

Journal of Hygienic Engineering and Design

Volume 7



INFLUENCE OF FUNCTIONAL COMPONENTS ON THE PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF FERMENTED SAUSAGES

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Abstract

In this paper, the physico-chemical and sensory characteristics of functional fermented sausages with addition of probiotic culture *Bifidobacterium longum* BB536 and inulin, (sausages B and C) were examined and compared with those of conventionally fermented sausages (K).

Fermented sausages were produced under industrial conditions in The Meat Industry in Republic of Macedonia. Chemical composition was evaluated according to standard ISO methods. The energy value of the sausages was calculated by formula according to Golob [4] and Kuhar [5]. Sensory characteristics were estimated by experienced professionals using method of scoring according Radovanović and Popov-Raljić [13].

Functional fermented sausages contain above 28% protein and 36% fat. Their energetic value is smaller by 165.2kJ/100 g compared to conventional ones. The lowest score of all tested sensory properties of the sausages have control group K (4.31) produced by standard recipe.

Based on this conducted research can be concluded that the addition of functional components in the production is justified, not only to improve the nutritional and biological value, but for the sensory quality that is an important factor to greater demand for these types of sausages.

Key words: Fermented sausages, Functional components, Physico-chemical composition, Sensory characteristic.

1. Introduction

Consumers currently demand that food products offer not only organoleptic qualities (e.g. taste) but also health benefits. Efforts for new product development are being directed towards the newly emerging area

of 'functional foods'; these are products with health enhancing properties beyond the provision of essential nutrients [1].

Fermented sausages belong to the group of meat products that possess specific functional properties. On the one hand, fermented sausages can not handle the heat, and highly valuable meat nutrients did not change significantly. On the other hand, there is the possibility that as a starter culture used probiotic bacteria that have a positive impact on health, as well as the composition of the sausages can enrich with other supplements important to the health, such as prebiotics, omega-3 fatty acids and other additives ([2], [12], [7], and [18]).

Fermented sausages with addition of functional components should keep their sensory properties.

Vuković *et al.* [18] determined that the presence of probiotics, inulin, fibers and omega – 3 fatty acids makes fermented sausages a foodstuff of high nutritional value with a high potential to have positive effects on human health status.

Addition of probiotic *Lactobacillus plantarum*, strain AJ2 in the fermented sausages manufactured in the Southern region of Brazil, had influence on intensity of product brightness and red color (Sawitzki *et al.* [15]).

Addition of plant fibers like: inulin, wheat, citrus, potato, oats and peas improves the nutritive value of the normal fat pork sausage and beef burger (< 230 g.kg-1) and the reduced fat pork sausage and beef burger (<100 g.kg-1) (McDonah *et al.* [9]).

Therefore, the basic objective of this research was aimed at introduction of probiotics, prebiotic in the technology of production of fermented sausages produced in the meat industry in Macedonia and examining their influence on the quality and sensory characteristics.

2. Materials and Methods

The fermented tea sausages are produced under industrial conditions in the Meat Industry and Slaughterhouse in Sveti Nikole, Republic of Macedonia. The mixture for the sausages is prepared from a first category pork meat (380 g.kg^{-1}), second category meat (380 g.kg^{-1}), and pork fat tissue (240 g.kg^{-1}). The frozen meat and the pork tissue are being diced until the particles are 10 mm and then additives and starter culture are added, (sausages K). Functional fermented sausages (B and C) have the same formulation and addition of probiotic *Bifidobacterium longum* BB536 ($30\text{g}/50 \text{ kg}$) and inulin (10 g.kg^{-1}).

The mixture was stuffed into artificial casings ($\varnothing 36$). After filling, the sausages have undergone a regime of smoking and drying in the climate chamber for a period of 20 days according to the program used in the meat industry.

During the ripening period, pH and aw (water activity) were measured on the 3th, 7th, 14th day and 20th day. After the manufacturing process, the chemical composition and the sensor analysis was carried out for the finished product. Moisture, fat, protein and ash contents of samples were determined according to the methods described by (IDF, ISO and AOAC).

Sensory evaluation of investigated sausages was performed by a panel consisting of 7 trained members. Evaluations were performed according to the point system of scoring [13], using a scale from 0 to 5.

3. Results and Discussion

The data on pH and aw analysis of the produced sausages are presented in Table 1.

Table 1. pH and aw dynamics of conventional (K) and functional fermented sausages (B and C) during ripening period

Group of sausages	K		B		C	
	parameters					
Ripening period/days	pH	aw	pH	aw	pH	aw
3	5.13 ± 0.02	0.949 ± 0.01	5.15 ± 0.01	0.939 ± 0.01	5.14 ± 0.03	0.943 ± 0.02
7	4.66 ± 0.03	0.933 ± 0.01	4.68 ± 0.02	0.915 ± 0.02	4.63 ± 0.02	0.914 ± 0.02
14	4.70 ± 0.02	0.905 ± 0.01	4.70 ± 0.01	0.909 ± 0.01	4.79 ± 0.02	0.906 ± 0.01
20	4.83 ± 0.02	0.871 ± 0.01	4.76 ± 0.01	0.887 ± 0.02	4.96 ± 0.02	0.880 ± 0.01

Results presented in Table 1 shown that pH values of functional fermented sausages (B and C) on 3th day after their making are higher ($5.15 \pm 0.01 - 5.14 \pm 0.03$) in comparison with the conventional (K) (5.13 ± 0.02).

By the 7th day of ripening, the pH has decreased in all groups of sausage. Then they reached the lowest pH value. After the 7th day begin slight increase in pH value by the end of the process of ripening as a consequence of proteolytic changes in fermented sausages.

To obtain a stable fermented sausage and to extend their shelf life a pH 5.3 or lower should be provided at the end of the fermentation [19]. All groups of sausage meet this criterion (at the end of the production process pH ranged from 4.76 to 4.96).

On the seventh day after their making aw-value was 0.933 ± 0.01 in the (K) sausages and reduce to ($0.914 \pm 0.02 - 0.915 \pm 0.02$) in functional fermented sausages with addition of probiotic and inulin (B and C). On the 20th day aw-value dropped from (0.871 ± 0.01) at conventional sausages to ($0.887 \pm 0.02 - 0.880 \pm 0.01$) at functional fermented sausages. Differences in aw values between groups (B and C) and (K) are statistically significant ($p < 0.05$). The results of our study are consistent with studies that have been made by various authors - [2], [6], and [11].

The chemical composition of conventional (K) and functional fermented sausages (B and C) are shown in Table 2 and Figure 1.

Table 2. Chemical composition and energy values of functional fermented sausages compared to control

Group of sausages	K	B	C
Moisture (%)	28.45 ± 0.32	30.90 ± 0.21	31.50 ± 0.26
Protein (%)	28.90 ± 0.32	28.15 ± 0.28	28.20 ± 0.34
Fat (%)	38.18 ± 0.12	36.70 ± 0.34	35.75 ± 0.30
Ash (%)	4.31 ± 0.12	4.16 ± 0.09	4.22 ± 0.16
Energy value (kJ/100g)	1979.4	1917.7	1916.9

Moisture content in the sausage C (31.50%) was significantly higher ($p < 0.001$) compared to control (28.45%). On the other hand, the fat content in sausage C (35.75%) was significantly ($P < 0.001$) lower compared to sausage K (38.18%). Protein content in functional fermented sausages of B and C groups (28.15% : 28.20%) did not differ significantly ($P > 0.05$), and the values were within the standard defined by Macedonian legislation [8]. Their energetic value is smaller by $165.2\text{kJ}/100 \text{ g}$ compared to conventional ones.

The obtained values of chemical composition are typical for fermented sausages and the results are in agreement with the literature data [6], [14], and [16].

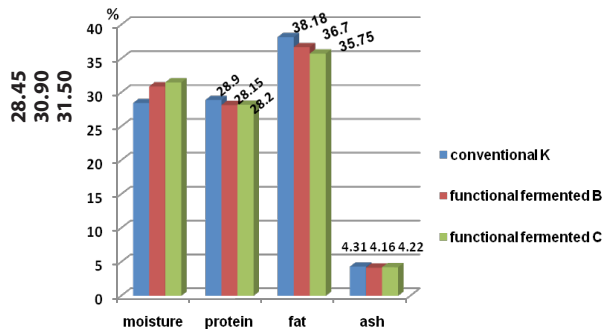


Figure 1. Chemical composition of conventional and functional fermented sausages

Results of the sensory evaluation are presented in Table 3. External appearance did not differ significantly ($P > 0.05$) between groups, while average score for the section appearance in sausage C was significantly higher ($P < 0.05$) compared to control (sausage K).

The samples with a starter culture and especially the samples with a probiotic and inulin had more attractive color to the surface and in the cross section, as well as a better and more solid consistency. Also, sausage A had significantly higher ($P < 0.01$) score for odor and taste than control (sausage B). Functional fermented sausages (B and C) had higher ($P < 0.01$) score for odor and taste than conventional sausages made with standard recipe (sausage K).

The high quality of functional fermented sausages, we believe that is result of the use of starter cultures and the supplement probiotic especially inulin. Starter culture during fermentation of the sausage give them better consistency and more evident odor and taste, while inulin improves nutritive value, gives a better texture and elasticity.

The results of our study in relation to the sensor quality of sausages go along with the results of the other authors ([3], [10], [17], and [18]).

Table 3. Sensory characteristics of functional fermented sausages compared to conventional

Sensory characteristics	K	B	C
External appearance	3.2 ± 0.40	3.3 ± 0.40	3.4 ± 0.39
Section appearance	4.0 ± 0.28	4.3 ± 0.33	4.3 ± 0.37
Consistency	4.7 ± 0.51	4.7 ± 0.55	4.5 ± 0.62
Color and color maintenance on the cutting	4.4 ± 0.67	4.7 ± 0.67	4.6 ± 0.58
Odor	4.3 ± 0.69	4.6 ± 0.69	4.7 ± 0.68
Taste	4.5 ± 1.03	4.8 ± 1.04	4.8 ± 0.97
Average value	4.31	4.40	4.38

4. Conclusions

On the basis of gained results we can conclude following:

- At the end of the production process a pH value of (4.76 to 4.96) was achieved and aw values (0.871 to 0.880), which provide good stability and sustainability of the finished sausages.

- The use of functional components such as probiotic and inulin has certain properties and shows influence on the physico - chemical composition of the finished product.

- The high score for sensory properties have functional fermented sausages as a results of the use of starter cultures and the supplement probiotic especially inulin. This group of sausages has a higher nutritional value.

- Based on this, we can recommend the use of starter cultures, probiotic and inulin in the production of dry fermented sausages in the meat industry in Macedonia.

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