(Bé 3.5°).

(2) The amount of soluble matter nitrogen increased with increasing of number of times of boiling with the same water, and in consequence the quality of the canned crab become lowered.

(3) The number of times of boiling with the same water must be limited to twice.

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REPORT 4. STUDIES ON *B. coli* IN CANNING WATER

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1. Increase and decrease of *B. coli* which was in the factory water during crab canning.

Recently a question of cannery-water which is contaminated by bacteria of the digestive system has been raised in the canning industry. The authors have studied the fluctuation in *B. coli* which is an index of germs of infections disease of the digestive system in cannery-water during the canning process, and wish to discuss the fitness of the cannery-water

(1) Sample

In samples of *Erimacrus isenbeckii* which were caught off the shore of Oshamambe in August 1952, of which the freshness was comparatively good (The amount of volatile base nitrogen was 13.1 mg per 100 gm of the meat), the number of bacteria contained in 1 gm of the meat was 3×10^5, and contamination by *B. coli* could not be observed.

The processing course of a sample can of crab was as follows:
Crab (*Erimacrus isenbeckii*) → removing of carapace → boiling of leg and shoulder meat with crust (15 minutes after beginning of boiling) → cutting off the crust → removing meat → first washing (in tank) → selecting meat → second washing (in tank) → cutting of leg meat → weighing (190 gm per can) → packing in can → covering with parchment paper → clinching → exhausting (at 100°C for 10 minutes) → seaming → sterilization (at 108°C for 80 minutes) → cooling → canned crab.

In the whole canning process use was made of factory water in which *B. coli* was suspended. After every step in the process as here numbered counts were made of *B. coli* in the factory water and in the meat. (1) After removing of carapace, (2) after boiling, (3) after leaving in cooling water, (4) after first washing, (5) after second washing, (6) after exhausting, (7) after sterilization, (8) after 3 days' leaving of canned crab and (9) after one month's storage of canned crab.

(2) Method of Experiment.

In this experiment use was made of water in which *B. coli* (*Bact. coli communis*) was suspended. In this water 5.1×10^3 of *B. coli* was counted. As control, sterilized water was used. The number of *B. coli* in 1 gm of sample meat taken at every step in the canning process was counted by tenth dilution cultivation on ENDO's media at 37°C for 24 hours. The red colonies on ENDO's media were ascertained to be the same germ as *B. coli* which had been suspended in the factory water. The bacterial count for *B. coli* was made by triple system.

(3) Experimental results.

By the method just described, the following results were obtained as exhibited in Table 1.

Table 1. Fluctuation in *B. coli* in cannery water during the canning process.

The number of *B. coli* in crab meat. (per 1gm)		The number of *B. coli* in cannery water (per 1c.c.)	
(1) After removing of carapace	0	(1) Before boiling	5.1×10^3
(2) After boiling	0	(2) After boiling	0
(3) After leaving in cooling water	200	(3) Before cooling	5.1×10^3
(4) After first washing	400	(4) After leaving in cooling water	4.9×10^3
(5) After second washing	900	(5) Before first washing	5.1×10^3
(6) After exhausting	0	(6) After first washing	5.4×10^3
(7) After sterilization	0	(7) Before second washing	5.1×10^3
(8) After 3 days' leaving of canned crab	0	(8) After second washing	8.2×10^3
(9) After one month's storage of canned crab	0		

As seen in Table 1, there was no *B. coli* in meat after boiling nor in the boiling water. In crab meat which was left in cooling water there were 200 *B. coli* per 1 gm of crab meat. In the boiling water, there were 4.9×10^3 of *B. coli* after cooling. With the progress of the operation, the number of *B. coli* in crab meat increased. After second washing, there were 900 of *B. coli* in the meat. In factory water the number of *B. coli* increased gradually. The coli-bacillus which appeared in one stage may survive to the next stage. Particularly in washing water after the first and second washings, there were larger numbers of *B. coli* than in the washing water which had not yet been used. The reason for this may be, as above, survival from one stage to another. After the operation of exhausting, there was no coli-bacillus in the meat. The meat tolerance of coli-bacillus in the crab meat which was heated and in the boiling water is low. Generally, it may be stated that there are many crab canneries at which the cans are seamed by vacuum seamer without exhausting by heat. But if the exhausting operation is lacking, the heating at 108°C for 80 minutes is sufficient to sterilize *B. coli* in the meat.

2. Infusion of *B. coli* in can which was seamed in various degrees of seaming in cooling water which was suspended by *B. coli* after the sterilization.

When the canned crab was manufactured under commercial conditions and the seaming condition was also normal, even if *B. coli* were present in the factory-water, the canned crab which was commercially manufactured did not contain *B. coli*. Here, a question is raised, when the can is loosely seamed in commercial limit, whether coli-baciilus invades the can through the seaming part during the cooling in standing water which has become contaminated by the coli-bacillus after the sterilization.

The present authors have made sample cans which have various degrees of seaming such as "firmly seamed can", "medium firmly seamed can", and "loosely seamed can". Then an attempt was made to examine the invasion of *B. coli* through those variously seamed cans. Obviously if imperfect cans are used or cans are loosely seamed, those cans will be spoiled not only by *B. coli*, but also by putrefactive bacteria which invade the can through the seaming part.

Therefore, the authors' sample cans were in the limit of trade practice though they were loosely seamed.

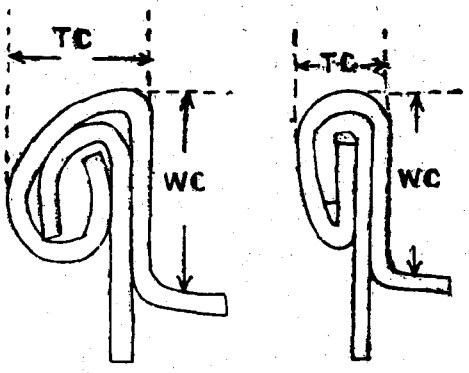

Fig. 1. Measuring of size of sample cans.

(1) Sample and method of experiment.

Crab cans of a half pound were manufactured as samples. Crab meat was packed in can and clinched as usual (in Fig. 1, TC=81/1,000 ~83/1.000″, WC=105/1,000~106/1,000″). After exhausting they were seamed by 2nd Roll as "firmly", "medium firmly", or "loosely" as indicated in Table 2.

Those sample cans were sterilized at 115°C for 60 minutes. (This high temperature is not fit for canned crab, but may be fit for many canned foods.)

Table 2. Seaming of sample cans.

Degrees of seaming		Seaming, "firmly"		Seaming, "medium firmly"		Seaming, "loosely"	
Sample No.		Sample-A		Sample-B		Sample-C	
		(a)	(b)	(a)	(b)	(a)	(b)
Seaming size	TC	62/1.000″	63/1.000″	68/1.000″	69/1.000″	75/1.000″	73/1.000″
	WC	126/1.000″	123/1.000″	119/1.000″	118/1.000″	115/1.000″	115/1.000″
Pressure strength		30 lbs.<		25 lbs.<		17 lbs.<	

After sterilization of seamed can, the sample cans were put into cooling water in which were suspended coli-bacillus (28×10^4 coli-bacillus per c.c.), and cooled. In sample cans, the sample (a) was cooled for 10 minutes in tank water, and the sample (b) was left for 24 hours in tank water.

After the sample cans were taken from the tank water, the surface of the sample can was sterilized with alcohol, and stored in an incubator where coli-bacillus grow easily at

37°C for 24 hours. Then the sample can was sterilily opened, and coli-bacillus was detected on the ENDO's media.

(2) Results of experiment.

No coli-bacillus was found even in the sample can which was loosely seamed in this experiment. That is to say, unless the seaming is too loose for causing the swelled can, even if factory-water is contaminated with *B. coli*, the canned food is sterile. As a conclusion, it may be said that *B. coli* which is originated from factory-water and attached to the meat, will survive until the completion of boiling, but after exhausting there will be found no coli-bacillus in the meat. If the can is seamed by vacuum seamer, *B. coli* which attached to the meat is sterilized by the last sterilization. Even if *B. coli* is present in the factory-water, when the cans are commercially surely seamed, *B. coli* does not invade into the can. Therefore, the presence of *B. coli* in the factory-water is not so important as other factors, chemical or physical, such as color, smell, etc.

Summary

The number of *B. coli* was counted in every stage of operation of crab canning where use was made of factory water which was contaminated with *B. coli*. The following results were obtained.

(1) With the progress of the operations in cannery, the number of *B. coli* in the crab meat and factory-water increased.

(2) However, after heating such as at the stages of exhausting or sterilization, no *B. coli* were found in the meat.

(3) If the cans were commercially seamed, there were found no coli-bacillus invaded in the canned meat through the seaming even in the cooling water which contained coli-bacillus after processing. Therefore the presence of *B. coli* is not so important as other chemical or physical factors such as the color, smell of the water etc.

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