant origin protein, immunochemical and histochemical detection of meat extenders, determination of chemocellulose, crude fiber, magnesium, phytine phosphorus etc./1 - 11/. Nevertheless, a reliable methods for determination of the foreign protein prepartes are under continuous elaboration and direct as well as indirect, as simple as possible, methods for detection and/or quantitative determination of meat tissue substitute in meat products are still required. In the present study attempts have been made to assess quantitatively the levels of texturized soy protein substitute in model comminuted sausages using a adopted and slightly modified procedure elaborated by Formo at.al./2/ which is based on the crude fiber determination.

Material and methods.

Model comminuted /emulsified/, scalded sausages was manufactured from beef and lean pork, 35% each and 30% fat. Other ingredients such as: NaCl, NaNO₂, Natrium ascorbate, spices, liquid smoke prepartes and water were added in accordance with usual practice for the sort of the model sausages manufactured. Sausages emulsion was stuffed into 150 ml glass beaker and after 20 min. sedimentation was heated in thermocontrolled water bath at 90°C until 70°C in the centre measured by thermistor thermometer. After cooling in running tap water beakers with model sausages were placed for 24 h in refrigerator at 4°C.

Model sausages was manufactured with the following levels of meat substitution by texturized soy protein substitute /SPS/, Supro 50A, Ralston Purina Co., namely: 0, 15, 25 and 35 percent. Three separate batches of the model sausages were manufactured.

Crude fiber determination

Adoption of the crude fiber determination method used by Formo at.al./2/ for estimation of soy protein substitute addition to ground beef / a relatively lean meat product / requires elaboration of conditions for saponification of the fat in the object under investigation i.e. emulsified sausages / comparatively high fat content product/. In the original method saponification was made using 8% solution of KOH in 95% ethyl alcohol. Such concentration of KOH was found insufficient to saponify the fat content in 10g sample of sausage. About 9-10% of fat remains unsaponified. The reduction of sample weight was found undesirable. Therefore several concentrations of KOH in 95% ethyl alcohol was tried and the best results were obtained using for saponification a 12% KOH solution in 95% ethyl alcohol. Asbestos was prepared according recommendations given in paper by Formo at.al./2/. Prepared asbestos should give a negative reaction for crude fiber content.

Model sausages approx. 300g were twice minced through plate with 2 mm hole in laboratory mincer and well mixed. 10g sample was placed into round bottom bulb and 50 ml 12% alcoholic solution of KOH was added, bulb was fitted with condenser and heated in gently boiling water bath for 25 min., then bulb was disconnected from condenser and 1g prepared asbestos was added and the content heated again for 5 min. Still warm, the content of bulb was filtered under vacuum

through Schott G-4 funnel and the sediment was washed with 25ml portions of hot ethyl alcohol four 50ml portions of hot distilled water and finally with two 12,5ml portions of hot 1,25% /O,255N/ H_2SO_4 solution. The sediment in Schott G-4 funnel was quantitatively transfer into 500ml round bottom bulb. In the original method a special device for handling of the sediment was used. Due to unavailability of it the following procedure was developed. The Schott G-4 funnel with sediments, firmly attached to its porous bottom was placed into 100ml beaker filled with 75ml hot 1.25% H_2SO_4 solution and the level of the solution was maintained slightly above the porous part of the funnel. This was achieved by connecting the rubber tube to the leg of funnel and using water vacuum pump H_2SO_4 solution from a beaker was sucked into leg of funnel. Thereafter by pressing air through leg the sediment was detached from porous part of the funnel.

Suspended sediment was then transfer into a round bottom bulb and the funnel and beaker was washed with small portions of hot H_2SO_4 solution using 125ml of it. The content of the bulb was kept for 30 min. in gentle boiling under condenser and internal wall of the bulb was periodically washed down by liquid part of the contents of bulb from the solids attaching to it. After completing of the digestion in 12,5% H_2SO_4 solution content of the bulb was filtered under vacuum through perforated Gocha crucible with Whatman 1 disc placed on its bottom. The fiber content in a Whatman 1 disc was predetermined. The sediment /mat/ consisting of the crude fiber and added asbestos was washed with four 50ml portions of hot water and then with 25ml hot 95% ethyl alcohol. The crude fiber - asbestos mat and paper disc from Gocha crucible was quantitatively transfer into ashing crucible of known weight, dried for two hours at $130^\circ C$, cooled down and the mass of the mat determined with precision order of 0,0001g and thereafter ashed at $600^\circ C \pm 15^\circ C$ for 30 min. The amount of crude fiber was calculated from the difference in weight before and after ashing and the results expressed in percent of fat free dry matter of model sausages. Determination of the crude fiber was made in triplicate for control and experimental sausages of each of the three batches processed. Six determinations of the crude fiber contents in soy protein substitute used for sausages manufacturing was made after desintegration of 1g sample in a mortar.

Results and discussion

The contents of the crude fiber in texturized soy protein substitute used for manufacturing of the model sausages is shown in Table 1.

Table 1.

Crude fiber contents in soy protein substitute / % /							
3,24	3,53	2,31	3,21	2,37	2,53	$\bar{x} = 2,864$	$Sd = 0,524$

The recovery of the crude fiber in sausages processed with different level of meat substitution by SPS is shown in Table 2. The recovery of the crude fiber added to a model sausages emulsion manufactured with SPS is sufficiently high and knowing the precision of the fiber determination a level of substitution could be estimated quite satisfactory. An average recovery of the fiber in sausages manufactured with 15,25 and 35% of SPS amounts to $77,96\% \pm 2,35\%$ with $ts/\bar{x} \pm 1,36\%$.

As observed by us precision of recovery of the crude fiber introduced into sausages emulsion with meat substitute depends on the yield of a given sort of sausages manufactured i.e. it corresponds with fat free dry matter of the ready products. Moreover, determination of the crude fiber in processed meat products could be considered as a simple method for detection of the soy origin protein prepartate addition into the recipe of processed meat products.

Fig. 1 and 2 are illustrating relations between the amount of the crude fiber and the level of substitution of meat by SPS in experimental sausages. A very small amount of the crude fiber determined in sausages processed without SPS /5.5 to 12 times smaller than in the sausages with SPS/ could origin from the spices added as an integral part of the recipe and was deducted

from the amount of fiber determined in sausages processed with SPS.

Table 2

Recovery of the crude fiber in sausages processed with substitution of meat by SPS
Model comminuted sausages with different level of meat substitution by SPS / % /

Batch	A - 0		B - 15		C - 25			D - 35		
	Fiber %FFDM	Fiber intro- duced with SPS %FFDM	Fiber deter- mined %FFDM	Reco- very %FFDM	Fiber intro- duced with SPS %FFDM	Fiber deter- mined %FFDM	Reco very %FFDM	Fiber intro- duced with SPS %FFDM	Fiber deter- mined %FFDM	Reco- very %FFDM
I	0,089	0,583	0,548	78,73	0,971	0,755	68,58	1,095	0,933	77,07
II	0,089	0,519	0,505	80,15	0,758	0,752	87,46	1,315	1,080	75,36
III	0,086	0,457	0,426	74,39	0,932	0,749	71,13	1,186	1,139	88,78
$\bar{X}$	0,088	0,520	0,493	77,75	0,887	0,752	75,72	1,199	1,051	80,40
Sd	0,023	0,051	0,071	3,00	0,113	0,053	10,24	0,111	0,116	7,30

A level of substitution i.e. the amount of SPS used for sausages emulsion composition could be calculated on a basis of determined amount of the crude fiber although bearing in mind an average percent of fiber recovery. According our findings the percent of SPS used for sausages manufacturing and calculated on a basis of determined amount of crude fiber ought to be increased by 22,04%. Substitution of animal raw material by SPS based on determination of crude fiber and already considering an average recovery factor could be read-out from the standard curve and/or calculated using the following equation: $y = 46,32x - 4,04$.

Conclusions

1. The level of meat substitution by SPS with known concentration of the crude fiber could be estimated using a standard curve prepared on a basis of the crude fiber determination in a given sort of comminuted, scalded sausages.
2. Estimation of the percent of substitution of meat by SPS used for sausages manufacturing based on crude fiber determination necessitates consideration of an average recovery of the crude fiber and in present experiments were achieved by increasing the percent of substitution by 22,04% or using the following equation:
 $y = 46,32x - 4,04$.

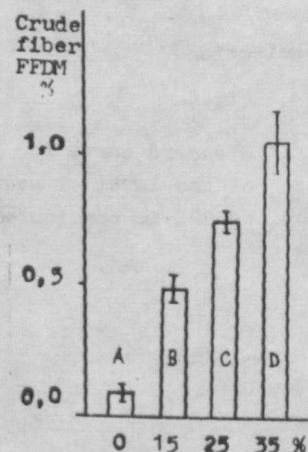


Fig.1. Content of the fiber in model sausages with 0, 15, 25 and 35% SPS

REFERENCES

1. de Hoog, P., van den Reek, S., 1970 Nachweis und Bestimmung von Aufgeschlossenem Milcheiweiß und soja-protein in Fleischer-Zeugnissen. Die Fleischwirtschaft, Vol. 50, No. 12, 1663.
2. Formo, M.W., Honold, G.R., 1974 Determination of Soy Products in Meat-Soy Blends. Journal of the AOAC, Vol. 57, No. 4, 841.

3. Frouin, A., Barraud, C.,
Jondeau, D.
4. Grudzińska, E.,
Skrabka-Błotnicka, T.
5. Hofmann, K., Penny, I. F.
6. Kozłowska, H., Zadernowski, R.,
Nowak, H., Przystalowski, J.
7. Kraack, J.
8. Lee, Y. B., Rickensrud, D. A.,
Hagberg, E. C., Briskey, E. J.
9. Parsons, A. L., Lawrie, R. A.
10. Rejt, J., Rutkowski, A.
11. Spell, E.
- 1973 Detection des proteines de soja ou de lait dans les produits de viande sterilises ou non. Proc. XIX European Congress of Meat Research Workers. Paris, J/8, Vol. III, 1409.
- 1978 Zawartość substytutów mięsa w jego przetworach. Przemysł Spożywczy, T. XXXII, Nr. 1, 23.
- 1973 Methode zur Identifizierung und quantitativen Bestimmung von Fleisch- und Fremdeiweiss mit Hilfe der SDS-Polyacrylamid-Elektrophorese auf Flachgelen. Die Fleischwirtschaft, Vol. 53, Nr. 2, 252.
- 1979 Próba wykrywania preparatów białka roślinnego w konserwach mięsnych. Przemysł Spożywczy, T. XXXIII, Nr. 2, 65.
- 1973 Bestimmung von Fremdeiweiss in Wurstwaren. Die Fleischwirtschaft, Vol. 53, Nr. 5, 697.
- 1975 Quantitative determination of soybean protein in fresh and cooked meat-soy blends. J. of Food Sci. Vol. 40, 380.
- 1972 Quantitative identification of soya protein in fresh and heated meat products. J. Fd. Technol. Vol. 7, 455.
- 1978 Detekcja histologiczna białek sojowych w przetworach mięsnych. Medycyna Weterynaryjna, Nr. 7, 416.
- 1972 Nachweis von Milcheiweiss und Sojaeiweiss in Fleischzeugnissen mit Hilfe der vertikalen Flachdisk-Elektrophorese. Die Fleischwirtschaft, Vol. 52, Nr. 11, 1451.

% substitution

Fig. 2.

Standard curve for determination
of the level of meat substitution
by SPS in comminuted sausages.

