

The quality of meat products - monitoring the content and type of protein in selected fermented meat products

Ladislav Staruch, Marcel Mati, Peter Gombita

Institute of Biotechnology and Food Science
Faculty of Chemical and Food Technology
Slovak University of Technology in Bratislava
Bratislava, Slovak Republic

Abstract

This thesis focuses on the determination of protein content in selected meat products using the Kjeldahl method, which is suitable for all food categories and is direct, reliable, internationally accepted („arbitrage“) as well as suitable for insoluble proteins. Using a method for the determination of hydroxyproline (according to the standard ISO 3496) we obtained the collagen content in the products. Through the conversion formula we obtained the net muscle protein content (BEFFE), which is an important indicator of a meat product's quality. The results provide insight into the quality of what are probably the best known fermented meat products on the market.

Proteins, meat products, collagen, hydroxyproline, BEFFE

Introduction

Meat and meat products are among the most popular, sought-after foods and they play an indispensable role in the diet of consumers. From a nutritional point of view, they are a rich source of complete protein, minerals, lipids and trace elements. In comparison to beef and pork, poultry is noted for its higher protein content. Protein is a unique and very essential food component. Since an organism is nearly unable to make protein reserves, it is important to ensure protein intake from food on a daily basis. The structure and composition of animal proteins are related to the proteins of human beings and thus their consumption is essential and unsubstitutable. The percentage of protein content in meat ranges from 18% to 22% (Hoogenkamp 1992). There has been a rising trend among meat producers to continue reducing the meat content in their products and, inevitably, essential additives as well. In the meantime, the proportion of supplements of less valuable sources of protein allowable in meat products according to legislation is on the rise. An important indicator of the quality of meat products is therefore the content of net muscle protein, which is the focus of this thesis.

Protein determination using the Kjeldahl method

The Food Code of the Slovak Republic specifies the quantity of complete proteins in Chapter 5 of Section 1 in Art.2 of Part 3 under the paragraph 54 by multiplying the quantity of nitrogen (N) determined by the Kjeldahl method by a factor of 6.25 (Decree of the Ministry of Agriculture of the Slovak Republic and the Ministry of Health of the Slovak Republic No. 1895/2004-100 of 18 August 2005). Nitrogen is determined by heating a substance in sulfuric acid in the presence of a catalyst, during which nitrogenous substances are converted into ammonium sulfate. Alkaline hydroxide is used on the ammonium sulphate to displace the ammonia, which, using water vapor, is distilled and captured in a solution of boric acid and is determined by titration. This method is used for the determination of protein in food, feed, cereals, legumes, oil-bearing plants and products made from them (Corporate literature – service manual).

Address for correspondence:

Ing. Ladislav Staruch, PhD.
Faculty of Chemical and Food Technology
Slovak University of Technology in Bratislava
Radlinského 9, 812 37 Bratislava, Slovak Republic

Phone: +421 903 834 126
E-mail: ladislav.staruch@stuba.sk
www.maso-international.cz

Determination of hydroxyproline content in meat products

Hydroxyproline, liberated by acid hydrolysis of protein, breaks down through oxidation into 3-hydroxy-4-amino-1,3 diene valeric acid, which reacts with p-dimethylaminobenzaldehyde to form a red compound whose amount is determined photometrically (ISO 3496 - Determination of hydroxyproline content 2003). Increased content of hydroxyproline in meat products infers the addition of skin or a skin emulsion during its manufacture. The Food Code of the Slovak Republic defines net muscle protein (BEFFE) as the difference between the quantity of total protein and the quantity of connective tissue protein and added non-meat protein. Connective tissue protein is defined by the paragraph (57) as a protein of connective tissue consisting of collagen and elastin. It is possible to calculate (in percentages) the amount of collagen in the total quantity of protein according to Art. 2 paragraph (58) using the following formula (Decree of the Ministry of Agriculture of the Slovak Republic and the Ministry of Health of the Slovak Republic of 18 August 2005 No. 1895/2004 – 100 and Decree of MASR and MHSR - Meat Products and Edible Animal Fats):

$$\% \text{ of collagen} = \frac{\text{hydroxyproline} \times 100 \times 8}{N \times 6.25}$$

Collagen is the most abundant and most represented stromal protein, which is characterized by high levels of the amino acid hydroxyproline. The collagen content in muscle tissue ranges from 1% to 2%. Collagen is often white and hard. Native collagen is resistant to proteases, digestible by pepsin and indigestible by trypsin. When heated, collagen fibers shorten to one-third of initial values.

Materials and Methods

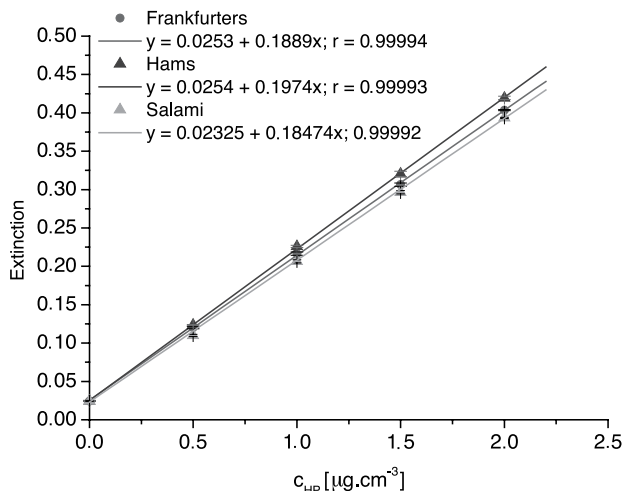
Selected types of meat products from various producers as well as products purchased in stores were analyzed. We focused on a wide range of products, but in this section we are presenting selected fermented meat products which are, from a legislative perspective, not allowed to have non-meat proteins added to them.

Table 1. Comparison of BEFFE (Bindegewebeeitweissfreies Lebereiweiss) and total protein content in selected salamis

Samples - Salami	Total proteins (%)	BEFFE content (%)
Ponitran salami	21.62	19.75
Carmen salami	25.48	23.40
Nitran salami	21.81	19.78
Austria salami	21.68	19.87
Lovecká salami	25.26	23.40
Malokarpatská salami	18.45	16.59

Table 2. Determination of collagen content in salamis

Samples - Salami	Extinction	Hydroxyproline (g·100g ⁻¹)	Collagen (%)
Ponitran salami	0.735	0.234	1.87
Carmen salami	0.816	0.261	2.08
Nitran salami	0.796	0.254	2.03
Austria salami	0.711	0.225	1.81
Lovecká salami	0.732	0.232	1.86
Malokarpatská salami	0.733	0.233	1.86



Equation of a line: Standard curve of salami $Y = A + B \cdot X$

A	0.02325
B	0.18474
R	0.99992

Fig. 1. Calibration curve

Results and Discussion

Comparison of the content of total muscle protein and net muscle protein.

On the basis of selected analyses (physicochemical, sensory, and primarily on the basis of net muscle protein content - BEFFE) it is possible to state that Carmen salami from the company Tauris was evaluated as the best. The total protein content amounted to 25.5%, which was the highest achieved value. It is a fermented meat product for which the key elements of preservation are water loss, drying and fermentation. The loss of water content during such production can be up to 50%. This product contains approximately 10% less fat in comparison with regular traditional durable heat-untreated products on our market. As opposed to Carmen salami, the lowest net muscle protein content (BEFFE) was found in Malokarpatská salami, which amounted to 16.6%. This product in particular showed a significant proportion of adipose tissue. The collagen content in all analyzed samples was at a level of approximately 2%, which refers to an equal proportion of raw materials without the further addition of some other incomplete proteins. The lowest percentage of collagen content was measured in the Austria salami produced by Mecom. We recommend that attention in the future stay focused on the monitoring of net muscle protein content (BEFFE) in meat products as an indicator of meat product quality. This should be based on the methods used for determining total nitrogen using Kjeltex devices. In addition, attention should be given to additives of collagen components by monitoring hydroxyproline and extend the monitoring of protein components by microscopic methods for the detection of selected food components (including non-meat protein).

Conclusions

The thesis deals with the monitoring of the quality of meat products from the point of view of net muscle protein content (BEFFE). There has been a rising trend among meat

producers to reduce the meat content in their products and, inevitably, essential additives as well. In the meantime, the proportion of supplements of less valuable sources of protein allowable by legislation in meat products is on the rise. An important indicator of the quality of meat products is therefore the net muscle protein content (BEFFE). The thesis gives an analytical overview whose objective is to monitor the real situation on the market with meat products, which are among the most popular consumer products. These are products of the three largest producers of meat products in the Slovak Republic: Tauris, Mecom and Berto. The analyses were based upon the use of the Kjeldahl method for the determination of protein together with the KJELTEC AUTO 1030 Analyzer device.

The thesis also includes a section dealing with the determination of hydroxyproline in meat products, which is used in the detection of the quantity of either present or added collagen into the aforementioned products.

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