

## THE INFLUENCE OF SOME STARTER CULTURES ON THE TEXTURE OF INDUSTRIALLY PRODUCED MACEDONIAN TRADITIONAL SAUSAGE

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**Abstract:** The aim of this paper is to monitor the influence of two starter cultures on texture of industrial produced Macedonian traditional sausage. The research covered three variants: Variant 1: Control variant (conventionally produced Macedonian traditional sausages using nitrite salt and powdered acerola); Variant 2: Macedonian traditional sausages where the basic formulation was enriched by the addition of starter culture CS-300 in combination with powder Swiss chard and powdered acerola; Variant 3: Macedonian traditional sausages where the basic formulation was enriched by the addition of starter cultures CS-300 and BLC-78 in combination with powdered Swiss chard and powdered acerola. The greatest strength (penetration force) on the surface was determined in the sausages from variant 3 (8.773 N), and the sausages from variant 2 (8.521 N) are characterized with the smallest hardness.

**Key words:** Macedonian traditional sausage, starter cultures

### Introduction

The processing of meat in meat products records its first beginnings in the Phoenicians, and hence it starts to extend all over the world. According to numerous written data, the first meat preparations have been started with the salting of the meat, and later, other means of conservation began to be applied (Hammes and Hertel, 1998.; Čavlek, 2001.). The various properties of sausages, including their overall quality, are conditioned, above all, by the type and quality of the meat, but also by the added additives, spices, preservatives, and the applied technological procedures in the production (Feiner, 2006.; Leroy et al., 2006.; Honikel, 2008.). One of the most types of sausages that are produced in the Republic of Macedonia is the traditional *Vevcanski* sausage, whose formulation is 1400 years old. Traditional food is considered as a legacy that is transmitted by generations, and consumers expect specific sensory properties and high quality food. At the same time, traditional food must be safe from the microbiological and chemical-physical aspect, without uncontrolled processing and without the presence of preservatives.

The texture of meat products has a significant role on the overall organoleptic properties of the product. One of the most important factors for quality of sausages is the direct impact of the texture as a property, on the formation of consumers' opinion for a particular product through the use of senses of touch and taste (Hathwar et al., 2012.). So, Bourne (2002.) defines the texture as a response to the perception of the

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consumer created on the basis of the received external incentives, and is caused by the interaction between some part of the body and the food. The specific raw materials added during the industrial production of sausages, as well as the applied technological conditions, are the basic factors responsible for the formation of the overall texture properties. These factors include the process of denaturation of muscle proteins which is responsible for forming a fine texture in sausages. During storage, texture changes as a result of biochemical degradation, which usually results in a loss of product hardness (Lorenzo et al., 2000.). Accordingly, strength is a very important feature of meat products and is one of the factors that define the overall quality and acceptability of the final product by the consumers. In sausages and other meat products, the desired texture is achieved by adding nitrites and other chemicals, and in a natural way it is obtained by adding appropriate starter cultures (Janssens et al., 2012.; Maksimović et al., 2015.).

From the aspect of full realization of this potential, research on the influence of starter cultures and their metabolites on the quality of foodstuffs is of great importance, and in order to become their obligatory part of the regular, industrial production processes (Casaburi et al., 2007.; Bhat et al., 2012.). The use of starter cultures in the food industry is a substitute for many chemical additives (including additives containing natural components), which contributes to the creation of new and attractive products containing less chemical preservatives (Demeyer et al., 2000.; Arihara, 2006.).

Accordingly, obtaining of quality products is possible only if during fermentation dominates useful, homo-enzymatic types of lactic acid bacteria, and otherwise production errors are very common (Djukic et al., 2015.).

The aim of this research paper is to monitor the influence of two starter cultures on instrumental values for texture of industrially produced *Macedonian traditional sausage*.

## Material and methods

As a material for work was used *Macedonian traditional sausage* produced in industrial conditions in the meat industry "Soleta" in Skopje. As a basis for the production of this product the traditional formulation of *Vevcanskisausage* was taken, modified for industrial use. Pork meat (I category) and dorsal bacon were used in the ratio 75:25%. Water was added in an amount of 150 mL/kg mixture. Then additives, spices and starter cultures were added to the mixture. The following starter cultures were used: CS-300 (*Staphylococcus carnosus* ssp. *utilis* + *Staphylococcus carnosus*) and BLC-78 (*Pediococcus acidilactici* + *Staphylococcus carnosus*).

The research in this paper covered three variants:

- *Variant 1*: Control variant (conventionally produced *Macedonian traditional sausages* using nitrite salt and powdered acerola);
- *Variant 2*: *Macedonian traditional sausages* where the basic formulation was enriched by the addition of starter culture CS-300 in combination with Swiss chard powder (as a substitute for nitrite salt) and powdered acerola;
- *Variant 3*: *Macedonian traditional sausages* where the basic formulation was enriched by the addition of starter cultures CS-300 and BLC-78 in combination with Swiss chard powder (as a substitute for nitrite salt) and powdered acerola.

The meat and bacon were ground to pieces of 8 mm. Then all spices and starter cultures were added, according to the determined formulation. The aim of adding Swiss chard powder is to provide a natural source of nitrates that the added starter cultures will convert into nitrites, so it is expected to achieve better results compared to the control variant where nitrite salt is added during production, and the only source of nitrates is the leek that is part of the basic formulation. In this way, not only nitrite salt is completely excluded from use, thus eliminating its adverse effects on the health of consumers, but also improvements in the quality of sausages have been achieved. The meat, together with the added spices and starter cultures, was mechanically mixed in a stirrer. Then, the mixture was left to stand for 48 hours in a refrigerator at a temperature of 1-3 °C.

After leaving the mixture, it was accessed to filling of the sausages in the machine, where between the filling of the mixture of each variant, detailed washing and cleaning of the filler was carried out. Sausages were then thermally treated with following program: 1. Incubation (2h on 42°C); 2. Drying (20 min on 65 °C); 3. Smoking (40 min on 65 °C); 4. Cooking (on 80 °C till reaching 70 °C in the center); 5. Smoking (10 min on 80 °C).

The following analyses were made:

- *Penetration force*: The penetration force was determined on the final product on 4<sup>th</sup> day of the production, and the results are shown as the arithmetic mean of the three analyzed samples taken randomly, separately from each variant. The analysis was made by penetrating the probe on the sausage surface at a speed of 2 mm/s, at a depth of 10 mm, in three places on each specimen, using the Texture analyzer - TA.XT plus, Stable micro systems.

- *TPA test (Texture Profile Analysis)*: The TPA test (Texture Profile Analysis) was determined on the final product on 4<sup>th</sup> day of the production. The results are obtained by moving the probe at a speed of 2 mm/s, at a depth of 2 mm to precisely cut pieces of sausage. They are shown as an arithmetic mean of three analyzed samples taken randomly, separately from each variant. The analysis was performed by penetrating the probe using the Texture Analyzer appliance - TA.XT plus, Stable micro systems.

Data are statistically processed with ANOVA test in SPSS program package.

## Results and discussion

According to data shown in Table 1, can be seen that with the highest hardness (penetration force) on the surface are characterized the sausages from the variant 3 (8,773 N). Minor hardness was measured in sausages from the control variant (8,603 N), while the sausages from the variant 2 (8,521 N) are characterized with the smallest hardness.

Tabela 1. Prosečne vrednosti instrumentalne analize teksture Kobasica na 4. dan proizvodnje  
 Table 1. Average values from the instrumental analysis of texture of sausages on the 4<sup>th</sup> day of production

Mostra Sample	n	Tvrdoća (silapenetracije) Hardness (penetration force) (N)
		$\bar{x} \pm SD$
Varijanta 1 (kontrola) Variant 1 (control)	7	8,603 <sup>a</sup> ± 0,98
Varijanta 2 (CS-300) Variant 2(CS-300)	7	8,521 <sup>a</sup> ± 1,44
Varijanta 3 (CS-300 + BLC-78) Variant 3(CS-300 + BLC-78)	7	8,773 <sup>a</sup> ± 1,33

<sup>a</sup> – the values for texture marked with same letters have no statistically significant difference between the examined variants (p>0.05)

Tabela 2. Prosečne vrednosti iz TPA testa kobasica na 4. dan proizvodnje  
 Table 2. Average values from TPA test of sausages on the 4<sup>th</sup> day of production

Sample	n	TPA test					
		Tvrdoća (napreku) Hardness (of intersection) (N)	Kohezivnost Cohesiveness (%)	Lepljivost Springiness (%)	Elastičnost Resilience (%)	Gumljivost Gumminess (N)	Pogodnost za žvakanje Chewiness (mJ)
		$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$
Varijanta 1 (kontrola) Variant 1 (control)	7	13,85 <sup>a</sup> ± 299,19	0,722 <sup>a</sup> ± 0,32	1,363 <sup>a</sup> ± 1,57	0,537 <sup>a</sup> ± 0,13	480,113 <sup>a</sup> ± 136,52	970,707 <sup>a</sup> ± 114,45
Varijanta 2 (CS-300) Variant 2(CS-300)	7	6,86 <sup>a</sup> ± 269,95	0,864 <sup>a</sup> ± 0,01	1,114 <sup>a</sup> ± 0,23	0,605 <sup>a</sup> ± 0,04	647,960 <sup>a</sup> ± 157,74	851,293 <sup>a</sup> ± 271,41
Varijanta 3 (CS-300 + BLC-78) Variant 3(CS-300 + BLC-78)	7	5,85 <sup>a</sup> ± 412,87	0,852 <sup>a</sup> ± 0,06	1,808 <sup>a</sup> ± 1,90	0,578 <sup>a</sup> ± 0,04	783,509 <sup>a</sup> ± 237,72	987,711 <sup>a</sup> ± 243,75

<sup>a</sup> – the values for TPA test marked with same letters have no statistically significant difference between the examined variants (p>0.05)

The highest hardness of intersection have the sausages from the control variant (13,85 N). The highest coefficient of cohesiveness (0,864%), springiness (1,114%) and resilience (0,605 %) have the sausages from the variant 2. On the other hand, the sausages from the variant 3 are characterized with the highest values for gumminess (789,509 N) and chewiness (987,711 mJ).

Accordingly, can be concluded that the best texture characteristics have the samples from the variant 2, where one starter culture was added, i.e. they have medium hardness, maximum cohesiveness and resilience, the slightest stickiness and medium gumminess. However, there are no statistically significant differences in the examined parameters between the variants.

Vesković Moračanin et al. (2013) found that the traditional laundered fermented sausage produced in November is characterized by a higher value for the parameter penetration force (23,55 N), while in its production in January, the value declines to 12,49 N, and the reason for this, according to the authors, is the different production conditions. In their research, Dincer and Çakli (2015) found that bovine sausages have a higher hardness (3,18 N) compared to chicken sausages (2,73 N). But, on the other hand, chicken sausages have greater cohesiveness (0,68%), compared to bovine sausages (0,35%). Pietrasik and Duda (2000) point out that the values of cohesiveness in sausages increase as a result of lowering the fat content.

### Conclusion

According to the analysis, can be concluded that the sausages where starter cultures have been added are characterized with better texture characteristics compared to the sausages from control variant. The best texture properties have the samples from the variant 2 (CS-300), so they have medium hardness, maximum cohesiveness and resilience, the lowest stickiness and the medium gumminess.

Starter cultures have a positive influence on the texture of the industrially produced *Macedonian traditional sausage*. According to the obtained results, with the use of the starter culture CS-300 (*Staphylococcus carnosus ssp. utilis*+ *Staphylococcus carnosus*) good quality of the sausages is achieved. At the same time a safe product is obtained where the use of nitrite salt is completely eliminated.

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