

BIOTECHNOLOGICAL METHOD FOR PRODUCTION OF SAUSAGES WITHOUT CASINGS BY USING OF MIXED BROTH CULTURE
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ABSTRACT: In the present study is offered a modern biotechnological decision for production of raw-dried sausages without casings. The purpose is achieved by using of mixed broth culture from *Streptococcus* species, strains 136 and 167. The mixed broth culture is used in 1:1 ratio and is added to the meat batter in such a quantity, that assures 10^5 - 10^6 microbial cells per 1 g meat batter. Comparative observations are made with another two technological variants. The most dramatically increasing of pH values and the most intensive processes of batter exchange in the products are observed in sausages, prepared with mixed starter culture. The same sausages have received an excellent evaluation also according to 9th hedonic scale.

INTRODUCTION: The production of raw-dried fermented sausages without casings is accomplished by accelerated technological methods and the main prerequisite for the production of high quality sausage is the achievement of rapid ripening and souring of the meat by means of decreasing the pH values. That ensures necessary sausage firmness and possibility for slicing, Kiseva et al. /1984/ and Vomberger /1988/. These properties of rapid ripening sausages do not achieve at the expense of sausage drying. In order to receive necessary compact filling batter, the technological process has to be directed at the definite direction for carrying out of technological processes, Knorr /1987/ and Zlámalová /1987/. The initial accelerating of ripening has been accomplished by increase of added carbohydrates in the filling batter and temperature enhancement. Later in the production begins to use glucono-delta-lacton, which formed gluconic acid in the filling batter. This process of acid forming carry out more rapidly. Glucono-delta-lacton causes quickly solidifying of the filling batter and good colour, but regarding flavour and aroma the question is left open, Bacus /1985/. Our great experience in the production of other types raw-dried meat products with broth bacterial cultures gives us foundation to search possibility for development of modern biotechnological decision for production of sausages without casings, Kiseva /1985/. The objective of the study is to achieve necessary ripening intensity as the type specificity of the product is preserved and to improve significantly the organoleptic properties of the finished product by use of mixed broth culture from *Streptococcus* species, strains 136 and 167.

MATERIALS AND METHODS: In order to carry out our experiments, we used raw-dried sausage without casing, prepared from beef and pork, with mixed broth culture from *Streptococcus* species strains 136 and 167. For comparison and objectivity of the results, we prepared also two control batches, except for experimental samples. Thus we received three comparative variants. The preparation of raw materials, machine treatment

of the filling batter and the filling were accomplished according to the technological instructions. There were changes only in the curing formulations, as follows:

Curing mixture %	I variant /with Str.sp.136,167/	II variant /with Str.lac.P ₄ /	III variant /with GDL/
Salt kg	2,8	2,8	2,8
Sugar kg	0,5	0,5	0,1
Nitrite kg	0,014	0,014	0,014
Ascorbic acid kg	0,020	0,020	0,020
GDL kg	-	-	0,700
Broth culture	0,500 /1:1/	0,500	-

After sorting, the raw materials were freezed. The filling batter was prepared by cutter and filled in polyamide casings Ø 100. The broth starter cultures were prepared by our traditional technology. The same are applied as 24 h broth culture in Hottinger yeast broth of such a quantity, ensuring 10^5 - 10^6 microbial cells per 1 g raw material. We used mixed broth starter culture from Streptococcus species 136 and 167 in 1:1 ratio. We placed the filled products in air-conditioned rooms for ripening and drying with electron programming. We carried out the observations by several times repetition of the experiments at two temperature-humidity regimes: I.1. Initial ripening at 26°-18°C and relative air humidity 96%-87% for 77 h as the values were periodically decreased and 2. Drying at 12°-13°C, relative air humidity 75% and air speed 1m/s to finished product. II.1. Initial ripening at 18°-14°C and relative air humidity 92%-78% for 72 h as the values were periodically decreased and 2. Drying at 12°-13°C, relative air humidity 75% and air speed 1m/s to finished product. The laboratory observations were carried out in dynamics of the technological process. The changes in pH values, quantity of the residual nitrites, batter exchangeable processes and the development of the starter culture, that was applied, were rendered /by quantity and quality assessment/. There was made a panel evaluation of the finished products according to 9th hedonic scale. The received results were framed mathematico-statistically.

RESULTS AND DISCUSSION: There are not significant differences between the results of the two temperature regimes, that do not effect the technological product treatment. This means that the initial temperatures between 26°C and 18°C satisfy completely the technological process. Analysis of the results, received in the second thermal regime, is carried out. The data in table 1 present the results of quantity and quality development of the microflora and applied broth culture. From varied growth in the filling batter at the variants with broth starter cultures at 72 h, we receive pure growth of broth culture colonies - "++++/1". At the 10th day the picture changes hardly at the GDL variant. These results correlate with the laboratory examination results of the other

indices /table 2/.

Table 1.-Microbiological processes

Period of examination	I variant		II variant		III variant	
	qty.	qual.	qty.	qual.	qty.	qual.
Filling batter	++++	4	++++	4	++++	4
At 72 h	++++	1	++++	1	++++	2
On 5 day	++++	1	++++	1	++++	2
On 10 day	++++	1	++++	1	++++	2,1
Of finished product	++++	1	++++	1	++++	1
Qualitative growth characteristic:				Quantitative growth characteristic:		
0 - absence of colonies				1 - pure smear		
+ - to 20 colonies				2 - pure smear with single others		
++ - from 20 to 50 colonies				3 - mixed smear		
+++ - over 50 colonies, but calculated				4 - various growth		
++++ - compact growth						

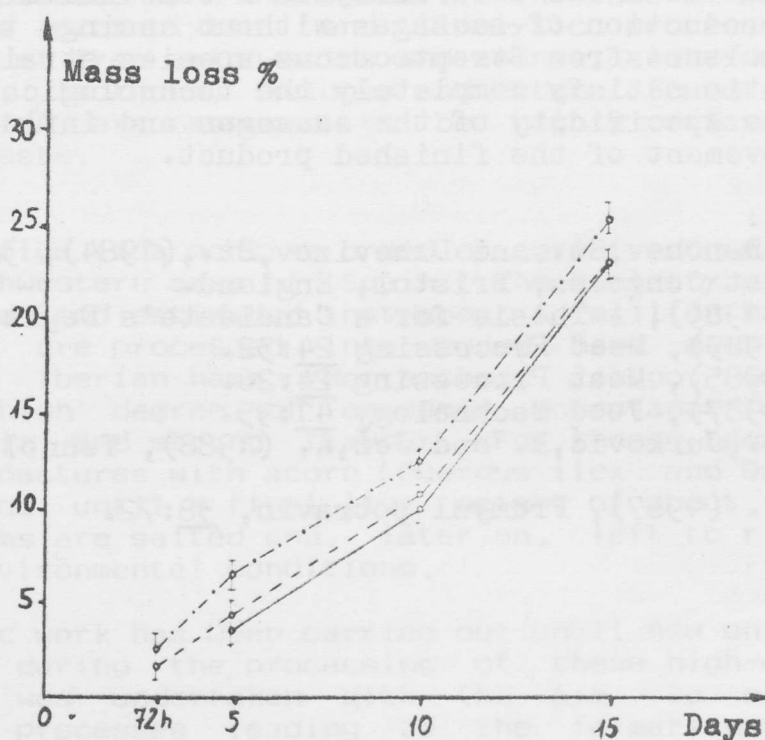
Table 2.-Biochemical processes

Period of examination	I variant /with Str.sp.136,167/	II variant /with Str.lac.P ₄ /	III variant /with GDL/
<u>pH</u>			
Filling batter	5,98±0,10	5,88±0,12	5,32±0,10
At 48 h	4,88±0,11	5,31±0,11	5,13±0,12
At 72 h	4,74±0,11	4,92±0,09	5,11±0,11
On 5 day	4,61±0,12	4,62±0,10	4,70±0,08
On 10 day	4,70±0,10	4,76±0,12	4,67±0,12
Finished product	4,70±0,12	4,74±0,11	4,66±0,12
<u>Residual nitrites</u>			
<u>mg %</u>			
On 5 day	1,14±0,023	1,03±0,031	0,97±0,032
On 10 day	0,74±0,035	0,90±0,030	0,87±0,029

Independently of sharp pH decrease in the filling batter of GDL sausages, the pH decrease of sausages with mixed starter culture at 48 h leaves behind that of the other two types. This trend is preserved till the fifth day, and after that is nearly equated. After 72 h, pH is significantly under 5. This is received due to the highest acid forming possibility of the mixed starter culture. In conformity with the pH decline, the casings of the sausages, produced with mixed broth culture and with GDL, were "undressed" at 48 h. The sausages, prepared with the other broth culture were "undressed" at 72 h. From these results the issue follows, that by necessary ripening intensity

that ensures the desirable firmness of product in order to realize the technological treatment. Regarding good slice and colour, after 72 h visible differences are not detected. The correlation relationship between the parameters is remained the same also at the values of residual nitrites. The results show, that still at the beginning of the process conditions are created for maximum consumption of the used nitrite. Till the fifth day the values of the residual nitrites are rather under the maximum, permissible in the finished product. The batter exchangeable processes, which are expressed by mass losses /graph. 1/, are forerunning for products, prepared with mixed starter culture, from the beginning to the end of the process. This favours the intensifying of the production-technological process and ensures very good quality parameters.

Graphic drawing 1. Batter exchangeable processes



- Sausage, produced with mixed culture from Streptococcus species 136 and 167
- Sausage, produced with culture from Str.lac.P₄
- Sausage, produced with GDL

In the sensory evaluations of the products during the period of experimentation, visible differences regarding colour and slicing surface are not established. There was found out definitely sourer flavour in GDL products. Nevertheless of low pH, in the products with broth cultures such a souring do not perceived. They are more palatable and more spicy. After the storage of 10 days, these differences increased. In table 3 are presented the results from the specialized panel evaluation.

Table 3.-Organoleptic score

Parameters	I variant	II variant	III variant
Colour	7,3	7,3	7,2
Structure	7,3	7,3	7,2
Consistency	7,3	7,3	7,2
Smell	7,3	7,0	6,5
Flavour	7,3	7,0	6,5
Juiciness	7,3	7,0	6,5
Total score	7,3	7,0	6,5

I and II variants are with scores of excellent quality, and III variant - very good.

CONCLUSIONS: From the data analysis a conclusion can be drawn that in the production of sausages without casings the use of mixed broth culture from *Streptococcus* species strains 136 and 167 in 1:1 ratio satisfy completely the technological demands about the type specificity of the sausages and influence the quality improvement of the finished product.

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