PE4.110 Research on the Impact of Bulgarian Starter Cultures on the Colour Characteristics of Quick-Ripened Raw-Cured Sausages 402.00

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The application of starter cultures has acquired an ever increasing significance, which rests both on the attempt to optimize the production of raw-cured foodstuff by accelerating the ripening of meat products as well as on the efforts to improve the sensory characteristics of food. The present paper demonstrates the impact of three different combinations of lyophilized starter cultures on the colour characteristics of quick-ripened raw-cured sausages. These starter cultures include the Bifidobacterium longum, Lactobacillus plantarum, Lactococcus lactis, Pediococcus acidilactici and Micrococcus sp. strains and have been procured by Lactina Ltd., based in the town of Bankya, Bulgaria. In order to determine how the cultures under study affect the colour characteristics of cured and ripened samples of sausages, the research team examined the modifications in the pH values and the colour-determining parameters (L*, §Ñ*, b*). It was discovered that the Bulgarian starter cultures used aid the acceleration of colour formation processes as well as the preservation of the improved and stable colour characteristics of the final product.

Index Terms : colour, raw-cured sausages, starter culture.

I. INTRODUCTION

The significance of colour as an essential and primary quality parameter bearing upon consumers` attitudes towards meat products has been well recognized by meat-processing plants. Therefore, colour formation and fixation processes going on during ripening and curing of quick-ripened raw-cured sausages are some of the most important biochemical processes influencing to a great extent the quality of the final product. It is widely known that the natural colour of meat products is mainly determined by the presence of the sarcoplasmic protein myoglobin which undergoes a number of chemical changes peculiar to meat processing. The technology for raw-cured meat products is characterized by the fact that salting accelerates the oxidation process due to the presence of cooking salt. As a result, myoglobin and oxymyoglobin are converted into metmyoglobin which makes the final product gray-brown in colour (1, 2). It must be pointed out that in the manufacture of meat products of the type the changes in heme pigments are exclusively determined by the action of the natural enzyme systems in meat products. A number of researchers claim that the usage of bacterial inoculum influences the development of the rather complicated process of denitrification which is very likely to bear upon the colour intensity and stability of meat products (3, 4). The objective of the present paper is to study the impact of three combinations of Bulgarian bacterial cultures including the Bifidobacterium longum, Lactobacillus plantarum, Lactococcus lactis, Pediococcus acidilactici and Micrococcus sp. strains on the colour characteristics of raw-cured meat products.

II. MATERIALS AND METHODS

Samples were prepared by recipes shown at Table 1. Beef II grade was mined on a wolf-machine with grade apertures diameter 24 mm, then salted and gelatin, additives and enzyme preparation added to it. The research was conducted for three different combinations of lyophilized starter cultures procured by Lactina Ltd., based in the town of Bankya, Bulgaria, namely: “Lactina 1” starter culture - Lactobacillus plantarum, Micrococcus sp., Bifidobacterium longum; “Lactina 2” starter culture - Lactobacillus plantarum, Micrococcus sp., Lactococcus lactis, Bifidobacterium longum; “Lactina “ starter culture - Lactobacillus plantarum, Micrococcus sp., Pediococcus acidilactici, Bifidobacterium longum.

In order to find out how the starter cultures affect the colour characteristics of meat products, the research team carried out experiments with quick-ripened raw-cured sausages having the following composition: 3 kg of first-quality veal, 3 kg of lean pork, 4 kg of semi-lean pork, 0.002 kg of ascorbic acid, 0.010 kg of sugar, 0.050 kg of black pepper, 0.010 kg of garlic, 0.005 kg of nutmeg, 0.280 kg of salt, and 0.0014 kg of sodium nitrite. The preparation of the filling was done with the help of a “Kutter” machine. The filling was stuffed into

polyethylene casings. The sausages were initially placed in a climatic chamber at a temperature of 20 - 24°C and at 96% relative humidity of the air to stay for 24 ¨C 48 hours, after which the relative humidity and the temperature were decreased in stages from 85 ¨C 90% and 18 - 22°C, respectively, to 85 ¨C 75% and 15°C. The influence of the inoculum used on the parameters mentioned below was determined by examining the filling immediately after its preparation, i.e. on the 1st day, 3rd day, 5th day, 7th day, and 12th day. The research was carried out for three variants of sausage samples, as follows: ¡ñ Variant I ¨C with lyophilized starter culture 1, for an inserted amount of 1.00g/kg of filling; ¡ñ Variant II ¨C with lyophilized starter culture 2, for an inserted amount of 1.00g/kg of filling; ¡ñ Variant III ¨C with lyophilized starter culture 3, for an inserted amount of 1.00g/kg of filling. The amount of inoculum added provides 106 cfu/g of meat mass.

Simultaneously, control samples of raw-cured sausages were produced whose preparation did not utilize starter cultures. In order to examine how Bulgarian starter cultures affect the colour characteristics during curing and ripening of quick-ripened raw-cured meat products, the research team determined the pH and the colour-defining parameters of colour brightness L*, presence of the red colour component §Ñ*, and presence of the yellow colour component b* of the cut surface. During the technological processing, the studies on the objective determination of the cut-surface colour characteristics of the experimental and control samples were done with a CR 410 (KONIKA MINOLTA) Hunter Chromameter.

III. RESULTS AND DISCUSSION

Some of the most important biochemical processes during the production of quick-ripened raw-cured sausages actively break down the carbohydrates added in the course of salting. The adequate development of the biochemical processes in the fraction of carbohydrates in the filling for the entire technological process ensures to a large extent the desirable beneficial conditions for the formation of the characteristic structure, odour, taste, and colour of high-quality quick-ripened raw-cured sausages. The initial biochemical changes in the filling for quick-ripened raw-cured sausages have to do with the transformation in the hydrogen-ion concentration (pH). The decrease in the pH values during the initial period of salting and ripening influences considerably a number of other technological parameters, such as moisture retention, consistency, etc. What is more, the low pH values in the complex biological system of the animal tissue building up the meat mass play a vital role, especially at the onset of curing, in the accelerated formation of the colour and the characteristic flavour of raw-cured meat products. In the production of quick-ripened raw-cured sausages, the intensified acidification of the filling, especially in the initial stage of curing, is desirable since the preservative action of curing has not yet affected the development of some groups of microorganisms that can subject the final product to the risk of being biologically contaminated. In view of this, the pH values of the filling are essential indicators in determining the quality characteristics of quick-ripened raw-cured sausages.

Table 1 illustrates the results from the tests to determine the impact of the mixed inoculum on the changes in the pH values of the experimental and control samples of quick-ripened raw-cured sausages.
Table 1. Changes in the pH values of quick-ripened raw-cured sausages depending on the type of inoculum used: control sample ¨C without inoculum; sample 1 ¨C with “Lactina 1” starter culture; sample 2 ¨C with “Lactina 2”starter culture; sample 3 ¨C with “Lactina 3” starter culture.

The results demonstrate that there are significant differences in the changes of the pH values between the experimental samples, produced with inoculum, and the control samples, produced without inoculum. They also show that the pH change went on in two subsequent stages, namely the initial decrease was followed by an increase in the pH values (Table 1).

The pH values of the experimental samples, produced with microbial inoculum, decreased on the 3rd day of curing with approximately 0.70 units, in comparison with the pH values of the filling immediately after its preparation. With the control samples of raw-cured sausages, the decrease was with 0.50 units. The results also show that the lowest pH values of the control samples were identified on the 7th day, the pH being 5.38. The decrease in the pH for the samples produced with “Lactina” 1, 2, and 3 starter cultures was identified on the 5th day, i.e. 5.26¡À0.01; 5.19¡À0.01; and 5.20¡À0.01, respectively. The research team is convinced that the Bulgarian “Lactina” 1, 2, and 3

starter cultures contribute to the immediate and accelerated acid formation at the very onset of the technological process, which is one of the main requirements concerning starter cultures in view of their application to raw-cured sausages.

Figures 1, 2, and 3 illustrate the results having to do with the impact of the Bulgarian " Lactina"1, 2, and 3 starter cultures on the parameters determining the colour formation and stability of quick-ripened raw-cured sausages. It was discovered that the L* values, determining the colour brightness of the experimental and control sample cut surface of quick-ripened raw-cured sausages, go up until the 3rd-7th day, after which they decrease. Fig. 1 also illustrates that colour brightness for control samples reaches maximum values on the 5th-7th day, whereas experimental samples acquire the same values on the 3rd-5th day.

Moreover, the maximum values for samples with "Lactina" 1, 2, and 3 starter cultures were, respectively, 7.7%, 10.1%, and 7.8% higher than those for the control samples on the 5th day. Fig. 1. Changes in the "L" values of quick-ripened raw-cured sausages depending on the type of inoculum used: control sample ¨C without inoculum; sample 1 ¨C with "Lactina 1" starter culture; sample 2 ¨C with "Lactina 2" starter culture; sample 3 ¨C with "Lactina 3"starter culture. Fig. 2. Changes in the ¡°a¡± values of quick-ripened raw-cured sausages depending on the type of inoculum used: control sample ¨C without inoculum; sample 1 ¨C with "Lactina 1" starter culture; sample 2 ¨C with "Lactina 2"starter culture; sample 3 ¨C with "Lactina 3"starter culture.

The §Ñ* parameter, both with control samples and experimental samples with "Lactina" 1, 2, and 3, demonstrated a tendency towards an increase until the 5th-7th day of the technological process as well as a relative stability of values during curing and ripening (Fig. 2). The red colour was vivid during salting and at the onset of ripening for all three experimental samples. This parameter also showed that with the control samples its maximum values were reached on the 7th day, whereas with the starter culture samples this happened on the 3rd-5th day. In addition, the maximum values of the samples with "Lactina"1, 2, and 3 starter cultures were, respectively, 17.4%, 20.6%, and 19.4% higher than those of the control samples on the 5th day. The results for the presence of the red colour component show that the colour formation processes for all three experimental samples are completed by the 5th day after sample preparation and maintain higher values than the control samples in the course of the entire technological process. This means that "Lactina" 1, 2, and 3 starter cultures aid colour stabilization. Fig. 3. Changes in the ¡°b¡± values of quick-ripened raw-cured sausages depending on the type of inoculum used: control sample ¨C without inoculum; sample 1 ¨C with "Lactina 1" starter culture; sample 2 ¨C with "Lactina 2" starter culture; sample 3 ¨C with "Lactina 3" starter culture. The studies on the presence of the yellow colour component, b*, demonstrate that the values of the control samples and the experimental samples decrease during the entire period of curing and ripening. A marked decrease of this parameter, however, was observed with the experimental samples of the sausages under study (fig.3).

IV. CONCLUSION

The organoleptic analysis results have provided evidence that the enzyme preparation used largely improves the quality of meat cans made from meat raw materials of low-functional properties obtained from large ruminants. The results concerning the changes in the colour characteristics of the examined quick-ripened raw-cured sausages prove that "Lactina"1, 2, and 3 starter cultures accelerate the colour formation process. The authors believe that the more intense colour modifications of the experimental samples, during salting and at the beginning of ripening and curing, were brought about by the intense growth of the bacterial strains at this stage. The contribution of the starter cultures to the formation of a stable colour can be attributed to the quick lowering of the pH to values approximating 5.4 at the beginning of the technological process, which allows for an accelerated rate of the biochemical reactions resulting in the production of nitroso-myoglobin. The cut-surface colour of the ready sausages, produced with "Lactina" 1, 2, and 3 starter cultures, is more stable under storage of the meat products.

REFERENCES

[1] Cornforh, D. P., Jayasingh, P. (2004). Colour and Pigment. In W. K. Jensen, C. Devine, & M. Dikeman (eds.). Encyclopedia of Meat Sciences (pp. 249 - 256). Oxford, UK: Elsevier LTD

[2] 2. Mancini, R. A., M. C. Hunt. (2005). Current Research in Meat Colour (pp. 100 - 121). Meat Science (71)

[3] 3. Miralles, M. C., J. Flores, and G. Peres-Martinez. (1996). Biochemical Tests for the Selection of Staphylococcus Strains as Potential Meat Starter Cultures. Food Microbiol. 13:1-10

[4] 4. Talon, T., S. Leroy-Setrin, and S. Fadda. (2004). Dry Fermented Sausages. In Y. H. Hui, L. M. Goddik, J. Josephsen, P. S. Stanfield, A. S. Hahsen, W. K. Nip, and F. Toldra (eds.). Handbook of Food and Beverage Fermentation Technology (pp. 397 ¨C 416). New York: Marcel Dekker.