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Пример: Ibrishimov N, H. Lalov, 1984. Clinical laboratory investigations in veterinary medicine, 1984, Zemizdat, S. 363 p. (Bg)

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EFFECT OF STARTER CULTURES AND GLUCONO DELTA-LACTONE (GDL) ON SENSORY CHARACTERISTICS OF FERMENTED SAUSAGES PRODUCED IN MACEDONIA

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Abstract
Fermented sausages are the result of biochemical, microbiological, physical and sensorial changes occurring in a meat mixture during ripening. These products are attractive to consumers because they offer a wide variety of color, flavors and textures. This study was conducted to determine some sensory characteristics (appearance, color, odor, aroma, flavor and texture) of four different samples of Macedonian fermented sausages made in an industrial way of production, where different meat category, spices were used and two of the products are produced with starter culture and the other with Glucono delta-lactone (GDL). As seen from the results, all samples show similar average values (3.90; 3.70; 3.92; 4.05) that point to high quality of the fermented sausages based on consumers' expectations of taste. There was a significant difference ($p<0,05$) between products produced with starter culture and Glucono delta-lactone on the texture, color and odor.
Key words: fermented sausages, sensory analysis, starter cultures, Glucono delta-lactone

Introduction

Most of the meat products produced today is based on traditional practices (Ahmad S. and Amer B., 2013). The process of fermentation was carried out throughout centuries without any scientific information regarding the nature of the processes involved in the fermentation of meat products (V.P. Singh et al., 2012).

Sausages are produced from a meat batter composed of lean and fat meat, and other ingredients (curing agents etc.), stuffed in natural or synthetic casings, and, then subjected to a ripening process under controlled temperature and relative humidity (Coloretti et al., 2014). In addition to meat, many other ingredients can be added to the batter, including spices (black and red peppers, fennel, nutmeg, cumin, etc.), curing agents (nitrate and nitrite), sodium chloride, sugars (to favor lactic fermentation) and starter cultures (lactic acid bacteria, micrococci, staphylococci and fungi) (Toldrá, 2006).

For manufacturing of fermented sausages usually are required starter cultures such as Lactic Acid Bacteria (LAB) strains, for example *Lactobacillus pentosus, L. casei, L. curvelius, L. planterium, Pediococcus acidilactici* and *P. pentosaceus.* Starter culture reduces pH and lowers the water activity which protects the product from pathogenic microorganisms. Fermented sausages

produced with starter culture are more tender (soft) than non fermented sausages due to activity of certain enzymes produced by the starter culture (V.P. Singh et al., 2012). Starter cultures improve product's taste, aroma, flavor and color. They play important role on proteolysis which affects the consistency of the product by the degradation of myofibrillar structure and on its taste through the accumulation of small peptides and free amino acids (Ahmad S. and Amer B., 2013).
GDL (glucono delta lactone) is a weak acid, which converts to gluconic acid in water and slowly dissociates in hydrogen ions with time (Chang et al., 2009). Glucono delta-lactone functions as a curing and pickling agent, leavening agent, pH control agent and sequestrant. GDL lowers the pH and helps preserve the food from deterioration by enzymes and microorganisms. GDL accelerates the cured color development. According to Ngapo 1996 higher GDL concentrations increase lightness of meat protein gel and produces lighter and more yellow sausages. According to Chun 2014 adding GDL increases texture profiles such as hardness and cohesiveness of pork meat and its products.
There a many factors affecting the sensory characteristics of meat products such as the meats used as raw materials (genetic type, feed, age, sex and rearing system), microorganisms selected as microbial starters for the fermentation and type of processing technologies (cooking, drying, smoking etc.) (Ahmad S. and Amer B., 2013).
The sensory evaluation is needed to determine the influence of sensory characteristics of fermented meat products manufactured with Glucono delta-lactone or starter culture on the consumer acceptability.

Material and methods

The fermented sausages used as samples for this study were manufactured from pork or beef meat in four different factories of the meat industry in Macedonia. The samples were obtained from local meat market. Two of the products used as samples for the study are produced with starter culture and the other with Glucono delta-lactone (GDL).
The experiment was prepared as part of the Faculty of biotechnical sciences, by 43 panelists. The panelists, who were involved, were faculty members, students, and stuff, between the age of 21 to 61. Selection of the panel members was based on their willingness to participate and a training session was carried out before the testing.
The samples of the fermented sausages were cut in slices and placed on plastic plates individually for every panelist. The samples were kept anonymous for the panelist by assigning product codes with three digit numbers on every sample. A glass of water was provided for rinsing mouth between samples.
The evaluation method was based on quantitative descriptive ranking method with the 5 point scale (1 = worst, 5 = the best) to evaluate the samples. The final score was calculated by multiplying with a coefficient of significance which represents the contribution of individual parameters in the maximum sensory profile (appearance 2, color 3, odor 5, aroma 3, flavor 5 and texture 2 of maximum sensory profile).

Results and discussion

The obtained results from the sensory evaluation of the four different samples of fermented sausages, two manufactured with starter cultures, and two with Glucono delta-lactone, using the quantitative descriptive ranking method with 5-point scale are presented in the following table.
According to the results from sensory evaluation, we can conclude that the sample 654 (C) which is sample from fermented sausage produced with Glucono delta-lactone, has the best score (4,05). The other sample from fermented sausage produced with Glucono delta-lactone, the sample 323

(D) has score 3,90 which is very approximate with the score of the sample 543 (B) from fermented sausage produced with starter culture. The lowest score has the sample 432 (A) which is sample from fermented sausage made with starter culture. There was a significant difference ($p<0,05$) between products produced with starter culture and Glucono delta-lactone on the texture, color and odor.

The high value of the color and odor were recorded in the fermented sausage produced with GDL 4,23 and 4,28 respectively, while the lowest value of the color and odor were recorded in the fermented sausage produced with starter culture 3,67 and 3,70. The high value of the texture was recorded in the sausage produced with starter culture (4,02), and the lowest value was recorded in fermented sausage manufactured with GDL (3,69). These differences probably are based on the different meat category, spices and technological process that were used in the manufacturing of the fermented sausages.

Table 1. Determination of sensory characteristics of fermented sausages

	Starter cultures		**GDL**	
	A	**B**	**C**	**D**
Appearance	4,23	3,77	4,33	3,65
Color	$3,67^{a}$	$3,93^{a}$	$4,23^{b}$	$3,84^{b}$
Odor	$3,70^{a}$	$4,16^{a}$	$4,28^{b}$	$4,12^{b}$
Aroma	3,63	3,98	4,19	3,98
Flavor	3,51	3,95	3,72	3,88
Texture	$4,02^{a}$	$3,78^{a}$	$3,83^{b}$	$3,69^{b}$
$\bar{x}$	3,70	3,92	4,05	3,90
% of maximum quality	74,09	78,40	81,02	77,95

$^{a, b}$ – values (mean) in the same row with different superscripts differ significantly ($p<0,05$)

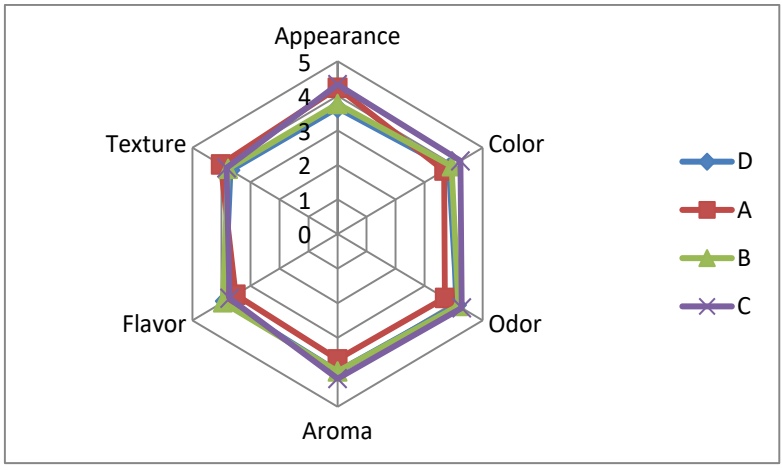

Figure 1. Sensory analysis of fermented sausages

Conclusion

We can conclude that variant C has 81,02% of the maximum quality and has the best sensory properties according to the results, and the lowest sensory properties has the variant A (74,09% of the maximum quality). There was a significant difference ($p<0,05$) between products produced with starter culture and Glucono delta-lactone on the texture, color and odor. According to the results the fermented sausage produced with Glucono delta-lactone shown better result of the color and odor, and fermented sausage produced with starter culture shown better result of the texture. These results are based on consumers' expectations of taste, and probably the observed differences mostly depend on the different technological processes, the different category of meat (beef or pork), added spices, and foremost addition of starter culture or Glucono delta-lactone in the manufacturing of the fermented sausages.

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