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Comparative analysis of bologna sausages made from turkey meat raw materials

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Abstract

The aim of our research was to compare the characteristics of turkey fillet-, MDM- and MSM-based Bologna sausage. In addition, we also used water, pork fat, sodium nitrite salt mixture, and Soluprat for the production. 1 mix was 280 g. The products were heat treated in a can (75 °C, 55 min). Summarizing our results, in most cases, MSM-based meat products differed from the other samples. The pH value and water activity of the MSM product didn't differ significantly from fillet and MDM product. During chemical composition tests, it was established that the fat content of the MSM-based product was significantly reduced in comparison to the pastes, thus MSM-based product had a higher protein content. It was observed that the MSM-based sample is darker, redder and similarly yellowish. From the results of our research, the quality of MSM is inferior compared to the other, i.e. comparing a meat paste with the same chemical composition and the product, we produced a lower quality product. In order to be able to produce a same quality product, we may need to use more additives (e.g. stabilizers, emulsifiers).

Introduction

Meat is the processed and certified skeletal muscle of mammals and poultry for human consumption. According to Regulation (EC) No 853/2004, meat is the edible parts of the following animals, including blood: pigs, cattle, calves, poultry (e.g., chickens, hens, ducks, geese, turkeys), other warm-blooded animals (sheeps, rabbits, goats, horses, etc.), wild animals (wild boar, deer, cervids, wild rabbits, etc.) and ratites (ostriches)

In addition to lean meat, meat removed from bones can also be used in meat products, according to the provisions of the Requirement No 1-3 / 13-1 of the Codex Alimentarius Hungaricus:

- Mechanically deboned meat (MDM), the production operation is limited to the mechanical removal of the bone from the boned meat and is not intended for the further extraction of meat from the bone remaining after boning.
- Mechanically separated meat (MSM) is a product obtained after boning from fresh, fleshy bones or poultry which have been removed by mechanical means in such a way as to damage or modify the muscular structure. This does not qualify as meat.

The basis of the method was developed in Japan in the early 1940s for remove and separating fish meat (Trindade et al., 2004; Oliveira et al., 2015). According to Regulation (EC) No 853/2004, MSM cannot be made from poultry skins, neck skin and heads. Bone-in meat packaged for up to 3 days at 2°C can be used as raw material. The regulation stipulates a shelf life of 3 months when stored at -18°C. It is important that MSM can only be used in heat-treated products. MSM does not qualify as meat due to its unfavorable chemical (high fat and calcium content) and functional (poor water binding) properties. The composition and name of the product must also include 'mechanically separated meat (MSM)'. Previously, this was also classified as meat, but - due to its unfavorable properties - its use in meat products was maximized by 10% (Req. No 1-3 / 13-1 of the Codex Alimentarius Hungaricus). Of course, it can also be used in larger quantities to produce a product, but in this case the product cannot be called e.g., bologna sausage, vienna sausage.

Fig. 1. Raw materials (fillet meat, MDM, MSM).

	Fillet	MDM	MSM
Meat (%)	56.00	56.00	80.00
Pork fat (%)	21.00	20.00	5.50
Ice (%)	23.00	24.00	14.50
Nitrite salt (%)	2.00	2.00	2.00
Soluprat (%)	0.35	0.35	0.35
Total (%)	102.35	102.35	102.35

Table 1. Recipes of the prepared products.

Materials and methods

Minced turkey drumsticks (particle size: 3 mm), mechanically deboned meat made from turkey drumsticks and MSM made from turkey backs were obtained from Gallfood Ltd. (Kecskemét, Hungary) and Gallicoop Ltd. (Szarvas, Hungary) (*Fig. 1*).
In addition, we also used water, pork fat, nitrite salting mixture, and tetrasodium-pyrophosphate (Soluprat) to produce the samples. The recipe can be found in Table 1. 1 mix was 280 g. Based on the Requirement No 1-3/13-1 of the Codex Alimentarius Hungaricus and the chemical composition of the raw materials (Mihalkó et al., 2022), pastes were created with the same chemical composition. The manufacturing process can be seen in *Fig. 2*. The finished products were placed in cans and heat-treated in this way (in a water bath at 75 °C for 55 minutes). We used this procedure instead of the natural casings filling, because due to the small amount of the experimental products, a significant amount of technological loss should have been expected. The raw and the finished products can be seen in *Fig. 3*.
Cooking loss was measured by simple mass loss calculation. The mass of the meat paste was measured during filling it in a can, and then after heat treatment, the mass of the product was measured. From these, the cooking loss value was calculated as a percentage (on three repeats).
Pressing loss was determined by the following method. 0.5 to 1 gram of raw samples was placed on dried filter paper. The samples were placed between glass plates and were weighed at 1000 g for 5 minutes. To determine the cooking loss, the 2x2x2 cm raw samples were heat-treated in an airtight plastic bag until a core temperature of 72 °C was reached. In determining the roasting loss, two sides of the 2x2x2 cm raw samples were heat-treated in a contact grill heated to 170 °C for 5 minutes. Measurements were performed on three repeats.
During our work, instrumental color measurement (*Fig. 5*) was performed in 10 different points on the meat pastes and on the surface and inner part of the products with MINOLTA CR-300 CROMAMETER (Osaka, Japan). The obtained color coordinates (L*, a*, b*) were used to determine the color stimulus difference (ΔE*), which was determined by the formula of Lukács (1982). We performed analytical measurements on examined products. We measured fat, moisture, protein content with FOSS FoodScan 2 (*Fig. 4*).
The pH value of the samples was measured with a Testo 206 device (on three repeats). The sensory evaluation of the samples was carried out by a total of 10 people, who were students and lecturers. The sensory evaluation was performed by 35 participants. The properties studied were color, smell, taste, hardness, juiciness, and order of preference. In the case of the preference ranking, the reviewers ranked the samples in total. The participants were able to rate the samples on a scale of 0 to 100 (using the method of profile analysis). The higher value was darker for color, more pleasant for smell and taste, and harder for stock.

Fig. 2. The manufacturing process of the samples.

Fig. 3. The raw and finished samples (from fillet meat, MDM, MSM).

Fig. 4.
FOSS FoodScan 2.

Fig. 5. MINOLTA CR-300 CROMAMETER.

Results and discussion

Cooking loss: It can be clearly observed that, based on the percentage of the cooking loss, there was a significant difference ($p < 0.05$) between the samples (fillet: 1.5 ± 0.15%; MDM: 2.6 ± 0.12% and MSM: 3.9 ± 0.29%). However, it should be noted that the cooking loss was reduced by tetrasodium pyrophosphate, without which we would certainly have noticed a higher cooking loss.
Pressing loss: It can be clearly observed that, based on the percentage of the pressing loss, there was a significant difference ($p < 0.05$) between the samples (fillet: 2.60 ± 0.012%; MDM: 2.91 ± 0.006% and MSM: 4.03 ± 0.012%).
Color measurement: *Fig. 6* shows that the lightness (L*) of the samples is between 57 and 71, the red color intensity (a*) is between 2 and 12, and the yellow color intensity (b*) is between 14 and 18. A significant difference can be seen within some of these intervals. In terms of lightness, there is a significant difference between the MSM-based samples (pastes, porudct's surface and inner part) and the other samples ($p < 0.05$). In the case of red color intensity, the samples made of MSM took on a significantly higher value, i.e. it became redder compared to the other two samples. In the case of yellow color intensity, there is no significant difference between the samples (exception: between fillet meat paste and MSM-based paste). Using these values, the color stimulus difference was calculated between 2-2 samples. The large color stimulus difference values were between meat pastes, products' surfaces and inner part made from MSM and the other raw materials. There was a well noticeable difference between the product made from fillet and MDM. There was a visible difference between the meat pastes made from MDM and the other two samples (values of 2.39).
Chemical composition: As we can see in *Fig. 7*, there is a significant difference between the fat content of the samples ($p < 0.05$). The product made from fillet had the lowest fat content (20.9%), this value was not much higher for the product made from MDM (21.12%). The sample with the highest fat content was the MSM-based meat product (24.64%). There is also a significant difference between the moisture content values of the samples ($p < 0.05$), however, the MSM-based product had the highest value (66.50%). This was followed by the sample made from fillet (65.88%) and MDM (65.43%). There is also a significant difference between the results of the protein content of the samples. The Bologna sausage made from MDM contains the most protein (12.54%), followed by the fillet- (12.30%) and the MDM-based sample (11.85%). In other words, the trend of the protein content follows the trend observed for the moisture content.
pH value: There was a significant difference ($p < 0.05$) between the pH values of the meat pastes and the pH values of the products, as the pH values of the meat pastes were as follows: the MSM-based one was 6.94 ± 0.00, the MDM-based one was 6.69 ± 0.01 and the fillet-based one was 6.88 ±0.01. The pH values of the products were as follows: the MSM-based one was 6.72 ± 0.01, the MDM-based one was 6.53 ± 0.01 and the fillet-based one was 6.66 ±0.02. In other words, it can be established that the pH value decreased as a result of the heat treatment. It can also be noticed that the MSM-based sample had the highest pH value, both in the case of meat pastes and in the case of products, followed by fillet meat and the MDM-based sample.
Sensory evaluation: As we can see in *Fig. 8*, the darkest sample was the filet sample, followed by the MDM-based sample, and the lightest sample was the MSM-based sample. According to the reviewers, the MDM-based product had the best smell, followed by the fillet sample, and the MSM-based sample had the worst smell. The fillet and MDM-based samples were the best-tasting products, the MSM-based products were the least liked. Regarding the hardness and juiciness of the product, the most popular sample was the sample made from fillet and MDM, the least popular was MSM. Order of preference:The most popular product was the product made from fillet (rank index: 1.5), followed by the product made from MDM (rank index: 1.6), the least liked sample made from MSM (rank index: 2.9). Overall, it can be determined based on the sensory assessment that the MSM sample was significantly different from the other samples.

Conclusion

Summarizing our results, in most cases, MSM-based meat products differed from the other samples. The pH value and water activity of the MSM product didn't differ significantly from fillet and MDM product. During chemical composition tests, it was established that the fat content of the MSM-based product was significantly reduced in comparison to the pastes, thus MSM-based product had a higher protein content. It was observed that the MSM-based sample is darker, redder and similarly yellowish. From the results of our research, the quality of MSM is inferior compared to the other, i.e. comparing a meat paste with the same chemical composition and the product, we produced a lower quality product. In order to be able to produce a same quality product, we may need to use more additives (e.g. stabilizers, emulsifiers).

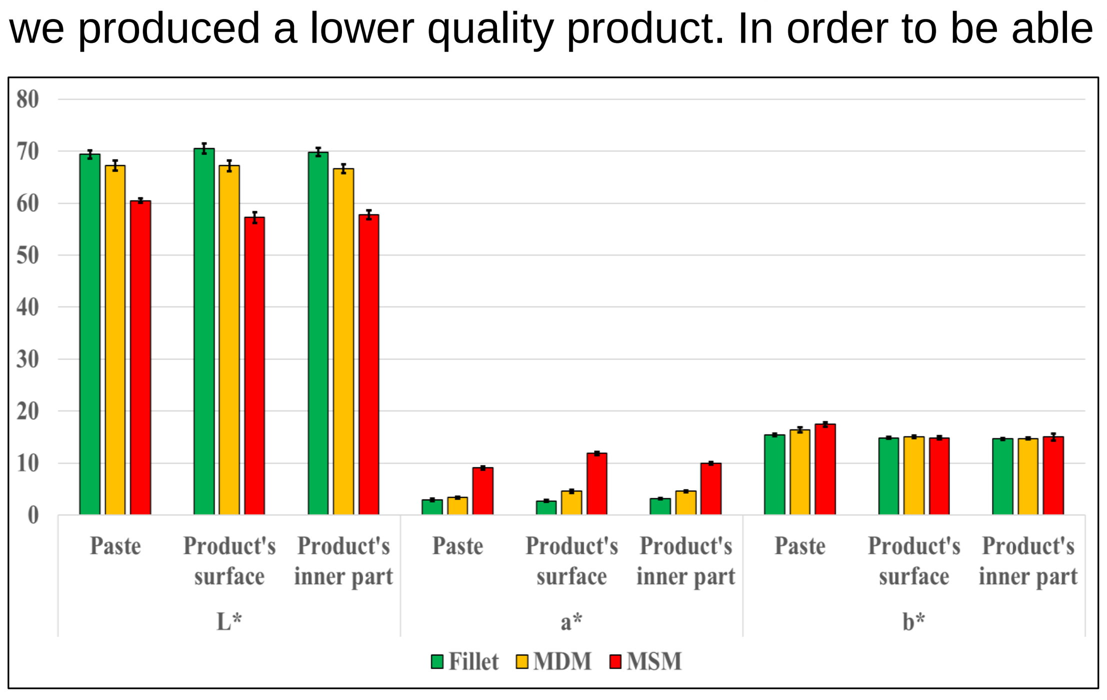

Fig. 6. Color coordinates of the samples. L*: lightness value, a*: red color intensity, b*: yellow color intensity, MDM: mechanically deboned meat, MSM: mechanically separated meat

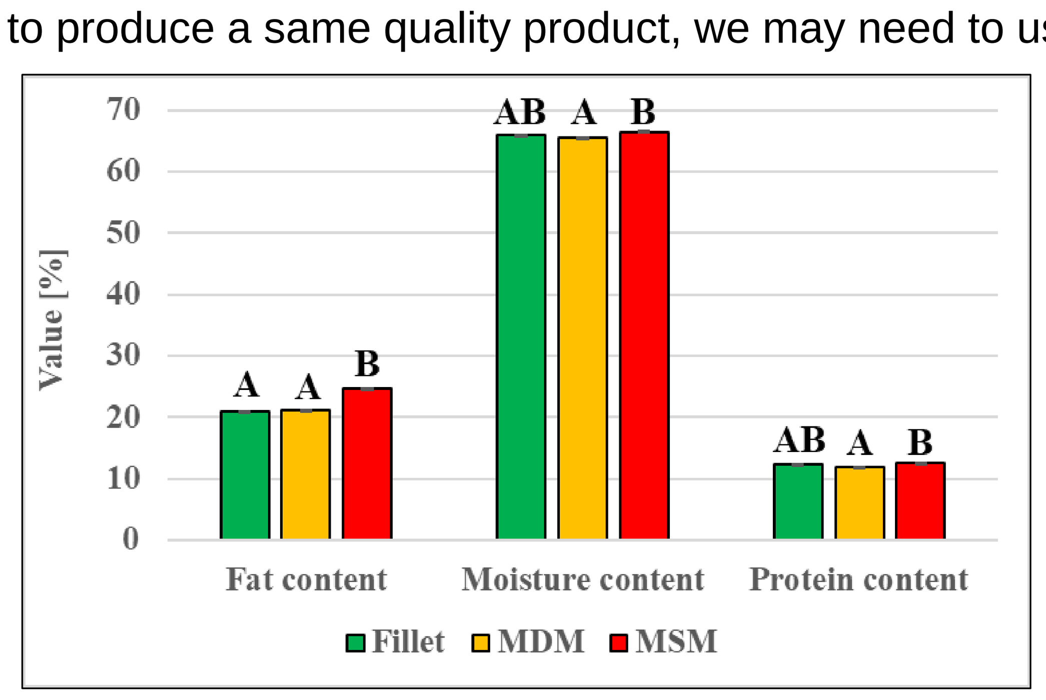

Fig. 7. Chemical composition of the samples. MDM: mechanically deboned meat, MSM: mechanically separated meat.

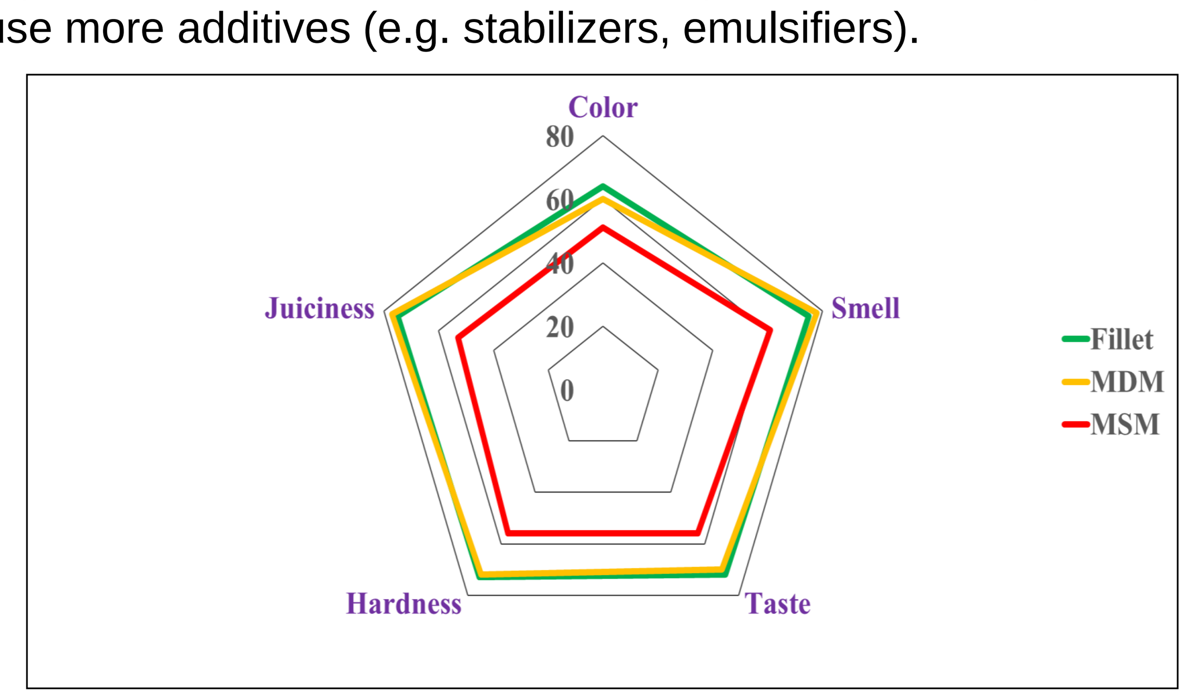

Fig. 8. Results of sensory evaluation. MDM: mechanically deboned meat, MSM: mechanically separated meat.

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