**IMPACT OF FUNCTIONAL MIX AND STARTER CULTURES ON THE SENSORY PROPERTIES OF PERMANENT SAUSAGES PRODUCED IN INDUSTRIAL CONDITIONS**

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**Abstract:** The aim of their search is the impact little bit of functional mixed (composed of glukono delta lactate, ascorbic acid and vitamin C) and starter culture (commercial preparation F - SC111 Bactoferm product company Chr Hansen DK). This product contains a mixed culture composed of *Lactobacilus sakei and Staphyococus Camosus* frozen in dry form. In three varieties of tea and sausage: I - added a simple sugar sucrose which serve as a control sample, II - with the addition of starter culture, III - functional mix of durable sausages. The best results in terms of sensory properties rehearsal was produced with the addition of starter culture and lowest sample with added sucrose.

**Keywords**: functional mix, starter culture, sucrose,

**Introduction**

The most numerous group of meat is sausages. We have several hundred species with several hundred thousand commercial names. In Europe the production of sausages began about 250 years ago in Italy. Italiаn masters150 years ago this technique was transferred to Hungary from where it began to spread throughout Europe.The production of durable sausages in R. Macedonia is the beginning of 90 years of last century. The first attempts were made to produce tea sausage. Until then in R. Macedonia durable products are supplied from other former Yugoslav republics. Permanent sausages are demanded in the market due to its culinary and nutritional properties. The quality of the raw material, the long production process, which requires consumption of large amounts of energy makes the production of these expensive sausages *(Veskovic - Moracanin and Obradovic 2009).*

Today durable sausages produced in industrial conditions during the process of maturation takes place in special chambers under controlled conditions. Maturation of permanent sausages is a complex process involving chemical, biochemical, physical-chemical and microbiological reactions between the ingredients of the charge, additives and components of smoke *(Vasilev 2009; Karan et al., 2009; Raseta et al., 2010).*

The production of durable sausages especially important given the decline in pH during fermentation and maturation. This is achieved in two ways: the action of certain microorganisms and adding special additives *(Vukovich and Saar 1989).* Lactic acid bacteria regularly present in charge of raw sausages. In modern industrial production are increasingly using selected strains of bacteria lactic acid and some other microorganisms or starter cultures *(Radetic 1997; Bacus 1984, Luche and Hecelman., 1968).* Starter cultures perform fermentation of sugars using them as a source of energy while creating lactic and other acids that decrease the pH of the sausages (*Veskovic - Moracanin et al., 2008).* Starter cultures are not yet found application in the production of durable sausages in R. Macedonia.

The additives used in the manufacture of durable sausages mostly used GDL. GDL causes a rapid drop in pH (towards the isoelectric point of aktomiozine) and fast release of water *(Koreti 1971; Kuzelov et al., 2008).* The way he comes to quick release of water from the fast charge and binding components. The 5.2- 5.5 pH protein easily turn into a gel sheet that gives the required consistency sausages *(Vukovic 1983).*

In the last 20 years in the R. Macedonia has built more plants to produce meat. Some of them produce tea and pork sausage with added spices and GDL and various other products with trade names Tari S 77 receiving rapid, edelsausage primal, primal mediterano consisting of a GDL, ascorbic acid, sodium ascorbate, spices to flavor boosters, cookery salt etc. All these preparations contain in addition a means of reducing the pH and rapidly maturing of sausages and other durable assets in different ratio and are relatively expensive. The purpose of this study was to investigate the impact of functional mix (which is prepared in the laboratory of a local industry in the R. Macedonia to replace Tari S 77) and starter cultures on the sensory properties of tea sausage.

**Material and method**

As a material for making tea sausage serve frozen pork first category (thigh) and second category pork (shoulder) before cuttering whose temperature was -3.7ºC and hard fat -12.5ºC. Frozen meat and TMT are cuttering to the granulationofparticles 3 mm. After the charge cuttering temperature was 2.5 to 3.2 ºC.Charge was prepared from 35% pork first class 35% pork second category and 30%TMT (dorsal bacon). The additives are used nitrite curing salt (2.4%), sodium ascorbate (0.05%) ground black pepper (0.020%), garlic powder (0.010%) mixture of spicy tea *(Kolinska*) (0.55%). As a starter culture used commercial preparation F - SC111 Bactoferm product company Chr Hansen Denmark. This product contains a mixed culture composed of *Lactobacilus sakei and Staphyococus Camosus* frozen in dry form. *Lactobacilus sakei* causes rapid souring and *Staphyococus Camosus* causes stable color and a mild aromatic flavor.

Charge is prepared in three variants: I 0.7% simple sugar sucrose (without Tarim S77 and functional mix) control sample, II Starter Culture 25g/100 kg. III 0.3% functional mix of durable sausages composed of GDL, Dextrose and Vitamin C.Functional mix is prepared in laboratory conditions in a meat industry in the R. Macedonia. Thus prepared charges are stuffed with vacuum pump in collagen wrapper diameter of 36 mm and pairs with a length of 30 cm. Upon filling all varieties of Tea sausage are displayed in the same mode of smoking and drying in air chambers for a period than 21 days.

During the drying and fermentation of sausages is measured temperature and pH 8 days early every day and 21 days. Aw value is measured 8 and 21 days. At the end of the manufacturing process is performed sensory analysis of the finished product. The value of pH was measured with pH potentiometric - EBRO HT 810 meter with a combined electrode probe thermometer and built for simultaneous measurement of pH and temperature. Aw value is measured by aw - meter Aqyalab (Wasington). Loss of weight (Callow) during ripening of sausages is determined by the difference in mass between the two measurements in the technological process and is expressed as a percentage relative to the initial mass

Sensory analysis of finished products is performed according to the method of the ninth - grader scale scoring method developed by VNIMP - Moscow 7 experienced professionals. Evaluated following sensory attributes: appearance of sausage, looks at the intersection consistency, smell, taste, color fastness results. The test is processed by mathematical statistical method ANOVA MICROSOFT EXEL 2010-2013th. Differences between mean values were tested with Takejev test. Statistical processing is processed with software (Stat soft Inc).

**Results and discussion**

The results of the examination of the dynamics of pH Tea flask are given in Table1.

**Table 1.Dynamics of pH Tea sausage**

|  |  |  |  |
| --- | --- | --- | --- |
| Variants | | | |
| Days after preparation | I  ± Sd | II  ± Sd | III  ± Sd |
| 0 | 5.92 ± 0.07 | 5.88 ± 0.05 | 5.83 ± 0.04 |
| 1 | 5.88 ± 0.05 | 5.62 ± 0.08 | 5.58 ± 0.02 |
| 2 | 5.82 ± 0.05 | 5.58 ± 0.04 | 5.50 ± 0.07 |
| 3 | 5.78 ± 0.04 | 5.47 ± 0.07 | 5.43 ± 0.05 |
| 4 | 5.75 ± 0.02 | 5.37 ± 0.05 | 5.37 ± 0.04 |
| 5 | 5.72 ± 0.05 | 5.30 ± 0.04 | 5.30 ± 0.08 |
| 6 | 5.68 ± 0.07 | 5.27 ± 0.07 | 5.24 ± 0.05 |
| 7 | 5.65 ± 0.04 | 5.24 ± 0.05 | 5.20 ± 0.04 |
| 8 | 5.62 ± 0.08 | 5.19 ± 0.03 | 5.14 ± 0.07 |
| 21 | 5.59 ± 0.05 | 5.25 ± 0.02 | 5.10 ± 0.05 |

= mean, Sd = standard deviation;

The table shows that the initial values of pH in all varieties ranging from 5.83 to 5.92. By the 8th day of ripening and drying are determined lowest pH values in all three variants (5.62; 5.19; 5.14). In trials with starter culture and functional mix in the first day of registration fastest drop in pH (from 5.88 to 5.62 and from 5.83 to 5.58) compared with the control sample (from 5.92 to 5.88). The results of the measurement of pH obtained in the survey are consistent with results obtained (*Stamenkovic et al., 1990)* who found that Tea sausage produced with the addition of GDL pH declined faster and were eventually registered lower values (5.20) compared with Tea sausage which has only added sugars (5.68). The results of the examination of the activity of water in all three variants are given in table number 2.

**Table 2. Average aw -values Tea sausage**

|  |  |  |  |
| --- | --- | --- | --- |
| Variants | | | |
| Days after preparation | I  ± Sd | II  ± Sd | III  ± Sd |
| 8 | 0.920 ± 0.01 | 0.912 ± 0.02 | 0.910 ± 0.02 |
| 21 | 0.880 ± 0.03 | 0.838 ± 0.05 | 0.848 ± 0.05 |

= mean, Sd = standard deviation;

The table shows that on the 8th day of production of sausages aw ranged from 0.910 in the variant III to 0.920 in variant I. Somewhat larger decline was observed invariant II (to 0.074) versus variant III (to 0.062) and variant I (about 0.040). Aw differences are small and not statistically significant. Our results are consistent with the results of (*Ambrosidias et al., 2004; Kozacinski et al., 2008)* who found greater and more rapid decline in aw variants tea sausage made with GDL in terms of variants produced with starter culture sand plain sugar. The loss of weight (Callow) during drying and ripening of Tea sausage on 8 day of production is 28.5 to 29.85 (Table 3). No significant differences were identified in Callow the eighth day of production in all three groups Tea sausage.

**Table 3. Loss of mass during drying and fermentation Tea sausage.**

|  |  |  |  |
| --- | --- | --- | --- |
| Variants | | | |
| Days after preparation | I  ± Sd | II  ± Sd | III  ± Sd |
| 8 | 28.50 ± 0.25 | 29.85 ± 0.20 | 28.84 ± 0.18 |
| 2 | 38.60 ± 0.58 | 36.35 ± 0.15 | 37.04 ± 0.14 |

= mean, Sd = standard deviation;

The 21 days of production is determined loss of mass 36.35 to 38.60%. Statistical processing of the data showed that there were no statistically significant differences in loss of mass in all three variants tea sausage. The results we obtained are consistent with results obtained (*Shutich et al., 1990).* They found loss of mass in the production of tea sausage produced in Tari S 77 of 36.16%. Based on there results of sensory testing Tea sausage can be seen that the lowest score of all tested sensory features a variant with added sugar and sensory bests cores in all sensory attributes studied variants produced with the addition of starter culture (Table 4).

**Table 4. Sensory evaluation of Tea sausage**

|  |  |  |  |
| --- | --- | --- | --- |
| Variants | | | |
| Sensory properties | I  ± Sd | II  ± Sd | III  ± Sd |
| Appearance | 7.52 ± 0.037 | 8.52 ± 0.31 | 7.59 ± 0.35 |
| Appearance of intersection | 7.06 ± 0.36 | 8.98 ± 0.037 | 8,62 ± 0.37 |
| Consistency | 6.29 ± 0.39 | 8.51 ± 0.28 | 7.85 ± 0.25 |
| Color | 6.15 ± 0.35 | 8.80 ± 0.33 | 8.20 ± 0.30 |
| Scent | 6.53 ± 040 | 8.90 ± 0.37 | 7.98 ± 0.35 |
| Taste | 6.75 ± 0.42 | 8.98 ± 0.29 | 8.20 ± 0.22 |
| Overall acceptability | 4.12 ± 0.48 | 8.52 ± 0.20 | 7.95 ± 0.28 |

= mean, Sd = standard deviation;

The variant with added sugar was evident felled wrapper the surface and darker color on the surface and the intersection unlike variants with the addition of starter culture having good consistency, attractive color to the surface of the sausage section of hopes without cavities and appearance cracks in hopes. The overall acceptability between the (I) first and second (II) group (4.12 - 8.52 ) and between the first and the third group (4.12 - 7.95) are statistically significant differences (p <0.01). There are no statistically significant differences between the other sensory attributes tested in all three variants studied tea sausages (p> 0.05).

The results in terms of sensory testing of all three variants tea sausage are consistent with the results obtained (*Radetic 1997; Morettia et al., 2005; Ambrozidias et al., 2004; Sincic et al., 2006)* who studied sensory properties of tea sausage. They noted improved sensory properties in tea sausage produced with the addition of starter cultures.

Based on the results of sensory analysis and the results of other authors can conclude that the use of starter cultures in the production of tea sausage gives products with good sensory characteristics and functional mix is a good substitute for Tari S-77.

**Conclusions**  
 From executed tests and results can be derived the following conclusions:

-Initial values of pH in all varieties ranging from 5.83 to 5.92. By the 8th day of ripening and drying are determined lowest pH values in all three variants (5.62; 5.19; 5.14). In trials with starter culture and functional mix in the first day of registration fastest drop in pH (from 5.88 to 5.62 and from 5.83 to 5.58) compared with the control sample (from 5.92 to 5.88).

-Functional starter culture and mix showed no influence of the Tea loss of mass sausage  
-Tea sausages made with the addition of starter culture had better sensory properties compared with tea sausage produced with the addition of functional mix and sucrose.

-Functional mix is a suitable replacement for Tari S-77. It can be prepared in any plant before production of durable sausages and cheap in the Tari S-77.

**Uticaj funkcionalnog miksa i starter culture na senzorne osobine trajnih kobasica proizvedenih u industriskim uslovima**

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**Rezime:** Cilj našeg istaživanja e uticaj funkcionalnog miksa (sastavljen od GDL, askorbinske kiseline i vitamin C) i starter culture (komercijalni preparat F – SC 111 Bactofеrm proizvod firme Chr Hansen Danska). Ovaj preparat sadrži mesanu kulturu sastavlenu od *Lactobacilus sakei и Staphyococus Camosus* u smrznutoj suhoj formi. Izradjeni su tri varijante čajne kobasice i to: I – sa dodatkom obicnog šečera saharoze koja nam je posluzila kao kontrolna proba; II - sa dodatkom starter culture; III – sa dodatkom funkcionalnog miksa za trajne kobasice. Najbolje rezultate u odnosu na senzorne osobine imala je proba proizvedena sa dodatkom starter kultura a najslabije proba proizvedena sa dodatkom saharoze.

**Ključne reči:** funkcionalni miks, starter kultura, saharoza

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