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INFLUENCE OF SOME FACTORS ON SHELF - LIFE OF CANNED PASTEURIZED PRODUCTS

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INTRODUCTION

In the last few years, Yugoslav meat packing Industry has become a potential manufacturer and exporter of a very wide assortment of canned pasteurized products for different European markets, and lately in steadily growing quantities for U.S.A.

In the technological way of processing, storage and transportation there were many variations to a very wide extent, and still there are, especially in the application of low temperatures, for which reason a very different hygienic quality and limited shelflife of these products could be expected. The above allegations are confirmed by the data from our literature /B. Skenderović, i Ž. Trumić /15/, V. Oluški i R. Srbljin /11/, N. Mašić i B. Lebović /1o/, Z. Bem /5/, J. Rašeta /12/, V. Višacki i M. Petrović /6/, M. Stefanović /16/, I. Savić, M. Ćirić i D. Aleksić /14/, M. Ćirič, B. Stanojlović i Ž. Trumić /17/. Foreign literature /F. Lörenz i K. Incze /9/, K, Incze

/8/, W. Gisske /7/, E. Barnes, M Ingram /2/, H. Riemann /13/, is also very rich with data about bad influence of all above mentioned factors on shelf-life of canned pasteurized products.

For those reasons in one of our meat processing factory were processed a few manufacturing lots of canned ham under the definite and controlled thermal treatment, and the final products were stored at the temperatures of 5, 1o and 2o°C. At definite time intervals a certain number of cans were opened and the number of bacteria and the presence of species supposed to have bad effect on shelf-life of these products were examined.

As in the processing of experimental lots of canned ham has been applied a definite technological process, which certainly had some effect on microflora of the final products, it is, no doubt, necessary to show some of its important moments.

A short description of the technological process of manufacturing of canned ham

After the rest of at least 12 hours, pigs meant for manufacturing of canned ham, were processed in industrial way using electricity for stunning. The sides from processed pigs were cooled with fast treatment, while the temperature in the centre of meat after 16 hours, during the cooling process, was about 4°C. The sides cutting was done in an air-conditioned room, and

the temperature never went over 10°C. The same day those cooled sides were cured with injections of curing solution into the blood vessel in the ratio of 7% to the weight of ham. The curing solution had 24 Bé, and the day before use it was boiled and cooled to the temperature of 4°C. Bacteriological examination proved the curing solution to be sterile, or consisted only single germs. The hams were dipped into the curing solution of the strength 23 Bé. In the curing room, during the three days of hams curing, was maintained the temperature of 4°C. Under the same thermal treatment, the hams were held in metal boxes for draining during 7 days, and during that time they were twice over-arranged.

The boning and the final processing of hams, putting the hams into the tins and closing the tins were held in a room with the temperature of 10°C. The canned hams were pasteurized in open cauldrons at the temperature of 80°C, in the duration of 1 hour to 1 kg of weight. By using the thermo-couple it is found out that in the geometrical centre of canned hams during the pasteurization the temperature was 64°C, and it was maintained for a little longer than 30 minutes.

After the pasteurization the hams were cooled in water for about 2 hours, and after that in the freezing chamber with temperature of ±0°, till reaching the temperature of 10°C in the geometrical centre of the ham. To reach such temperature it took 12 hours.

In all phases of canned hams processing, special attention was paid to hygienic work conditions in order to prevent any possible contamination of raw materials that go into a tin.

MATERIAL, METHODS AND THE TECHNIC OF WORK

Under the above described conditions three manufacturing lots of canned hams were processed during three weeks. In each of the processed lot there were 45 hams filled into tins of the height of 1oo, 12o and 14o mm.

Our examinations of the bacterial flora of canned hams were divided in two parts, as following:

a. the bacteriological examination of the surface and the centre of the cured hams prior to fillingof of tins, and

b. the examination of the bacterial flora of canned hams stored at the temperatures of 5, 1o and 2o°C, at time intervals of 1o, 3o, 6o and 9o days.

a. <u>The examination of hams prior to filling of tins</u>

In the boning room, with sterile scissors and a pincette, samples of about 5 g from the surface /sample B/, and from the centre /sample A/ were taken. In the plant laboratory, from each sample dilutions with saline solution were taken. For de-

termination of the total bacterial count the method by Koch was used. The total count of Streptococci was determined in the Packer medium and the plates were incubated for 72 hours at 37°C. For determination of the number of sporeforming aerobes, the dilutions were held in water bath for 5 minutes at 100°C. For determination of presence of anaerobe microorganisms V.F. agar was used. For determination, from every plate 10 colonies were translated on slant agar. The results of these examinations are shown on the tables 1a, 1b, 1c, 1d, 1e, 1f, 2a, 2b, 2c, 2d, 2e, 2f, 3a, 3b, 3d, 3e and 3f.

b. <u>The examination of canned hams after the storage</u>

Following the premade plan, each 10th, 30th, 60th, and 90th day, a certain number of tins was opened under the sterile conditions, which had been stored at the temperatures of 5, 10 and 20°C with sterile drillers, about 10 g of samples were taken from three different places of hams:

fore lower part /a/
middle of ham /b/
back upper part /c/

The material was diluted with 3% NaCl solution. The total bacteria count was determined using the Koch method, and the total number of Streptococci using the Packer medium. For determination of growth of sporeforming aerobes, the dilutions with 3%

NaCl solution were treated for 5 minutes at 100°C. For determination of the presence of sporeforming anaerobes, V.F. agar was used. The results of these examinations are shown on the tables 4a, 4b, 5a, 5b, 6a and 6b.

RESULTS and DISCUSSION

Out of the complex of great number of factors which were supposed to have influence on bacterial flora of canned hams as well as on their shell-life, in the discussion will be brought out only those that, in our opinion had some influence on the final results.

The technological process of manufacturing for all three lots of canned hams involved in our experiments, was controlled very strictly, so naturally, it had a very good effect on the bacterial flora and on the shelf-life of the final products, particularly on those that were stored at lower temperatures. In this process three important moments should be accentuated: fast cooling of sides strict application of a definite thermal treatment during the boning and curing processes, as well as the pasteurization at 80°C, for 1 hour on 1 kg of the product. Probably the last mentioned factor had a very strong effect on the decrease of the number of bacteria, as well as on the elimination of certain species in the final product.

In the first manufacturing lot, bacteriologically were examined 45 hams, whose samples being taken from the centre of cured hams, shortly before filling of tins, showed the total bacteria number from 39o to 3o.ooo, and on the surface 1.72o to 45.ooo /tables 1a, 1b, 1c, 1d, 1e, 1f/. In the pasteurized hams, stored at the temperatures of 5°C from 1o to 9o days, the bacteria number was neglectable, and the hams themselves were without any organoleptic changes /table 4a/. By storing the hams from the same manufacturing lot at the temperature of 1o°c, were obtained nearly identical, very favourable results both in the bacteriological and organoleptic point /table 5a/. However, in 4 hams stored at 2o°C, after 6o days, in the sample from the back part of ham, 56o.ooo bacteria in 1 kg were found. There were no organoleptic changes in these hams /table 6a/.

In the second manufacturing lot, the total bacteria count in the samples taken from the centre of cured hams, varied from 1.o8o to 68.ooo, while in the samples taken from the surface, the number was from 2.5oo to 48o.ooo /tables 2a, 2b, 2c, 2d, 2e, 2f/. The pasteurized hams from this manufacturing lot, held at the temperature of 5°C, showed a very small number of bacteria, one sample showing only 27o bacteria in 1 kg /table 4a/. With the hams stored at 1o°C, the picture is even better /table 5a/. With the hams stored at 2o°C, the greatest number of bacteria in 1 kg, after 9o days of storing, was 55.2oo /table 6a/.

The total bacteria count in the third manufacturing lot, in the samples taken from the centre, varied from 84o to 28.4oo. In the samples taken from the surface, the total count of bacteria varied from 4.6oo to 276.ooo /tables 3a, 3b, 3c, 3e, 3f/. In the hams of this lot, stored at 5°C, a deviation in the number of bacteria was observed, and in the ham number 92., in everyone of the three taken samples was found an exeptionally great number of bacteria /2.ooo, 2.24o, and 1.o8o in 1 kg/. By determination of isolated strains it was found that the ham in question had been infected by sporeforming rods /B. pantothenticus and B. subtilis/. Out of the hams from this lot, stored at 1o°C, in one case there was again found a very high total bacteria count /12.3oo, and in only one sample/. The other three hams were either without bacteria, or with only a very small number /table 5a/. From the hams stored at 2o°C, in one case, and in one sample, a number of 44.ooo bacteria was isolated from 1 g, while a ham stored at the same temperature for 9o days, showed in everyone of the three samples a high number of bacteria /12.ooo, 13.2oo, 18.ooo/, /table 6a/.

The total count of Streptococci in the samples of cured hams, taken from the centre and from the surface, prior to filling of tins, was in all cases pretty high, for example, 13.ooo, 22.4oo, 26.5oo in 1 g /tables 1b, 2e, 2f/. From the total number of 18o samples of cured hams prior to filling of tins /9o from the centre and 9o from the surface/, in 12 samples Streptococci could not be found, one sample being from the surface, and

eleven from the centre.

However, there arose a very interesting fact, and that is, that from the pasteurized hams, Streptococci /Str. zymogenes/ were isolated in only two cases, that being the hams stored at 2o°C, and opened on the 3oth day. Both hams originated from the first lot /table 6a/. The number of isolated streptococci was in both cases very high, the plates being overgrown and the colonies uncountable. To obtain the total count of Streptococci, in our experiments was used the Packer medium, where in many cases a growth of Micrococci and grampositive Sporeforming bacilli was observed. A. Beganović, F. Hadžihalilović and I. Hadžidedić /4/ wrote about insufficient selectivity of that media.

The results obtained in our experiments are contradictory to those obtained by Beganović and Hadžihalilović /3/ and Beganović Hadžihalilović and Hadžidedić /4/. In the first paper the results of examination of pasteurized canned hams manufactured in 1959 at one of our meat packing plant, stored for more than one year, were shown. In all 38 examined pasteurized canned hams, whether they were before incubated at 37°C, or not, Streptococcus faecalis in smaller or higher number was found. In the second paper, in which there is no data of the origin and the year of processing of canned hams and shoulders, from these products Streptococcus faecalis was isolated in 87,5% cases.

Concerning the time interval of 4-5 years between the examnination of stated authors and our examinations held in this year, as well as a very great progress in application of the freezing technic in manufacturing of canned pasteurized products, and in the end the strict treatment applied in manufacturing of the experimental lots of canned hams, the percent of 1.85 of isolated streptococci in our experiments may be treated as real.

The sporeforming aerobes were unfrequently isolated from the samples taken from cured hams prior to filling of tins. In the first lot, from the centre of hams were isolated 17.7%, and from the surface 26.6%; in the second lot from the centre 2.2%, and from the surface 4.4%; in the third lot from the centre 4.4%, and from the surface 2.2%.

From the pasteurized hams stored at 5°C, sporeforming rods were isolated from only 4 hams of the total of examined 36, being 1o to 2o bacteria in 1 g.

In the second lot of pasteurized hams stored at 1o°C, sporeforming rods were isolated from 6 hams in somewhat higher number, it being 1o to 7o in 1 g.

From pasteurized hams stored at 2o°C, these microorganisms were also isolated from 6 examined hams, in one case in a very high number, so that the plate was completely overgrown. The same ham showed before opening the signs of bombage.

The sporeforming anaerobe bacteria were isolated from the samples taken from the centre and the surface of cured hams prior to filling of tins, in the following percentage: in the first lot from the centre 8.7%, and from the surface 33.3%; in the second lot from the centre 4.4%, and from the surface 15.5%; in the third lot from the centre 6.6%, and from the surface 8.7%.

The bacterial species isolated from canned hams prior to filling of tins, and canned hams stored for the different time intervals and at the different temperatures

Fram the samples of canned hams taken prior to filling of tins and from pasteurised canned hams, during our examinations we have isolate more than 2.ooo bacterial species, which by Bergey were determine as: B. megaterium, B. cereus, B. licheniformis, B. subtilis, B. coagulans, B. badius, B. firmus, B. polymyxa, B. macerans, B. stearotermophilus, B. cirkulans, B. pulvifaciens, B. brevis, B. panthotenticus, Micrococcus sp., Staphylococcus sp., St. Zimogenes i Str. durans /determined by Sellemann/, Pseudomonas sp., Xantomonas sp., Sarcina sp., and Enterococcus sp.

CONCLUSION

On the ground of the obtained results, the following conclusions could be drawn:

- by applying strict and controlled thermal treatment in manufacturing of pasteurised canned products, good results in bacteriological and organoleptic view could be obtained,
- by applying the method of pasteurisation at 80°C, for 1 hour to 1 kg weight, the number of streptococci in cured product decreases in hams to a minimum,
- the percentage of 1,85 of isolated streptococci from the pasteurised hams represents a real value with regard to the applied technological process,
- Packer's medium has not in these experiments shown the full selectivity,
- the temperatures over 10°C are not favourable for the storage of pasteurised canned hams, and
- as to the duration of the storage at various temperatures, is necessary to continue with experiments.

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The results of bacteriological examinations of the samples taken from the center of cured ham prior the canning
/The weight of ham 3.400 g/

Sample	Total count of bacteria	Total count of strept.	Total count of aerob. spor.	Presence of anaer. spor.
A_1	2.200	300	-	-
A_2	4.400	4.500	-	-
A_3	4.200	1.300	-	-
A_4	1.160	800	-	-
A_5	2.600	500	-	-
A_6	3.300	200	-	-
A_7	2.040	300	-	-
A_8	3.300	600	360	-
A_9	4.600	800	-	-
A_{10}	4.600	1.200	420	-
A_{11}	4.500	2.000	540	-
A_{12}	16.000	2.600	-	-
A_{13}	7.200	4.400	640	-
A_{14}	14.500	1.300	-	-
A_{15}	4.400	1.200	-	-

The results of bacteriological examinations of the samples taken from the center of cured ham prior the canning

/The weight of ham 4.2oo g/

Table 1b

Sample	Total count of bacteria	Total count of strept.	Total count of aerob. spor.	Presence of anaer. spor.
A_{16}	4.8oo	13.ooo	-	-
A_{17}	9.6oo	7.2oo	-	-
A_{18}	21.6oo	1.9oo	-	-
A_{19}	8.8oo	4.ooo	-	-
A_{2o}	3.ooo	9.ooo	-	-
A_{21}	19.6oo	5.5oo	-	-
A_{22}	3o.ooo	6.4oo	3.6oo	+
A_{23}	39o	7oo	-	-
A_{24}	2.48o	5oo	-	-
A_{25}	7.72o	4oo	7.7oo	-
A_{26}	1.3oo	1.2oo	-	-
A_{27}	6.3oo	9oo	-	-
A_{28}	4.2oo	1oo	4.4oo	-
A_{29}	54o	-	4oo	-
A_{3o}	2.ooo	1.1oo	-	-

The results of bacteriological examinations of the samples taken from the center of cured ham prior the canning
/The weight of ham 5.000 g/

Table 1c

Sample	Total count of bacteria	Total count of strept.	Total count of aerob. spor.	Presence of anaer. spor.
A_{31}	2.400	2.300	-	-
A_{32}	2.800	4.500	-	-
A_{33}	6.200	7.700	-	-
A_{34}	2.000	2.100	-	-
A_{35}	5.600	1.800	-	-
A_{36}	4.800	3.100	-	-
A_{37}	6.200	1.800	-	-
A_{38}	2.320	600	-	-
A_{39}	2.800	1.000	-	-
A_{40}	3.300	800	-	-
A_{41}	6.800	7.800	-	-
A_{42}	8.800	7.800	-	-
A_{43}	8.000	2.900	-	-
A_{44}	520	400	-	-
A_{45}	1.600	1.600	-	-

The results of bacteriological examinations of the samples taken from the surface of cured ham prior the canning

/The weight of ham 3.4oo g/

Table 1d

Sample	Total count of bacteria	Total count of strept.	Total count of aerob. spor.	Presence of anaer. spor.
B_1	7.7oo	3.2oo	-	-
B_2	21.ooo	4.2oo	-	-
B_3	8.8oo	1.2oo	-	-
B_4	12.4oo	1.8oo	-	-
B_5	18.8oo	1.1oo	-	-
B_6	7.3oo	2.ooo	-	-
B_7	13.2oo	3.5oo	-	-
B_8	13.5oo	5.4oo	-	-
B_9	29.ooo	7.9oo	-	-
B_{1o}	8.ooo	4.4oo	-	-
B_{11}	5.6oo	2.8oo	-	+
B_{12}	38.ooo	1o.7oo	-	+
B_{13}	24.5oo	5.3oo	-	+
B_{14}	24.8oo	3.1oo	-	+
B_{15}	13.2oo	2.3oo	3.8oo	+

The results of bacteriological examinations of the samples taken from the surface of cured ham prior the canning

/The weight of ham 4.2oo g/

Table 1e

Sample	Total count of bacteria	Total count of strept.	Total count of aerob. spor.	Presence of anaer. spor.
B_{16}	17.6oo	6.8oo	16.8oo	-
B_{17}	19.2oo	9.5oo	-	-
B_{18}	8.8oo	7.6oo	2.32o	-
B_{19}	1o.8oo	2.5oo	-	-
B_{2o}	16.ooo	3.2oo	-	-
B_{21}	21.2oo	5.ooo	-	+
B_{22}	31.ooo	4.2oo	26.4oo	+
B_{23}	13.2oo	4.2oo	-	-
B_{24}	2.84o	4oo	8.ooo	-
B_{25}	12.ooo	6oo	-	-
B_{26}	45.ooo	9.7oo	-	+
B_{27}	18.ooo	1.4oo	12.4oo	-
B_{28}	29.6oo	3.3oo	18.8oo	+
B_{29}	3.1oo	1.4oo	2.5oo	-
B_{3o}	4.1oo	1.7oo	-	-

INFLUENCE DE QUELQUES FACTEURS SUR LA STABILITE DES PRODUITS CARNES PASTEURISES

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Dans un de nos abattoirs on a fabriqué trois lots de jambons en boîtes, sous les regimes termique soigneusement controlés. On a fait la pasteurisation à la température de 80°C, dans un délai d'un heure par kilo. Les jambons en boîtes ont été entreposés à la température de 5°, 10° et 20°C, dans un délai de 10 à 90 jours.

Par l'examen bactériologique des jambons salés, fait imédiatement avant le posage en boîtes, on a constaté que le nombre total des microbes de l'exemplaire pris du centre du premier lot allait de 390 à 30.000 et sur la surface de 1.720 à 45.000 par gramme.

Dans les jambons pasteurisés entreposés à 5°C, depuis 10 jusqu'à 90 jours, le nombre des microbes était insignifiants; les jambons entreposés à 10°C donnent presque les mêmes résultats, trés avantageux au point de vue bactériologique et organoléptique; dans ceux entreposés à 20°C aprés 60 jours on a constaté 560.000 de microbes par gramme.