USE OF FOOD ACIDS AND THEIR SALTS IN PRODUCTION OF DRY SAUSAGES

Lisitsyn A.B., Lubchenko V.I., Goroshko G.P., Korshunova T.N., Kuznetsova T.G.
All-Russian Meat Research Institute, Talalikhina 26, 109316, Moscow, Russia

Additives used in the production of dry sausages lead to reduction of sausage meat acidity, that have a further favourable effect on color-, structure-, aroma- and flavour formation of products. Acid formation is the main process in the production of dry sausages. Different kinds of sugars are often used for these purposes. Under the action of bacteria sugar is broken down into acids which reduce pH of the sausage meat. However, pH of sausage meat can also be reduced using the additives which simulate this biological acidification. We used for this purpose food acids and their salts, whose action is based upon inhibition of growth of pathogenic microflora and reduction of pH value of sausage meat and finished products that will contribute to the increase of storage time, stabilization of colour, flavour and aroma.

AIM OF INVESTIGATIONS

Investigation of the influence of food acids and their salts on the change of physico-chemical, microbiological, microstructural and organoleptical characteristics of dry sausages during their production.

OBJECT AND METHODS OF INVESTIGATIONS

To find out the influence of food acids and their salts on the process of ripening and drying or raw sausages of type salami, different doses of citric acids (CA), tartaric acid (TA) and the combination of citric acid and its sodium salt (CS) were used. pH was measured by a portable pH-meter "Zamer", moisture content - by express-method on a moisture gage LPVMP - I; the content of volatile fatty acids (VFA) - by distilling off by vapor with the following calculation for propionic acid; the contents of the sum of carbonyl compounds (SCC) - by bisulfite method with calculation for acetaldehyde.
Organoleptical characteristics were evaluated according to GOST 7616-85. Microstructural investigations: the specimens were fixed by 15 % solution of neutral formalin during 48 hours according to standard technique (Merkulov G.A., 1969). 20-40 μm thick sections made on microtome cryostat MK-25 were stained by the alcoholic solution Sudana 3 and the solution of hematoxylin according to Ehrlich with finishing staining by 0,5 % solution of eosin. The histological preparations obtained were analyzed under microscope "Ynaval" (Germany) with 200 x magnification.
The samples were withdrawn at different stages of production : in the initial sausage meat, after smoking, at 12, 20, 26 days of drying.

RESULTS AND DISCUSSION

Tables 1 and 2 show the results of investigation of the influence of food acids and their salts on changes of physico-chemical and microstructural indices at stages of ripening, smoking and drying of raw sausage of type salami.

Table 1. Change of pH value during manufacture of raw sausage of type salami

No. of experiment	Kind and dose of additive	pH of sausage meat					
		initial	after setting	after smoking	12 days drying	20 days drying	26 days drying
1.	0,15 % CA	5,20	4,92	4,82	4,78	4,79	4,82
2.	0,30 % CA	4,97	4,90	4,87	4,83	4,82	4,92
3.	0,15 % TA	5,29	5,02	4,76	4,77	4,80	4,88
4.	0,30 % TA	5,02	4,79	4,79	4,76	4,81	4,91
5.	0,29 % CS + 0,25 % CA	4,98	4,86	4,87	4,81	4,87	4,93
6.	control	5,68	5,25	4,86	4,82	4,89	5,02

Analysis of change of pH value in dry sausages showed similarity of dynamics of change of this index for food acids of the same concentration. Thus, sausages with 0,3 % of food acid after sausage meat preparation had a lower pH value, than with 0,15 % (4,97; 5,02 and 5,2; 5,29, respectively). In the course of technological process in sausages with lower concentration of food acids a greater decrease of pH value was observed. A lower pH value in sausages with 0,15 % of food acids is maintained at the end of the technological process. Probably, addition a higher dose of food acid has a sharper inhibitive effect on sausage meat microflora, including producing acids also. In the samples with lower concentrations of food acids the fermentative reactions of sugar fermentation are more intensive and as a result, acidity of sausage meat is somewhat higher.
It should be noted that initiation of growth of pH index in meats with citric acid comes later (after 18 days of drying), than in meats with tartaric acid (after 10-12 days of drying).
The samples, containing a mixture of CA and CS, pH changes are similar to changes in the samples with higher concentration of acids.
Carbonyl compounds also contribute to the aroma of foods. Volatile fatty acids are also important in creating the flavour of the product.

Table 2. Change of the sum of carbonyl compounds (SCC) and volatile fatty acids (VFA) during manufacture of sausage of type salami

No. experiment	Values at different stages of the process, mg%							
	sausage meat		after smoking		after 12 days of drying		after end of drying	
	SCC	VFA	SCC	VFA	SCC	VFA	SCC	VFA
1	0,740	26,43	1,767	66,08	1,513	95,94	1,665	60,52
2	0,623	18,76	1,826	44,67	1,932	54,71	1,628	47,57
3	0,666	36,74	1,798	64,22	1,877	72,68	1,672	57,62
4	0,748	22,46	1,932	44,67	1,804	54,71	1,826	48,10
5	0,666	24,84	2,068	45,46	1,841	64,48	1,811	52,33
6	0,843	20,61	1,665	40,70	1,672	69,77	1,722	74,00

During smoking an intensive growth of these values is observed, which is more pronounced in the samples with additives.
Up to 12 days a slow accumulation of volatile fatty acids is observed, in the control sample this process continues up to the end of drying. The samples with additives have a slight decrease of the quantity of volatile fatty acids at the end of technological cycle.
The same pattern is observed with the sum of carbonyl compounds. A reduction in this value can be explained by the fact that one part is lost, and the other one is used for building new, more complex compounds (for example, polymerization reaction with nitrogen-bearing compounds, the reaction of aldehydes condensation, etc.), also having positive effect on the aroma of products.
Changes in moisture content in the samples of dry sausages allow to conclude, that a more intensive moisture transfer occurs in sausage meats, containing a higher concentration of food acids and a mixture of citric acid and sodium citrate. Then by their rates of drying follow the samples with a less dose of food acids, and the samples with tartaric acid by their rate of dehydration leave behind the samples with citric acid.
This pattern is confirmed by the data of mass losses of dry sausages samples.
Microstructural studies have shown that during smoking the arrangement of structural elements of sausage meat becomes more dense, homogenization and fusion of muscle fibers occurs, as well as the granular breakdown of their individual parts, destruction of nuclei and conversion of fat cells into plate-like ones, increase in the amount of lactic acid microflora.
The arrangement of the structural elements of the control after smoking of the surface layer is dense, the muscle fibers at the cross section are dense, thickness of the dense layer is 200-250 μm. In deep layers coarse ground fragments of muscular, fatty and connective tissue are separated by slot-like spaces that to some extent loosens up the mass of the meat.
The muscle fibers are swollen, destructive changes are revealed in the most muscular bundles and fibers and are expressed by weakening of cross striation and homogenization of the fibers structure, and by forming the areas of their granular breakdown.
Similar changes during smoking are marked in the structure of samples I and 3.
Samples 2,4 and 5 after smoking are characterized by loose arrangement of structural elements of the meat, the process of structure formation is poorly expressed. Lactic microflora doesn't form its characteristic colonies and is localized by diffusion.
Further development of coagulation interaction between protein particles, and the strengthening of links between them leads to the formation of dense spatial framework comprising the fragments of coarse ground muscular, connective and fat tissues and thus to the formation of uniform structure of the product.
Microstructure of the control during drying is characterized by a dense arrangement of structural elements of the sausage meat. Surface thickness of dense layer is 300-350 μm. In deep layers of meat the cross striation of closely adjacent muscle fibers is weakened, the nuclei of fibers are homogenous.
The fiber component of connective tissue is swollen, its structure in several parts is not discernible and uniform.
Between individual muscle fibers and their bundles, fine-grained protein mass is found which comprises large microcolonies of lactic acid microorganisms, large fat droplets. Vacuoli penetrating through the mass of the meat are of medium size and definitely arranged.
Microstructure of samples 1 and 3 is characterized, like the control,by a dense arrangement of the components of the meat. Destructive changes of connective tissue are more pronounced as compared to the control; in the most areas its structure is homogenous.
Samples 2, 4 and 5 are characterized by unformed structure of meat, both in the deep and in the surface layers. The mass of the meat is loose, has microvoids and slots of different size, the structural elements of sausage meat are poorly interconnected with each other.
The microflora is diffusively distributed over the meat and is in insignificant amount.
After drying the control sample, the sample 1 and 3 had a monolith well-bound structure of the product, and in the samples 2, 4 and 5 the destructive changes are less pronounced, that influenced the process of structure formation. According to organoleptical evaluation the investigated samples were ranked (according to the score) as follows: 1 (best), 3, control, 4, 2 and 5 (worst).

CONCLUSION

As a result of the investigations it was established, that:
- use of food acids in the production of dry sausages is useful, as it improves the acid formation in sausage meats, intensifies the process of moisture removal and contributes to stabilization of colour, flavour and aroma of the product.
- citric acid is preferable
- the dose of food acids shouldn't exceed 0,15 %.