DEFECTS OF COLOUR OF THE BULGARIAN DRY SAUSAGES CAUSED BY SOME SAPROPHYTE MICROORGANISMS AND THEIR REMOVING BY STARTER APPLICATION OF MICROCOCCUS STRAIN P_4

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Bulgarian raw-dried sausages of the 'loukanka' type are products in the ingredients of which pork and beef and spices are included in different ratios. Unlike round sausages, the loukankas are subjected to several pressings during drying, obtaining consequently a flat form when ready.

The improper colouring of the sausage meat is one of the main defects in the production of loukankas, expressed in greying at the sausage linking and in hollow greying (14).

The objective of the present work is to elucidate the effect of some saprophytic microorganisms on colour processes and their interrelation with strain P_4 in the environment of loukankas treated at different temperatures of drying.

MATERIALS AND METHODS

Technology. Museum strains were applied: E. coli 3277, Aer. aerogenes B 27, Proteus vulg. 401, B. mesentericus vulg. 66, B. subtilis, A.T.T.C. 7241, Micrococcus strain P_4 -22-1969.

The experimental work was carried out with sausage meat taken out of production lots. The sausage meat was divided into 12 samples treated in the following way: one control sample without a starter; five samples with individual application of pure cultures of the experimental saprophytic strains; five samples with a starter of strain P_4, a strain of the saprophytic microorganisms being applied in addition to each sample; and a sample with only strain P_4. The samples filled into artificial casings were divided into three groups, each being dried according to three different technologies:

Technology 1, drying at a temperature of 18-20°C, a relative humidity of 55-65%, and an air velocity of 0,1 m/sec.

Technology 2, drying for 3 days as in technology 1, and then at a temperature of 8-10°C, a relative humidity of 73-76%, and an air velocity of 0,1 m/sec.

Technology 3, drying at a temperature of 8-9°C, a relative humidity of 73-76%, and an air velocity of 0,1 m/sec.

A 24-hr. yeast broth culture was used as a starter in the amount of 5 cm^3 per 1 kg of sausage meat. It was cultivated at 30°C for the saprophytes and at 25°C for strain P_4 (9, 10), and contained over 10^8 living cells per 1 cm^3 of broth.

During drying, all samples from the three technological regimes were analysed parallelly on the 3rd, 10th, 17th, 24th and 31st day.

The following determinations were made:

Microbiological: contact preparation on yeast agar, bromothymol blue agar, azide medium (9). Species determination of introduced strains.

Physico-chemical: pH, free nitrites, water content.

Organoleptic: appearance, texture, binding, taste and flavour, colouring of cut surface.

RESULTS

The experimental work was carried out with 4 series of samples. The results from the organoleptic evaluation indicate, that in technologies 1 and 2, already from the third day of drying the samples with strain P_4 introduced either alone or in combination with any of the saprophytic strains distinctly differ from the control and the samples with saprophytes only. The texture is denser and with better binding; taste and flavour, with initial processes of ageing. The control and the samples with only saprophytes have milder texture, crumbly sausage meat and a taste and flavour of raw meat. In the samples with only Aer. aerogenes or Prot. vulg., after the tenth day an off-odour can be detected. The differences described, though in a lesser degree, are preserved till the ready product.

In technology 3, the differences are less pronounced and begin to be felt only after the tenth day, tending to equalize in the ready product. Generally taste and aroma indices in the ready product are not pronounced.

In the samples with strain P_4 (individually or in combination) in technologies 1 and 2, the sausage meat already after the third day has a light raspberry-red colour, distinctly differing from the control and the samples with saprophytes. No defects of colour can be detected.

In the same technological regimes of drying (technologies 1 and 2), the control and the samples with saprophytes during different periods of drying give a variance in the tints of sausage meat colouring, expressed in some cases in colouring defects, pronounced in technology 1.

The controls from series II, on the 31st day have a complete central colouring change in technology 1 and limited spots (of up to 3 cm) in technology 2.

The samples treated with E. coli from series II have a complete central colour alteration in technology 1 (on the 17th, 24th and 31st day) and in technology 2 (on the 24th and 31st day).

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Such changes were demonstrated in series III only with technology 1 (on the 24th and 31st day).

The same colouring alterations were detected in the samples treated with the remaining saprophytic species of microorganisms in the following series of samples:

Aer. aerogenes,in series II and III with technology 1 (on the 17th, 24th, 31st day),

Proteus vulgaris, in series I with technology 1 (on the 24th and 31st day) and with technology 2 (on the 31st day); in series II and III, with technology 1 (on the 24th and 31st day),

B. subtilis, in series II and IV with technology 1 (on the 24th and 31st day),

B. Mesentericus, in series II with technology 1 (on the 17th, 24th and 31st day) and technology 2 (on the 31st day); in series IV, with technology 1 (on the 24th and 31st day).

In technology 3, no colouring defects were detected in the controls and samples. Also the difference in the colouring tints between samples treated with strain P_4, and those with saprophytes and the controls, were insignificant.

The results from the microbiological analyses indicate, that in the samples treated with strain P_4, individually or in combination with saprophytic strains, already 24 hrs. after filling, strain P_4 gains the upper hand over the remaining microflora, being preserved till the product is ready. The results of the comparative microbiological analyses of the samples treated with only strain P_4 and those treated with a combination of strain P_4 and a saprophytic species indicate, that growth in combined samples is reduced to that in samples with only strain P_4 already in the initial period. In the controls, the accompanying normal saprophytic growthis greatly diminished after 10-15 days.

In the samples treated with the individual experimental strains of saprophytes, the strain introduced predominates in the initial periods of growth, while after 16-18 days the samples tend to equalize with the controls.

The results on the pH values indicate a direct dependence on the temperature regimes. So,in technologies 1 and 2, in the samples with strain P_4 (individually or in combination with a saprophytic strain) pH is significantly lowered already on the third day (5-5,2). With the same temperature regimes, a delay in the lowering of pH is observed in the control and the samples with saprophytes, a pH of 5,2-5,3 being reached only on the 10th day.

In technology 3, pH reduction of samples and controls is delayed, pH being reduced to 5,3-5,4 only after 17-18 days.

DISCUSSION

Improper colouring of sausage meat is one of the basic defects in raw-dried sausages. It is encountered both in individual links and in large-scale injuries of whole lots and production and is observed most frequently in semi- air-conditioned and air-conditioned drying rooms, when using artificial casings. The defect affects mainly the production of loukanka, and seldom round raw-dried sausages. It is located around the linking or spreads all over the central zones of the upper half of the links (14).

The mechanism of the origination of colouring defects in raw-dried sausages is still rather insufficiently studied. The existing microbiological, physico-chemical, purely technological theories or those based on exudative or frozen meats cannot give a complete answer nor explain the interdependence of a number of phenomena connected with the colouring defects of raw-dried sausages (1, 2, 3, 4, 7).

Data from literature, theories and our own observations (14, 15) give us grounds to assume, that the mechanism of colouring defects of the loukankas is a physico-chemical process due to physico-mechanical and microbiological factors. The physico-mechanical factor is directly dependent on dehydration, gravitation and static forces acting on the suspended product, and the type of casings (14). These factors are subject to control and guidance and can be managed by the technologist.

The problem of the microbiological factor is somewhat at variance with the above. While the technological methods applied (detention of sausage meat, temperature parameters) more or less favour the microbiological process, the basic, initial process, the contamination of the raw material and the sausage meat, is left entirely to chance. This chance is better pronounced and dominates in modern plants. In old factories there are conditions for retention and growth of 'plant' microflora. Due to the initial conditions, 'useful' microflora is selected in a natural way in amounts sufficient to inhibit the 'harmful' one and to contaminate the raw material during the technological process before filling. In the consequent technological steps, thanks to the domination of 'useful' microflora, biochemical processes soon take the desired direction. Along with plant modernization, the amount of 'plant' microflora diminishes sharply. Besides, there are no conditions for

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a natural selection of'useful' microflora. For this reason the raw material and the sausage meat are contaminated with casual microflora which retards the process of selection in the initial period after filling and transfers it to the later technological cycles. Retarded selection enables biochemical processes to take undesirable direction. This formulation of the problem can offer an explanation of frequent defects and quality deterioration of raw-dried sausages produced in modern plants. This is confirmed by the good results obtained using pure cultures in foreign (5, 6, 8) and local products (11, 12) in the same production circumstances and technology.

The results obtained in this work confirm these conceptions. The ready sausage meat from production lots used in the experimental work imparts to the latter an industrial aspect. I n this way the sausage meat is contaminated with constantly acting 'plant' microflora, in the contents of which participate with a great share saprophytic microorganisms of the same species as those used in the experiment. The results indicate that saprophytic microflora fallen into product in manufacturing circumstances or additionally introduced finds no conditions for growth in raw sausages and its quantity diminishes quickly after 10-15 days. In this very period of rapid selection processes saprophytic microflora exhibits its enzymatic activity. Results indicate that this activity is directly dependent on the temperature regime and the amount of cells. In optimum conditions, lasting or transitory colouring defects of sausage meat occur. This is confirmed in technology 3 where, due to the application of low temperatures, no colouring defects occur, despite the additional introduction of saprophytic microflora. In technologies 1 and 2, where the product is subjected to higher temperature regimes, defects can occur in normal production, while the risk is greater with greater contamination, i.e., introduction of additional saprophytic microflora into the samples.

Micrococcus strain P_4 was isolated out of Bulgarian raw-dried sausages, where it finds its natural growth medium (9, 12). With favourable temperature conditions, strain P_4 gets the upper hand over the remaining microflora already 2 or 3 days after filling of the product. Besides, strain P_4 has an inhibitory action with regard to saprophytic microflora (13). All of this contributes to the shortening of the period of selection processes and enzymatic action of saprophytic microflora. The results obtained

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from the samples treated with a starter of strain P_4 come in confirmation of the above. While in the controls and the samples with saprophytic strains colouring defects can be observed, in the samples in which strain P_4 is introduced together with any of the experimental strains of saprophytic microorganisms, no colouring defects can be observed. Furthermore, product quality in such samples is equalized with that of samples where only strain P_4 was introduced.

CONCLUSIONS

1. Saprophytic microflora from the species of E. coli, Aer. aerogenes, Proteus vulgaris, B. subtilis and B. mesentericus can be the cause for colouring defects and the deterioration of organoleptic indices of raw-dried sausages when high temperature regimes are employed.

2. In low temperature regimes of drying saprophytic microflora does not cause any colouring defects of raw sausages.

3. The application of pure bacterial cultures of the species of Micrococcus strain P_4 in the production of raw-dried sausages prevents the occurrence of colouring defects caused by saprophytic microflora, regardless of the drying temperature regimes. Strain P_4 controls microbiological processes, diminishes risk and improves ready product quality.

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