

## ПРОМЯНА НА ХИМИЧЕСКИЯ СЪСТАВ НА ТРАДИЦИОНАЛНИЯ МАКЕДОНСКИ КОЛБАС СЪХРАНАВАН НА РАЗЛИЧНИ ТЕМПЕРАТУРИ

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## CHANGE OF CHEMICAL CONSTITUTION OF THE TRADITIONAL MACEDONIAN SAUSAGE KEPT OF DIFFERENT TEMPERATURES

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*This study reports the changes that occur at vacuum packed Macedonian Sausage produced in the traditional way during the storage in cooling chambers at different temperature conditions of 6°C and 15°C. Changes that occur during the storage were examined on 2<sup>nd</sup>, 15<sup>th</sup>, 25<sup>th</sup> and 50<sup>th</sup> day from production. It was determined that during the storage time of the sausages substantial changes occur in the decreasing content of water and increasing content of proteins, fats and mineral materials. The total number of bacteria in the sausages increases during the storage mostly of those at 15°C. Best sensor characteristics till the 50<sup>th</sup> day showed the sausages kept on 6°C.*

**Keywords:** Macedonian sausage, chemical composition, temperature

### Introduction

In the last two decades a vast number of meat products are being produced in Macedonia, out of which the largest group are the sausages. Like everywhere so does Macedonia have its original product known as the Macedonian Sausage that falls under the group of semi-dry meat products, and has specific sensor characteristics due to the added spices. The Macedonian Sausage is produced from: grinded beef and pork meat of second category, head meat and meat trimmings, emulsion of hard pork fat tissue (ham), soya proteins, additives and spices. The meat that is used for production of the Macedonian Sausage comes from second category pork and beef, head meat and meat and fat trimmings. The fat tissue (back ham) that is used for production of the Macedonian Sausage preferably comes from adult pigs or sows deprived of accretion (Dzinleski 1985).

In the past the Macedonian sausages were often produced in domestic conditions in autumn, when the pigs were usually slaughtered. The meat for production of sausages was left to chill out and then was grinded with a knife or a grinding machine. The grinded meat was salted and left for one day and then the spices were added - onion or scallion, red pepper, black pepper and then stuffed into small pork or beef bowels. The domestic Macedonian sausage was smoked and dried on the attic or some secluded place and then consumed raw or thermally processed. The Macedonian sausage produced in industrial conditions differs from the traditional one since for

its production they use second or third category beef and pork, meat and fat trimmings, head meat, mechanically deboned meat, soya proteins, additives, spices, brine salt and is stuffed in artificial bowels. After stuffing the bowels, i.e. forming the sausages, they are thermally processed and smoked in thermal chambers, washed with cold water, cooled and drained. After the cooling of the sausages they are packed in vacuum foils and kept on a temperature of 6°C to 8°C (Dzinleski 1985). Because of its durability the Macedonian sausage falls in the category of semi-dry products. The durability of this type of sausage depends mostly on the conditions of its keeping (packing, temperature, relative humidity etc.). During the keeping of the sausage, from production till consumption, considerable changes occur that influence the weight of the product - due to water evaporation the weight decreases, thus imposing economic lost, and at the same time the chemical constitution and micro-flora of the sausage change depending on the keeping conditions. The goal of this study is to explore the chemical, microbiological changes that occur during the keeping on temperatures of 6°C and 15°C, thus influencing the sensor characteristics of the sausage.

### Material and methods

Processed material

Meat origin and ingredients

The material used for production of the Macedonian Sausage, also called National Sausage, was pork and beef meat. The brine was produced by Alkaloid -

Skopje, the spices were produced by Droga - Kolinska - Slovenia, the soya proteins were produced by Soya - Protein - Bechej and the additives (Polyphosphate preparation) were produced by Haifa - Israel. Sausage is produced by the following recipe: second category beef meat 15 kg; third category pork meat 15 kg; pork head meat emulsion 10 kg; hard fat tissue 20 kg MDM (mechanically deboned meat); ice 20 kg; spices 0,400 g; nitrite salt 2.2 kg; polifosfat 0.300 g; soya flour 2.5 kg; starc 2.5 kg. The produced sausages are cooled to an average temperature of 4°C and packed in vacuum foil with a vacuum packing machine Vebomatic. The 12 samples were randomly selected and divided in two groups. The first group was kept in a cooler at a temperature of 6°C while the second one was kept at a temperature of 15°C.

#### Method of examination

The sausages were marked and on the 2<sup>nd</sup>, 15<sup>th</sup>, 25<sup>th</sup> and 50<sup>th</sup> day each sample was weighed on an electronic scale Bizerba with accuracy of 0,1. The goal of the weighing was to determine the change of the mass of the sausages, although they were vacuum packed. At the same interval, examination of the chemical constitution and sensor analysis was performed, along with examination of microbiological changes and development of micro flora in the sausages during the period of storage.

The chemical analysis was performed by the commonly accepted methods used for scientific purposes. The content of water in the sausages was determined by drying in a drying chamber at a temperature of 105°C for a period of 24 hours, i.e. by gaining the same mass in two consecutive measurements.

The content of fats in the sausages was examined according to the usual method for extraction with an organic solvent (Wochs et. al 1961). The content of proteins in the sausages was examined by the method of Kjeldahl. The content of mineral materials was examined by burning in a Muffle oven at a temperature of more than 550°C (Pozarskaja et al. 1964). The pH value of the sausages was measured with a pH-meter type Lu-co. The sensor analysis was performed by applying the 9-degree scale designed by the High Institute for Meat Industry Moscow (VNIIMP Moscow) with 10 trained analysts. The sensor analysis graded the appearance, color, consistency, smell and taste. Each sensor attribute was graded from 1 to 9, having in mind that 1 means undesirable and 9 desirable (Aleksandrova et al. 1999).

The microbiological examination was conducted according to the usual practice in the meat industry

by planting the water solution of the sample on a nutritional bed and incubation at a temperature of 30°C for a period of 72 hours. The obtained results of the examinations were processed in compliance with the usual methods that are used for scientific purposes by a standard computer program ANOVA MS Excel program 1997-2003 in accordance to the established statistical methods. By using the Duncan test, the average values, variation intervals and the presence of significant deviations were calculated (Statistica v.6 Stat Soft 2003).

#### Results and discussion

The results of chemical analysis of the Macedonian Sausage kept on 6 and 15°C are shown in Table 1.

1. Changes in weight and proximate composition of Macedonian Sausage during its storage at 6 and 15°C

Indicator	Storage period, days							
	2 <sup>nd</sup> day		15 <sup>th</sup> day		30 <sup>th</sup> day		50 <sup>th</sup> day	
	6°C	15°C	6°C	15°C	6°C	15°C	6°C	15°C
Weight %	100	100	96.1	94.6	85.3	88.0	78.6	80.6
Water, %	68.5	68.5	65.8	64.8	58.4	60.3	53.9	55.2
Fats %	12.0	12.0	14.0	15.4	17.2	17.9	19.2	19.2
Proteins %	14.0	14.0	16.0	14.9	19.2	16.9	21.2	17.7
Mineral materials, %	4.0	4.0	4.2	4.6	5.2	5.2	5.9	5.5

\* Each value is mean of 12 replication

As the data from Table 1 show, on the 2<sup>nd</sup> day the average content was 68.5% of water, 14% of proteins, 12% of fats and 4% of mineral materials. After 15 days of storage on a temperature of 6°C the mass decreased to 96.1% and the water decreased to 65.8%, while the content of fats increased to 14%, the proteins increased 16% and the mineral materials increased to 4.9%. On the 30<sup>th</sup> day of production the chemical constitution of the sausages changes further since the mass decreased to 85.3% and the water decreased to 58.4%, while the fats increased to 17.2%, the proteins increased to 19.2% and the mineral materials increased to 5.2%. These changes are a result of the evaporation of the free water within the sausages. The last day of storage, i.e. on the 50<sup>th</sup> day, the mass decreased to 78.6%, the water decreased to 53.9%, the fats increased to 19.2%, the proteins increased to 21.2% and the mineral materials increased to 5.9%. The results of pH value of the Macedonian sausage kept on 15°C is 6,14. The results of chemical analysis of the Macedonian Sausage kept on 15°C are also shown in Table 1. As

the data from this Table show that after the 15 days of keeping the sausages on a temperature of 15°C the mass decreased to 94.6%, the water decreased to 64.8%, while the fats increased to 15.4%, the proteins increased to 14.9% and the mineral materials increased to 4.6%. On the 30<sup>th</sup> day the mass decreased to 88%, the water decreased to 60.3%, while the fats increased to 17.9%, the proteins increased to 16.9% and the mineral materials increased to 5.2%.

On the last day of storage the mass decreased to 80.6%, the water decreased to 55.2%, while the fats increased to 19.2%, the proteins increased to 17.7% and the mineral materials increased to 5.5%. The results of pH value of the Macedonian sausage kept on 15 °C is 6,19. The statistical differences between the changes of the chemical constitution of the sausages kept on 6°C and 15°C during its storage are not statistically significant  $p > 0.05$  ( Table 2). \*Each value is mean of 12 replications

2 – Analysis of variance between first and second group examined sausages during storage period

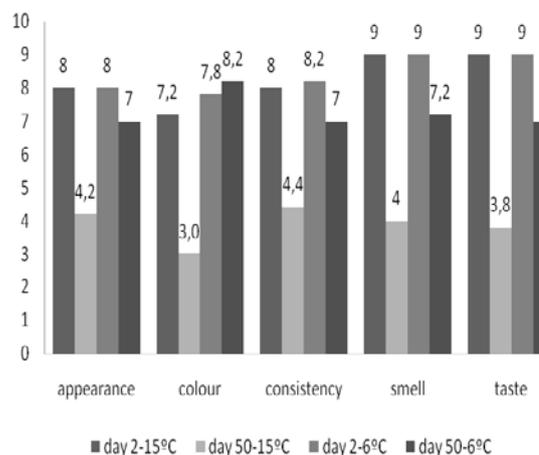
Source of variation	SS	df	MS	F	P-value	Fcrit
Between Groups	27.3	3	9.1	0.023	0.99*ns	3.0
Within Groups	9365.2	24	390.2			
Total	9392.4	27				

Legends: SS- Sum of squares Df- degree of freedom V- Variance \*ns- Non significant

Since the content of water decreases during the storage of the sausages the content of dry mater (proteins, fats and mineral materials) adequately increases. The increase of the dry mater is not proportional for all three components, but it shows bigger or minor variability for some of them. The biggest increase on the 15<sup>th</sup>, the 30<sup>th</sup> and the 50<sup>th</sup> day showed the fats of the sausages kept on 15°C. On the other hand, the sausages kept on 6°C show constant and standard increase of the content of fats and proteins. The differences between the changes of the fats and proteins in two samples are insignificant. The quantity of mineral materials for both cases (sausages kept on 6°C and 15°C) is nearly identical for the examination intervals and there is no significant variation. The differences show a  $p=0.05$ . During the storage period of the sausages the content of micro organisms also changes under the influence of evaporation of the water thus increasing

the content of dry mater especially the salt and the change of pH value. As a result of the change of the chemical constitution of the sausages their microbiological picture also changes. The sausages kept on 15°C show significant increase of their overall number compared to the ones kept on 6°C. On the 15<sup>th</sup> day of storage of the sausages on a temperature of 15°C the total number of bacteria was 900 in ml, while on the 50<sup>th</sup> day their number increased to 1.500 in ml. The sausages kept on 6°C showed a total number of bacteria of 700 in ml. on the 15<sup>th</sup> day and 900 in ml. on the 50<sup>th</sup> day.

The increased number of bacteria is a result of the favorable conditions for their development. The results from the sensor examination of the sausages kept on 6°C and 15°C show that there are significant differences. The sausages kept on 6°C significantly maintain their sensor characteristics even after 50 days of their storage, which is best shown on Figure 4, since the changes are minimal. The results of the sensor characteristics of the Macedonian Sausage kept on 15°C during a period of 50 days show significant differences which could be best observed on figure 1.



1. Sensory quality of Macedonian sausage kept at 6 and 15°C for 2 and 50 days

The sensor characteristics of the Macedonian Sausage kept on 15°C during a period of 50 days are significantly deteriorated (approximately by 1/3) compared to those on the 2<sup>nd</sup> day from production. Many authors studied the influence of vacuum packing on the durability of the meat and the sausages. Thus Ambrosiadis et al. (2004) studied the traditional Greek sausages and concluded that 5.9% of the sausages were stable, while 25.3% of sausages showed increase of fats due to storage period. Papadima et al. (1999) also studied the traditional Greek sausages and concluded that due to storage period the content of fats increases. V. Para et al. (2010) studied the durability of the Iberian Ham



Sliced and concluded that due to storage period the chemical and microbiological characteristics of the product deteriorate. Oksuz et al. (2008) explored sausages produced from fish and concluded that that the moisture and ashes of the sausage decrease while the content of fats and proteins increases. Our research confirmed the previous findings of the studies performed by others.

## Conclusions

Based on the examinations performed on the changes of the chemical constitution of the Macedonian Sausage Vacuum Packed kept on 6°C and 15°C the following conclusions can be made:

1. Both samples of the Macedonian Sausages kept on 6°C and 15°C show decrease of the content of water during their storage period. The differences of the two decreases are insignificant.
2. By decreasing of the water content, the content of dry mater percentually increases. The biggest increase was shown by the fats and then the proteins and finally the mineral materials.
3. The number of microorganisms in the Macedonian Sausage kept on 15°C is significantly increased on the 50<sup>th</sup> day of its storage, while the sample kept on 6°C showed only 900 in ml.
4. The sensor attributes of the Macedonian Sausage on the 2<sup>nd</sup> and the 50<sup>th</sup> day from production also change. Biggest changes occurred on the sausages kept on 15°C, while the changes of those kept on 6°C were minimal.

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