Detection and determination of pentoses and pentosans in meat and meat products.

Hugo Fredholm

SLAKTERIFÖRBUNDET

397

Detection and determination of pentoses and pentosans in meat and meat products.

Preliminary report

by

Hugo Fredholm

Research Laboratory Department, Sveriges Slakteriförbund
Stockholm, Sweden.

Introduction and general considerations.

All meat and meat products contain pentoses. Ribonucleic acids play an important rôle. "Free" ribose will appear to an increasing amount in meat e. g. during storage even if this storage is carried out under refrigeration or as cold storage, as was first shown by the author (Fredholm 1959 & 1960). The naturally occuring quantities of pentoses in meat are always small, in any case less than 0,1 % calculated on the water containing muscle.

As soon as cereals, vegetables, spices and alike are added to a meat or meat product the quantity of pentoses, mainly as pentosans, will increase markedly. This is especially the case when soy meal is added. Though this product is rich in protein and does not contain very much of carbohydrates, as a rule about 12 to 15 % of the kinds of soy meal used e. g. in sausage manufacture in some countries, an addition of soy meal to meat or meat products strongly increases the amount of pentosans and pentoses present, because the carbohydrates of soy meal are pentosans to a great extent.

During the last years soy meal has been used and is used in increasing amounts as a cheap additive to or as a component of meat and meat products. A manufacturer of meat products will gain not only by substituting meat protein for soy protein but also by an increased water binding capacity of the product. To loyal manufacturers of meat products as for Society it is of great value to

398

have means for detecting and determination of addition of e. g. soy meal, therefore.

A protein analysis of meat products may give valuable information as to the origin of the protein present. It has been found that certain polypeptides, especially tripeptides are characteristic to soy protein. Of course a simple amino acid determination is of no value in this connection. Our polypeptid-investigations will not be treated here. It seems as if detection and determination of pentoses, free and complex, might be a simple way to get first information, why it is treated here.

Materials and methods.

Meat from the longissimus dorsi muscle of beef and pork was used, as was bologna sausage with and without spices, liver pasty, white pepper and soy meal. Ten different kinds of ham and sausages were investigated too. The special type of bologna used, Falu, contained 4 % as dry matter of potato-starch, the liver pasty contained besides pork liver and pork 10 % milk, 4 % wheat meal, 1 % onion and 0, 4 % spices. The soy meal was delivered by General Mills as TSP 100 and according to our analysis it contained:

Table 1.

Analysis of soy meal.

		Original	Filtrate from a suspension after stirring with water during 15 min. at	
			20°C	45°C
Dry matter	%	93, 1	34, 6	39, 9
Ether soluble	%	2, 3		
Protein	%	52, 2	7, 6	
Soluble protein	%		22, 0	31, 1
Pentosans determined as phloroglucides	%	4, 7		

399

Detection of pentoses and pentosans. Small quantities of pentoses can easily be detected and estimated by the modifications of the orcinol test given by Schneider (1957) and Ceriotti (1955) as well as by the chromatographic methods used by Fredholm (1960). However, it is of definite interest to have a simple, rapid test method for pentoses and pentosans in meat products. It was found that the phloroglucin method can be carried out in such a way that it gives quick information about pentosancontaining additives e. g. soy meal. The following procedures were used. 1. To 20 g of the finely ground sample 100 ml of HCl (1:2) was added and distilled. The first 30 ml of distillate were replaced by HCl (1:2) and this operation was carried out three times. After filtering through paper filter 10 ml phloroglucin reagent (1 g phloroglucin to 150 ml HCl 1:2) was added to 10 ml of filtrate. The quantity of precipitation separated over night was estimated. 2. Hydrolysis of 20 g of sample was carried out in the same way as is described in Kungl. Lantbruksstyrelsens Kungörelse (1950) for the determination of the fiber contents of feeds, except that the KOH treatment was made before the H_2SO_4 treatment. Distillation and precipitation as above. 3. As 1. but using orcinol reagent of the same concentration as phloroglucin reagent for precipitation.

Determination of pentoses and pentosans. 1. The procedure described in Official Methods of Analysis - A. O. A. C. (1950) for the determination of pentosans in grain was tested for meat and meat products. As a rule 20 g of meat product were distilled. 2. As 1. except that orcinol reagent was used instead of phloroglucin reagent. 3. To 20 g of finely ground sample 100 ml of HCl (1:2) was added. The mixture was distilled. When 30 ml distillate had been collected, the same quantity of HCl (1:2) was added into the distillation flask. This was repeated until 360 ml of distillate had been collected. The distillate was diluted to 500 ml with dist. H_2O.

Orcinol reagent prepared according to Schneider (1957) was added and the light extinction at 6600 Å was measured in 10,00 mm cells. Blinds were always run. Normally 7 different dilutions were read. A standard curve was prepared by means of d-Ribose solution which was treated in the same way as sample.

Results.

Detection of pentoses and pentosans. Of special interest the results are which were obtained by method 2. The following samples were tested:

Sample	Result of testing
1. Beef	No precipitate
2. Beef treated with soy meal extract	White voluminous precipitate
3. Pork	No precipitate
4. Pork treated with soy meal extract	White voluminous precipitate
5. Liver pasty	Small white finegrained precipitate
6. Liver pasty with soy meal added	White voluminous precipitate
7. Canadian bacon	No precipitate
8. Cooked ham	" "
9. Calves meat	" "
10. Cocktail sausage containing 4 % potato-starch	" "
11. Luncheon meat	" "
12. Bologna sausage	" "

Figure 1. gives a picture of the relative volume of precipitate when the test was carried out as described above and in every test 20 g of sample was used and the soy meal of soy meal extract containing samples contained 1 g of soy meal or extract of 1 g of soy meal per 20 g of sample.

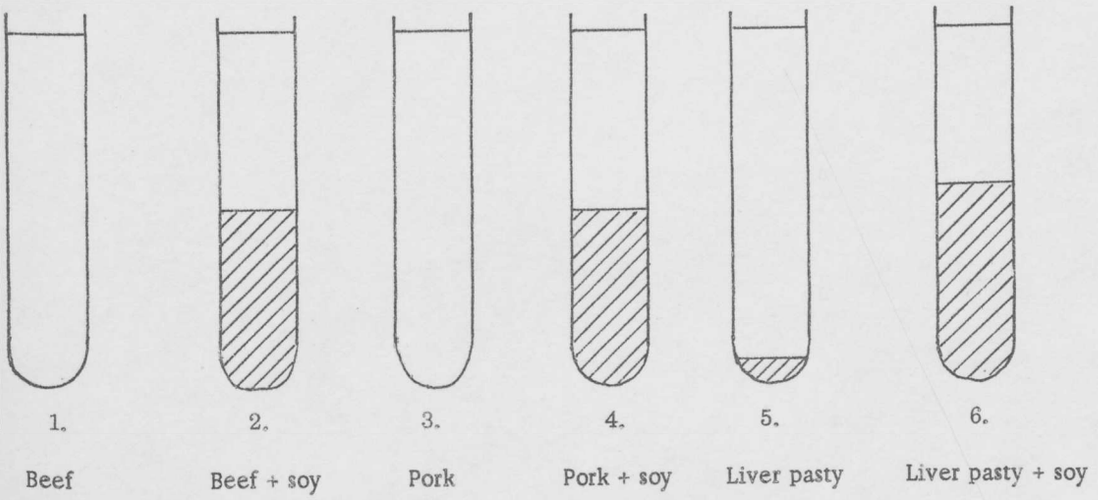


Fig. 1.

On the other hand, if the test is carried out as described under Method 1., small precipitates will appear from samples of beef and pork and other meats and meat products to which pentose- or pentosan-containing products have not been added. Of course this test is more sensitive.

Determination of pentoses and pentosans in meat. Table 2. gives some results obtained by using method 1.

Table 2.

Pentoses + pentosans in beef, pork and liver pasty. 20,0 g sample distilled with HCl (12 %). Distillation 5 times repeated. After filtering and dilution with HCl (12 %) to 360 ml precipitated with 40 ml phloroglucin reagent. Precipitate filtered through porcelain filter and dried for 4 h. at 103°C.

Sample	Pentoses + pentosans %
Beef	0,06
Beef + 5 % soy meal	0,23
Pork	0,06
Pork + 5 % soy meal	0,22
Liver pasty	0,25
Liver pasty + 5 % soy meal	0,41

Table 3 contains some results obtained by using phlorogucin reagent compared to orcinol reagent.

Table 3.

Quantity pentoses + pentosans in beef, pork and liver pasty. Results obtained with phlorogucin reagent in one series and orcinol reagent in another, 20 g samples.

Sample	Pentoses + Pentosans g.% Phloroglucin	Orcinol
Beef	0,04	0,05
Beef + 5 % soy	0,24	0,21
Pork	0,04	0,06
Pork + 5% soy	0,22	0,22
Liver pasty	0,26	0,26
Liver pasty + 5 % soy	0,48	0,50

The spectrophotometric method described was found to be the most convenient and also most accurate method for the determination of pentoses and pentosans. Fig. 2. shows a standard curve obtained by using d-Ribose solution treated as described and fig. 3. light extinction by solutions of distillates of beef and beef to which known quantities of soy meal had been added.

Fig. 2.

Extinction of light of 6600 Å in 10,00 mm cells with increacing concentrations of ribose.

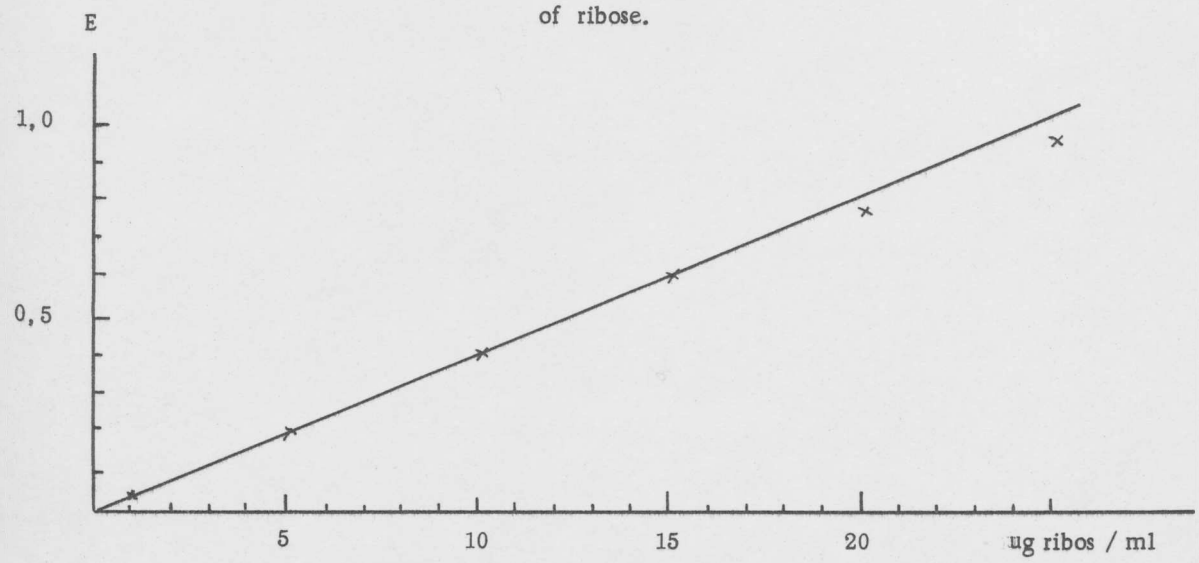
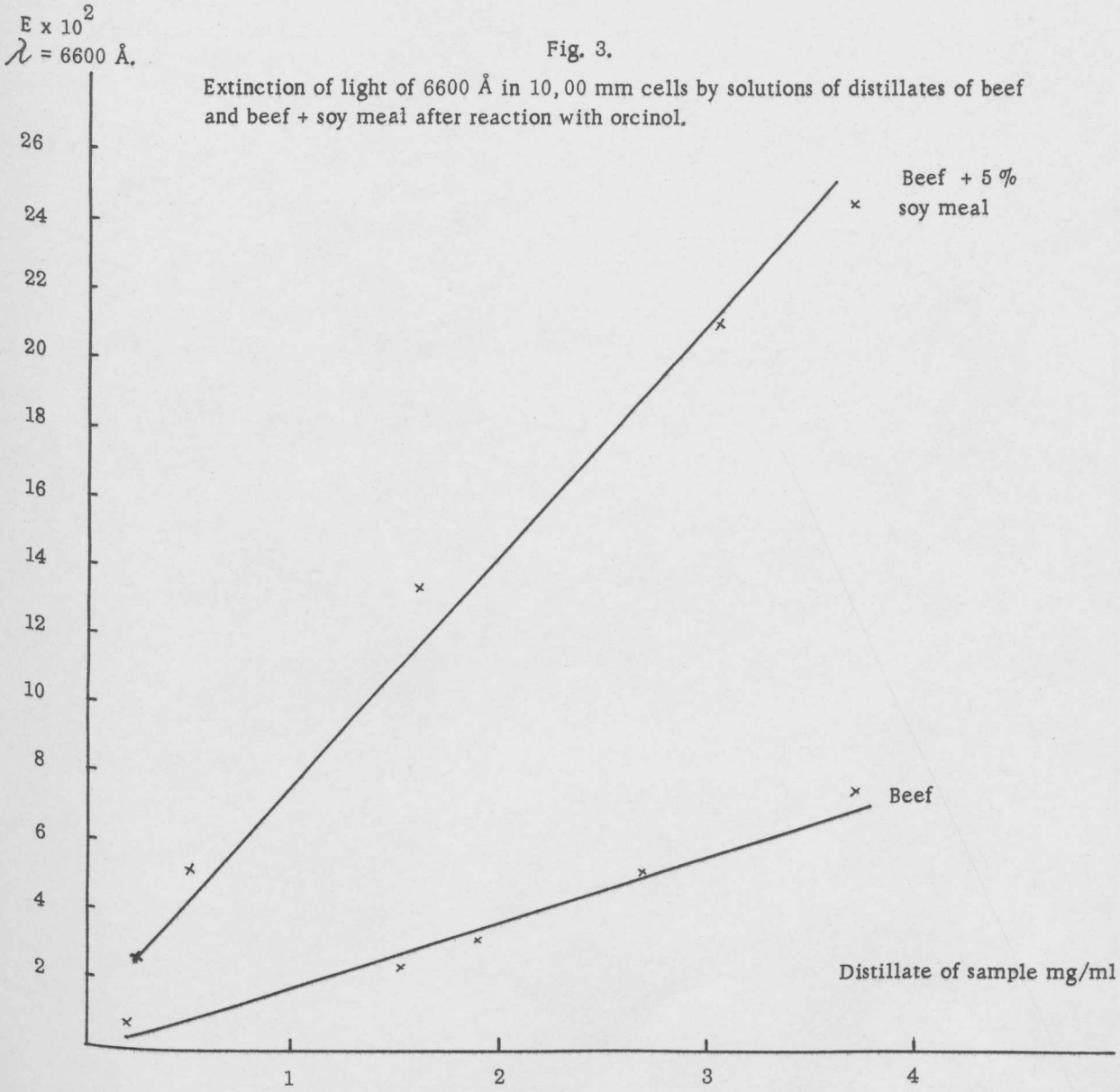


Fig. 3.

Extinction of light of 6600 Å in 10,00 mm cells by solutions of distillates of beef and beef + soy meal after reaction with orcinol.



As will be seen from the curves the sample of beef giving the lower light extinction curve of fig. 3. was found to contain 0,045 % pentoses and the sample of beef to which soy had been added was found to contain 0,167 % of pentoses + pentosans. The figures are in close agreement with those found by gravimetric analysis.

Summary.

Meat and meat products were investigated in regard to the presence of pentoses and pentosans. Meat from the longissimus dorsi muscle of beef and pork, several meat products, including sausages of different kind, liver pasty, ham, canadian bacon etc. as well as spices and soy meal were investigated.

Several methods for the detection as well as determination of pentoses and pentosans in meat and meat products were worked out and described in detail. One of the methods described for the detection of pentoses and pentosans gives pentosans and pentoses added only, whilst pentoses originally present in meat are not caught.

Methods for the determination of pentoses and pentosans in meat and meat products are compared. Both phloroglucin and orcinol methods are described. Spectrophotometric methods are compared to gravimetric. A spectrophotometric method whereby a distillate of a hydrolysate of the sample after reaction with orcinol is measured at λ = 6.600 Å and then the quantity of pentoses calculated from the light extinction value was found to be the most convenient and accurate method for the determination of pentoses and pentosans in meat and meat products within a wide range of concentrations.

Since soy meal, recommended for use in sausage manufacturing etc., was found to contain not less than about 5 % of pentosans even a small addition of soy meal will increase the values found very strongly.

References.

Ceriotti, G. (1955). Determination of Nucleic Acids in Animal Tissues. Journ. Biol. Chem. 214, 59 - 70.

Fredholm, H. (1959). Ribose in meat. Vème Reunion des instituts de recherches sur les viandes. Paris.

Fredholm, H. (1960). Ribose in meat. Acta chemica Scandinavica 14, 437 - 440.

Kungl. Lantbruksstyrelsens Kungörelse (1950). Bestämmelser för undersökning av fodermedel vid statens lantbrukskemiska kontrollanstalt etc. Nr 6, 40 - 41. Stockholm.

Official Methods of Analysis - A. O. A. C. (1950) Seventh Ed. p. 350 - 351. Washington D. C.

Schneider, Walter C. (1957). Determination of Nucleic Acids in Tissues by Pentose Analysis. Methods in enzymology III, 680 - 684, New York.