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ЕВРОПЕЙСКИЙ КОНГРЕСС РАБОТНИКОВ НИИ МЯСНОЙ ПРОМЫШЛЕННОСТИ

th EUROPEAN CONGRESS OF MEAT RESEARCH INSTITUTES

ter EUROPÄISCHER KONGREß DER FLEISCHFORSCHUNGSINSTITUTE

ème CONGRES EUROPEEN DES INSTITUTS DE RECHERCHES SUR LES VIANDES

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PROBLEMS IN THE PRESERVATION OF THE FISH SAUSAGE

№ 41

МОСКВА 1962г.

Problems in the Preservation of the Fish Sausage

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An annual output of sausage products in Japan, including hams and bacon, amounted approximately to 170,000 ton in 1960. Although the figure remained at considerably lower level than that for European countries, its increase in recent years has been extremely rapid, showing the average growth rate of 37.4 per cent a year during the years 1955-1960.

Fish sausages and hams constitute more than a half of the whole yield of sausage products. In 1960, approximately 85,000 ton of fish sausages and hams were produced. Their average growth rate for last five years reached to the figure of 52.8 per cent.

These rapid and overwhelming popularization of the fish sausages in Japan, where refrigerators are still in limited distribution, may mainly be ascribable to long storage life of the products.

The extension of the storage life of fish sausages has been attained through following three processes: (1) application of relatively high temperature of some 90 C in sausage processing, (2) the developement of artificial plastic casings such as rubber hydrochloride and polyvinylidene chloride, and (3) development of preservatives used in sausages. Thus, combining the heat-treatment with the use of artificial casings and effective preservatives, we have succeeded in keeping the good quality of the fish sausages for a period of over one month at room temperature (20 C).

Heat treatment

The fish emulsion differs from that of most animal meat in being able to heat at higher temperatures without the breakdown of its structure. The high actomyosin[1] and low fat content of fish muscle seem to be responsible for the high binding property of the muscle and heat stability of the fish emulsion. Furthermore, considerable amounts (2-10 per cent) of several kinds of starch are usually added as sausage ingredients to support the binding property of fish sausage.

Although the processing of fish sausages at high temperatures, coupled with the concurrent use of casing of rubber hydrochloride, lengthened the storage life of this food often to remarkable extent, it has been shown that some effective preservatives are needed for the satisfactory and constant preservation of fish sausages, especially for the preservation at higher temperatures.

Preservatives

The effect of preservatives on the storage of fish sausage has been examined by W. Simidu and his co-workers[2],[3],[4] Most of better known preservatives such as sorbic acid, dehydroacetic acid, Vitamin K_3, aureomycin and derivatives of nitrofurane have been tested. Among those so far examined only nitrofurazone (5-nitro-2-furfuralsemicarbazone) was found to show satisfactory effect in keeping good quality of sausage even for storage at higher temperatures.

The antimicrobial effect of nitrofurazone on various microorganisms and on spore forming bacteria is shown in Table 1 and Table 2. The inhibition dose was determined by agar streak method.

Table 1 & Table 2

The strong bacteriostatic effect of the nitrofurazone on spore forming bacteria gives special facility for its use for the preservatives of the fish sausage.

It is expected that the nitrofurazone, when accompanied by mild heating (approximately 90 C), destroy or keep the spores of most important spoilage bacteria from germination. The concurrent effect of heat and disinfectants was studied with the spore of Bacillus mycoides and B. mesentericus(5). In the experiment, spore suspensions of B. mesentericus were adjusted at pH 5.4 and heated at 86 C in the presence of nitrofurazone, Vitamin K_3 and sodium trichlorphenol. The heated suspensions were then transferred into both ordinary nutrient agar medium and the media containing the same disinfectants as were used in the heating process, and after appropriate incubation, the bacterial population in the media were counted. The results (Fig. 1) show that heat resistance of spores was reduced

Figure 1

in the presence of these disinfectants, and that the germination rate of survived spores was remarkably inhibited in the media containg these disinfectants.

Adequate time and temperature conditions in heating process were determined from the results of a series of experiments in which fish sausages containing several concentrations of above preservatives were heated at 85 C, 90 C and 95 C for various time intervals, and stored at

30 C[6]. It was shown that heating at 90 C, for 60 minutes is sufficient for the preservation of the sausages for a month or more when they containe 20 ppm of Neofuraskine (mixture of 1/4 of nitrofurazone and 3/4 of nitrofurylacrylamide).

The spoilage of fish sausage

The increase in bacterial counts during the storage of fish sausages at higher temperature of some 30 C was observed by many investigators, though it was a common case that only few sausages stored in such condition were found to be inedible.

The types of spoilage of fish sausage differ with the kinds and freshness of fish and other ingredients, coarseness of ground meat, seasoning, time and temperature in heating process and other manufacturing conditions. The common types of spoilage were classified by W. Simidu et al. in following 5 types: (a) swell, (b) flat-sour, (c) mixed types of (a) and (b), (d) sofnening and (e) other changes such as off-odor, off-flavor or changes in color[7].

The softening type of spoilage is most frequently encountered. Yokozeki[8] studied softening of fish sausages, and reported that the change may be caused by Bacillus circulans. Uchiyama[9] suggested that bacterial decomposition of starch which is usually added in fish sausage as binding material may be responsible for the softening of sausages caused by B. circulans.

However, Akamatsu[10] investigated microflora of 49 fish sausages from market which had been incubated at 30 C for two weeks and found that the dominant species in the markedly softened sausages were Bacillus subtilis and B. pumilis. We also isolated from softened sausages several species of Bacillus group, some of which, when inoculated into sterilized fish sausages and incubated at 36 C, caused the softening under anaerobic condition as well as aerobic condition.

These results suggest that different types of softening may be caused according to the species of causative bacteria, and under different conditions of manufacturing process and storage.

Recently, other types of deteriolation, called "black spot", has been reported. When stored at higher temperature, dark spots or cores appear on the surface of sausage meat. Experiment to elucidate the process of the deteriolation are being carried out.

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Table 1. Bacteriostatic effect of nitrofurazone on various microorganisms

(Maximum concentration for growth)

Species	Concentration of nitrofurazone (ppm)
Escherichia coli	6.7
Proteus vulgalis	6.7
Flavobacterium fuscum	5
Achromobacter liquidum	3.3
Bacillus subtilis	2.5
Bacillus mesentericus	5
Staphylococcus albus	5
Micrococcus subflavus	200
Pseudomonas schuylkilliensis	400 <
Saccharomyces cerevisiae	400 <
Willia anomala	400 <
Torula rubra	400 <
Aspergillus niger	400 <
Penicillium glaucum	400 <
Mucor javanicus	400 <
Rhizopus nigricans	400
Oidium lactis	400 <

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Table 2. Bacteriostatic effect of nitrofurazone on spore forming bacteria

(Number of strains grown at given concentration)

Species	Number of strains	concentration of nitrofurazone (ppm) 0.5	1	2	5	10	20	50
Bacillus megaterium*	5	5	5	5	0	0	0	0
B. cereus*	3	3	3	1	0	0	0	0
B. mycoides*	6	6	6	0	0	0	0	0
B. subtilis*	5	5	5	3	1	0	0	0
B. pumilis*	2	2	2	1	0	0	0	0
B. coagulans	3	3	1	0	0	0	0	0
B. lentus*	1	1	1	0	0	0	0	0
B. firmus	2	2	2	1	1	0	0	0
B. polymyxa	4	4	3	3	0	0	0	0
B. macerans	1	1	1	1	0	0	0	0
B. circulans	2	2	2	2	0	0	0	0
B. alvei	5	5	5	5	0	0	0	0
B. brevis	5	5	5	5	4	0	0	0
B. laterosporus	1	1	1	0	0	0	0	0
B. stearothermophilus	1	1	1	0	0	0	0	0
B. thermoacidurans	1	1	1	0	0	0	0	0
Clostridium sp.**	53	53	53	53	42	13	1	0
Cl. botulinum**	1	1	1	1	1	0	0	0

* Y. Yamazaki, Ann. Rep. Inst. Food Microbiol., 8, 48-63 (1955)

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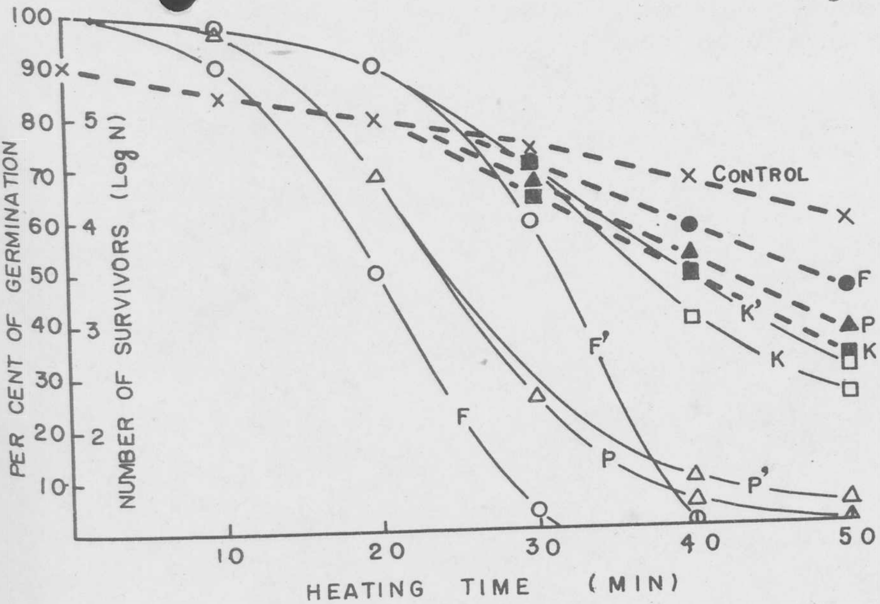

Figure 1. The log survivors/time curves of the spores of Bacillus mesentericus heated with disinfectants and germination rate of the survived spores in the media containing the disinfectants.

-------- : the log survivors/time curves

________ : germination rate

F : nitrofurazone (1 ppm)

P : pentachlorphenol (3 ppm)

K : Vitamin K_3 (4 ppm)

, : heated without disinfectant

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