

INFLUENCE OF STARTER CULTURES ON THE QUALITY AND HYGIENE INDICATORS OF RAW-DRIED “SUDZHUK” AND FILLET

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ABSTRACT

The application of selected microbial cultures, accelerating the ripening process of dried meat products, has a beneficial effect on economic results, but has changed their organoleptic and quality indicators. In recent years, however among the consumers there have been a return to the tastes of Bulgarian raw-dried products produced by traditional technologies. In the present study, indicators of raw-dried “sudzhuk” and fillet, produced in both ways, were compared. The research has shown that even without the addition of microbial cultures, based on the natural microflora of the raw materials and the production environment typical to the geographical region, “sudzhuk” and fillet can be produced with good drying characteristics (aw and pH) and excellent organoleptic qualities.

Key words: dried “sudzhuk”, fillet, starter cultures.

Introduction

The production of traditional raw-dried meat products in Bulgaria is a historical fact, which also determines the unique technologies for production of raw-dried meat products. This specificity is based on the non-use of starter cultures, glucono delta-lactone (GDL) and other products that would influence or correct the pH of the product. This national identity is in danger of fading away against the backdrop of innovative technologies that are massively entering the meat industry in this type of meat products. Raw-dried sausages represent a dynamic biological system that changes during the technological process under the influence of its own enzymes and those of the available microorganisms (10, 20).

The application of selected microbial cultures, accelerating the ripening process of dried meat products, has a beneficial effect on economic results, but has changed their organoleptic and quality indicators. In order to obtain a constant excellent quality, with shortened maturation and drying periods and inhibition of the pathogenic microflora, specially selected useful cultures of lactobacilli, micrococci, staphylococci, molds and yeasts are used, also known as starter cultures (10, 15, 19). Starters of ripening are embedded in the sausage structure. They decrease the pH to an acidic reaction, compact the filling mass, reduce water activity (aw), accelerate the drying process, and suppress the decaying and pathogenic microflora (11, 15). Starters of ripening are grouped as: 1) Bacteria with acidophilic and inhibitory activity (homofermentative); 2) Bacteria with reductive and flavoring activity (heterofermentative); 3) Yeast with neutralizing and flavoring activity (13, 15, 18).

In recent years, however among the consumers there have been a return to the tastes of Bulgarian raw-dried products produced by traditional technologies. In the present study the raw-dried “sudzhuk” and fillet, produced in both ways, with and without using starter cultures, in meat processing companies of different capacity, were compared.

Materials and methods

The research was made during the period from October 2017 to November 2018. Samples of raw materials and final products of raw-dried “sudzhuk” and pork fillet were taken from two manufacturers, located on the territory of Sofia City, with different production capacity of meat products.

Manufacturer A has been on the market since 2003, with the production and realization of raw-dried sausages and delicacies at 60 tons per year. In the production of “sudzhuk” and fillet the minced and nonminced raw material is treated with starter cultures: *Staphylococcus carnosus* (*S. carnosus*) and *Lactobacillus sakei* (*L. sakei*).

Manufacturer B was founded in 1996 and is entirely a family business. Annually, the production and realization of raw-dried meat products is 17.5 tons. In this company starter cultures are not used in the production of “sudzhuk” and fillet.

The products “sudzhuk” and fillet from both companies were tested for the following indicators: water content according to BDS-5712:1974; fat content according to the SOKSLE method (by BDS-8549:1992); nitrites according to BDS ENV 12014-3:2001; table salt according to the Argentometric method by Mohr (BDS-7168:1993 pt.4); pH according to BDS-1323:1975 pt.2.3.1; “aw” was determined by “Lab Master” according to the developed instruction manual. Five-point organoleptic indicator system to evaluate 7 indicators was used. The statistical processing of the results was done by Tukey [Hothorn et al. (16), Sachs and Hedderich (22)].

The determination of total microbial count (TMC) of 1 cm² was made according to the requirements of BDS EN ISO 4833-1/2013; The number of microorganisms of Enterobacteriaceae family was determined according to BDS EN ISO 21528-2/2017. The presence of *Salmonella* spp. was tested according to BDS EN ISO 6579:2003. The presence of *Listeria monocytogenes* in 25 g was examined according to BDS EN ISO 11290-1:2000/A1:2005. The raw materials were tested for TMC, Enterobacteriaceae family and *Salmonella* spp., the products after the last pressing and the final products – for TMC, Enterobacteriaceae family, *Salmonella* spp. and *L. monocytogenes*.

Results

Tables 1 and 3 show the technological indicators in the dryers during the production of “sudzhuk” and fillet in both companies. Tables 2 and 4 show the physico-chemical indicators of raw materials and the final products of “sudzhuk” and fillet in both companies. Tables 5 and 6 show the microbiological studies for the TMC and Enterobacteriaceae family of the raw materials, after last pressing and the final products. *Salmonella* spp. and *L. monocytogenes* have not been detected in any of the tested samples. Tables 7 and 8 show the organoleptic evaluations of the two products. Charts 1 and 2 graphically compare the organoleptic evaluations of “sudzhuk” and fillet produced in both companies.

Table 1: Technological indicators of “Sudzhuk”

Indicators	Manufacturer	
	A	B
Drying temperature, after last pressing	12°C	12,8°C
Humidity, after last pressing	76%;	64%
Drying temperature of final product	12°C	12.2°C
Humidity of final product	75%;	67.4%;

Table 2: Physico-chemical indicators of “Sudzhuk”

Indicators	Raw material		Final product	
	Mfr. A	Mfr. B	Mfr. A	Mfr. B
Nitrites, mg/kg			12.0	<4.5
Water content, %			35.02	29.9
Fat, %			26.12	30.74
Chlorides, %			4.80	3.9
pH	5.85	5.9	5.19	5.14
Aw/pH	0.961/5.75	0.963/6.02	0.851/5.19	0.837/5.14

Table 3: Technological indicators of dried fillet

Indicators	Manufacturer	
	A	B
Drying temperature, after last pressing	12°C	13°C
Humidity, after last pressing	75%	64%
Drying temperature of final product	11.6°C	13.5°C
Humidity of final product	78%	67%

Table 4: Physico-chemical indicators of dried fillet

Indicators	Raw material		Final product	
	Mfr. A	Mfr. B	Mfr. A	Mfr. B
Nitrites, mg/kg			6.0	16.5
Water content, %			37.25	53.22
Fat, %			3.60	1.94
Chlorides, %			5.63	5.3
pH	5.95	5.9	5.83	5.51
Aw/pH	0.958/5.64	0.952/5.61	0.822/5.84	0.891/5.56

Table 5: Microbiological studies of “Sudzhuk”

Indicators	Raw material		After last pressing		Final product	
	(0 day)		(15 day)		(30 day)	
	Mfr. A	Mfr. B	Mfr. A	Mfr. B	Mfr. A	Mfr. B
TMC	1.8x10 ⁵ Cfu/g	1.2x10 ⁴ Cfu/g	1.3x10 ⁸ Cfu/g	2.7x10 ⁶ Cfu/g	1.1x10 ⁶ Cfu/g	1.4x10 ⁵ Cfu/g
<i>Enterobacteriaceae</i>	<10	<10				

Table 6: Microbiological studies of dried fillet

Indicators	Raw material		After last pressing		Final product	
	(0 day)		(20 day)		(40 day)	
	Mfr. A	Mfr. B	Mfr. A	Mfr. B	Mfr. A	Mfr. B
TMC	3.6x10 ⁵ Cfu/g	5.5x10 ⁴ Cfu/g	1.6x10 ⁸ Cfu/g	3.7x10 ⁶ Cfu/g	3.8x10 ⁶ Cfu/g	3.3x10 ⁴ Cfu/g
<i>Enterobacteriaceae</i>	<10	<10				

Table 7: Organoleptic assessments of the 5 point system of “SudzhuK”

Food Taster №	Appearance		Color		Consistency		Odor		Taste		Cutting surface		Overall qualitative assessment	
	Mfr.		Mfr.		Mfr.		Mfr.		Mfr.		Mfr.		Mfr.	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1	5	5	4	4	4	5	4	4	4	5	4	5	4	5
2	4	4	4	4	3	5	4	5	4	4	4	5	4	5
3	3	5	4	4	3	4	4	4	4	4	3	4	4	4
4	4	4	4	5	4	5	4	5	4	5	4	5	4	5
5	4	4	4	5	3	4	4	5	4	4	3	4	4	4
6	3	4	4	4	4	4	4	5	3	5	4	4	4	4
7	4	5	4	5	3	4	4	4	4	4	3	4	4	4
8	4	4	4	4	4	5	4	5	4	4	4	4	4	4
Sum	31	35	32	35	28	36	32	37	31	35	29	35	32	35

Table 8: Organoleptic assessments of the 5 point system of dried fillet

Food Taster №	Appearance		Color		Consistency		Odor		Taste		Cutting surface		Overall qualitative assessment	
	Mfr.		Mfr.		Mfr.		Mfr.		Mfr.		Mfr.		Mfr.	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1	4	5	4	4	4	5	3	5	4	5	4	5	4	5
2	4	5	3	5	4	4	4	5	4	5	4	4	4	5
3	4	5	4	5	4	5	4	4	3	4	4	5	4	5
4	5	4	4	4	5	4	5	5	5	5	5	4	5	4
5	5	5	4	5	4	5	5	5	4	5	4	5	4	5
6	4	4	4	5	4	5	5	5	4	5	4	5	4	5
7	4	5	4	5	4	5	4	5	4	5	4	5	4	5
8	5	5	4	5	4	5	5	5	4	5	4	5	4	5
Sum	35	38	31	38	33	38	35	39	32	39	33	38	33	39

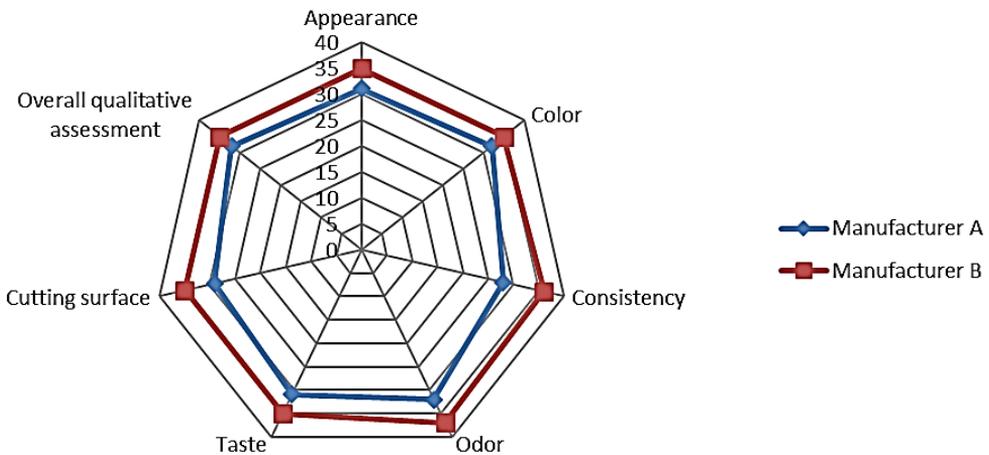


Diagram 1: Radar chart of the sum of estimates of individual organoleptic indicators of “SudzhuK” produced in both manufacturers.

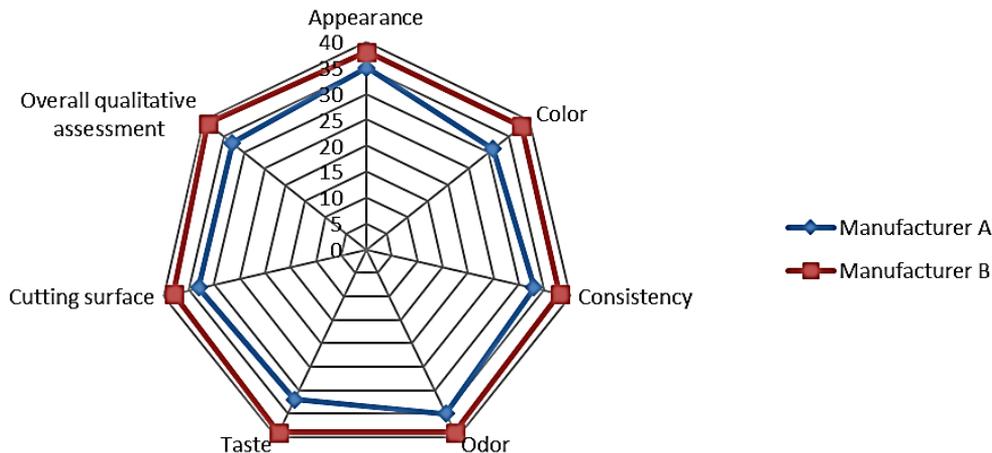


Diagram 2: Radar chart of the sum of estimates of individual organoleptic indicators of dried fillet produced in both manufacturers.

Discussion

According to BDS 2589-83 "Durable raw-dried and raw-ried and smoked sausages", the "sudzhuk" that were studied must have: A water content – 25 to 40% of the total mass; Table salt – not more than 4.6% of total mass; Nitrites - not more than 4.0 mg/100 g product. According to Technical condition № 22-83 of BDS 3423-80 the raw-dried pork fillet must have: Water content - not more than 55% of the total mass; Table salt - not more than 3.5 % of total mass; Nitrites - not more than 4.5 mg/100g product. In the present study, we also draw attention to two newer indicators for the drying and ripening process, such as a_w and pH. They are not included in our normative acts, but are discussed by many contemporary researches. According to Zahariev (12), at the end of the drying process of meat products a pH of 4.9 to 5.0 is reached. In addition to aromatic-flavor properties, another important condition for raw-dried products is their safe consumption. To achieve this, microbiological stability is required, i.e. low acidity (approximately pH 4.8 to 5.0) and low a_w value (below 0.85). Lorenzo et all. (21) and Kameník (17) found an a_w value of 0.82 in raw-dried salami on the 49th day of maturation.

The analysis of the results of the physico-chemical indicators shows that the "sudzhuk" of manufacturer B is superior than the "sudzhuk" of manufacturer A, with lower water content, salt, a_w and pH of the final product (Table 2). The lower water content can be explained with the lower humidity in the dryer of this manufacturer (Table 1). We should note the higher amount of salt in the product produced by manufacturer A. Furthermore, the advantage of "sudzhuk" of manufacturer B is the use of traditional technology without selected microorganisms.

The organoleptic results in Table 7 and Diagram 1, shows that the "sudzhuk" produced in Manufacturer B has a very good quality with almost identical evaluations of individual indicators. The "sudzhuk" of Manufacturer A has worse organoleptic qualities and particularly noticeable difference in the indicators consistency (texture) and cutting surface. The lower water content (29.9 %) and the higher fat content (30.74%) also contribute to the good organoleptic properties of "sudzhuk" B. Although, the lower content of nitrites "sudzhuk" B has better organoleptic evaluations of color.

The results in Table 8 and Diagram 2 shows that the dried pork fillet from Manufacturer B, again is of excellent quality and higher organoleptic assessment. The fillet from Manufacturer A has worse evaluations, the most problematic ones are again the indicators consistency and cutting surface. The fillet is made from a whole muscle with least possible amount of fat and high water content. In the fillet B the water content is 53.22% (just below the upper limit) and gives it some succulence, improving the organoleptic properties. On the opposite side is the fillet A with 2/3 lower water content 37.25% (Table 4). The higher amount of nitrites in fillet B corresponds to the better organoleptic evaluation of color. In the same table, we observe typical for dried products pH and aw values in both manufacturers.

Main normative act on microbiological criteria for foodstuffs is Regulation (EO) № 2073/2005 of European Commission. In the raw materials for “sudzhuk” (Table 5) in manufacturer A we found TMC 1.8×10^5 Cf/g and in manufacturer B - 1.2×10^4 Cf/g, which is an indication of better production hygiene. The TMC at the last pressing and in the final product gives us an indication about the fermenting microflora growth. In Manufacturer A, during the last pressing, there was a rapid growth of the microflora from starter cultures and in the final product their count slightly decreased. Although, the ripening of “sudzhuk” B is based on the natural microflora from the raw materials and the dryers, the level of TMC is balanced. The TMC remain almost at the same level during the last pressing as well as in the final product.

In raw-dried fillet (Table 6) produced in manufacturer A there was a TMC in the raw material 3.6×10^5 Cf/g. In comparison, the raw material in Manufacturer B is with better hygiene (5.5×10^4 Cf/g), which was also observed in the raw material of “sudzhuk” B. In the final product of Manufacturer A there was a higher TMC (3.8×10^6 Cf/g), probably as a result of the addition of fermenting microorganisms, while in Manufacturer B TMC is lower (3.3×10^4 Cf/g). During drying process, a typical microflora development in the products is observed, especially expressed in the middle of the fermentation period (around 20th day). Also, we need to keep in mind the difference in fermentation processes. The ripening of fillet B is based on the natural microflora of the raw material and the dryers, while fillet A is incorporated with additional microorganisms to improve fermentation. Prevalence of TMC in the products with addition of starter cultures is observed (Manufacturer A).

Conclusion

1. The aw and pH values determined in the final products from Manufacturer B (produced without starter cultures) are lower, that indicate a better drying process.
2. The products of Manufacturer B (without starter cultures) show better organoleptic characteristics that are statistically proven.
3. The microbiological characteristics of the final products in the two compared technologies are similar and meet the standard requirements.
4. Accelerating the ripening of raw-dried products by incorporating of selected microbial cultures in the raw material is not a guarantee for better quality of traditional Bulgarian raw-dried products.
5. The typical natural microflora of our environment can be sufficient to achieve high quality of traditional Bulgarian raw-dried products.

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