Table 1. The difference of the quality of canned crab made from the different classifications of meat of *Erimacrus isenbeckii*.

Items. / Can	Vacuum (inch)	Liquid pH	Colour, taste, smell of meat	Volatile base-N (mg %)	Amino acid-N (mg %)	Blue meat	Blackening	Result
Commercial canned crab	13.0	5.8	Normal Good	13	32	++	Can body 3 Cover 1	+++
Canned crab made from the white mince	10.3	6.6	〃	—	72	+	Bottom 2	+++
Canned crab made from the red mince	12.1	6.5	〃	8	49	+	Bottom 1	+++
Canned crab made from cheliped meat only	12.9	7.1	Liquid turbid Softening the meat	20	140	+++	Bottom 1	++

On the other hand, in the canned crab made from cheliped meat only, the amounts of volatile base nitrogen and amino acid nitrogen were more than in the other samples of canned crab, the meat became soft, and blue meat formed in a large quantity.

As a consequence, it may be started that the cheliped meat should not be used as raw material of canned crab of *Erimacrus isenbeckii*; as this is in accord with practice hitherto.

3. Summary

To compare the quality of canned crab made of meat from the different parts of *Erimacrus isenbeckii*, white mince (shoulder meat), red mince (leg meat) and cheliped meat were separately packed. The processed products after three weeks storage were compared with commercial canned crab of *Erimacrus isenbeckii* (shoulder and leg meat). The results of comparison were as follows:

(1) The canned crab made from white mince or red mince was almost same as the commercial canned crab.

(2) In the case of the canned crab made from cheliped meat only, the meat became soft, taste was bad, blue meat was formed. As a conclusion, it may be said that it is better cheliped meat be not used.

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REPORT 3. STUDIES ON THE INFLUENCES UPON THE QUALITY OF CANNED CRAB OF THE KINDS OF WATER USED AND NUMBER OF TIMES OF CHANGE OF WATER FOR BOILING CRAB REMOVED FROM CARAPACE

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In the canning of crab, as the boiling water, sea-water or fresh water with salt (sodium chloride) added is generally used. However, there are factories which use fresh water only. KANEKO[1] has made an experiment in which the difference of the quality of canned crab was considered in respect to breaking of shape of meat, falling off of surface skin of leg

meat, change of color of surface skin of leg meat, and hardness, the comparison being between cases where use was made of fresh water or of fresh water added with salt. He reported that there is no difference in the influence upon the quality of canned crab whether use was made of fresh water or of fresh water with salt. KANEKO [2] has also made a study on the influence upon the quality of canned crab of number of times of change of fresh water for boiling. He boiled crab meat (*Paralithodes camtschatica*) with fresh water which was changed four times and with fresh from crust of ambulatory leg meat which was boiled in stained water became more difficult with the increasing of number of times of changing the boiling water. Some years ago SEKINE and KAKIZAKI[3] (1926) estimated in crab cannery the change of amount of water soluble protein and volatile base as influenced by the number of times of changing of boiling water using fresh water and have compared general chemical components of meat. According to their results, there was an increase in the amount of soluble matter from the boiled meat in the boiling water and soluble matter nitrogen became larger with the increasing of number of times of boiling. They also compared the chemical components of crab meat which was boiled in fresh water with that was boiled with the same fresh water used several times; they found that the latter had a larger amount of nitrogen and sulphur and that the increase of these components was due to the non-protein form. They said that the repeated using of boiling fresh water must be limited to a certain definite times of repeated using.

The present authors have boiled meat of *Erimacrus isenbeckii* with fresh water (city service water) and sea water (Bé 3.5°), and have compared the amount of amino acid nitrogen, volatile base nitrogen, soluble matter nitrogen which were dissolved into the boiling water in order to determine the best kind of water and the limit on the number of times of change.

1. Method of Experiment.

The processing of canned crab was carried on as usual. Sea water (Bé 3.5°) and city service water were used for boiling the leg meat which was removed from the body. The number of times of change was three. At each change of water, boiling water and boiled meat were subjected to chemical tests.

The raw material of crab (*Erimacrus isenbeckii*) was caught off the shore of Oshamambe, Hokkaido; the elapsed time from catching to experiments was eight hours. The freshness of the meat was comparatively good; the amount of volatile base nitrogen estimated was 10 mg%. Five crab bodies (average 1,875 gm in weight) were prepared for a can of half pound. After removal of carapace of crab, each kind of boiling water was added in the same quantity (about 2 litres) and material was boiled. Each kind of water was boiled before putting in of raw material. The temperature of the raw material put in boiling water was estimated by the thermometer inserted into the shoulder meat. From the time when the temperature of center of shoulder became 100°C, boiling was continued for 15 minutes. After taking the material out of the water, second batch of raw crab meat material was put into the same boiling water as used in the previous operation; water was

added to the same volume of boiling water; the material was boiled the same as first boiling.

Therefore the volume of boiling water did not decrease between the first boiling and third boiling. After boiling every meat portion was cooled, packed in can, clinched, exhausted at 100°C for 10 minutes, and processed at 108°C for 80 minutes as usual. Those sample cans were left at 22°C (room temperature) for 14 days, and then opened.

Boiling water and boiled meat were employed for the estimation of the amounts of volatile base nitrogen (Weber and Wilson's method), amino acid nitrogen (Pope Stevens' method) and soluble nitrogen, and for the value of pH.

Table 1. The influence of kinds and number of times of changing water upon the quality of canned crab.

Samples	Estimated items	City service water			Sea water		
		After the 1st time of boiling	〃 2nd 〃	〃 3rd 〃	After the 1st time of boiling	〃 2nd 〃	〃 3rd 〃
Boiling water	pH	7.6	7.8	7.8	8.0	7.8	8.0
	Volatile base-N	0.8mg%	1.3	3.0	0.8	3.3	0.8
	Amino acid-N	52 mg%	153	320	40	92	184
	Water soluble-N	3.1%	6.6	17.7	10.1	5.1	5.6
Meat	pH	6.6	6.6	6.6	6.6	6.6	6.6
	Volatile base-N	1.2mg%	9.9	3.6	7.6	2.4	3.9
	Amino acid-N	217 mg%	175	254	171	270	260
	Water soluble-N	7.6%	7.3	8.9	5.1	9.3	7.6
Estimates of canned products	pH (Liquid)	6.6	6.6	6.4	6.7	6.6	6.6
	Vacuum (inch)	16 mg%	15.9	15.1	18.4	11.1	17.2
	Volatile base-N	3.3mg%	6.3	10.7	7.8	10.7	——
	Amino acid-N (meat)	73 %	31	56	105	112	93
	Colour, taste and smell etc. of meat	Good →	Bad	→	Good	Good	Less than the other
	Blue meat	Generated	Generated	Generated	Lack of blue meat	Same as left	Same as left
	Blackening	Can body 7 Cover 1	Can body 2 Cover 1	Cover 2 Bottom 1	Can body 2 Cover, bottom 1	Can body 1 Cover 1	Can body 2 Lap 1
	Result	++	++	+	++++	+++	++

2. Results of Experiments.

Experimental results obtained are shown in Table 1. Here, the amount of soluble matter nitrogen was estimated as follows: In the case of juice, 5 c.c. of the boiling water was hydrolyzed with conc. H_2SO_4, and in the case of meat, 10 gm of meat was added with water to 100 c.c. in total volume, and filtered, 10 c.c. of the filtrate was hydrolyzed with conc. H_2SO_4.

The amount of soluble matter nitrogen is indicated by mg per 5 c.c. of boiling water in the case of juice, and mg per 100 c.c. of the filtrate in the case of meat. The amounts of volatile base nitrogen, amino acid nitrogen are indicated by mg%. The sign, ++, which is written in the column of judgmeat of the quality of canned crab indicated the same quality as normal commercial goods. The increase or decrease of sign of + indicated the increase or decrease of the quality of goods.

As seen in Table 1, (1) the value of pH of boiling water was 7.8~8.0 after the first time of boiling, furthermore the value did not change with the increasing of number of times of boiling. (2) The value of pH of meat indicated no change throughout the experiment from the first boiling to the third. (3) The amounts of volatile base nitrogen, amino acid nitrogen, soluble matter nitrogen increased with the number of times of boiling with the same water. This fact agreed with the results of SEKINE and KAKIZAKI, therefore it may be stated that the successive using of boiling water has clearly a bad influence upon the quality of canned crab. (4) The quality of canned crab which was treated with sea water is clearly better than that treated by the city service water. (5) The quality of canned crab declined with the increase in number of times using of boiling water. Particularly in the canned crab meat which was treated with the repeated using of city service water for boiling, "blue meat" generated more frequently.

3. Discussion

According to KANEKO's report, the red skin of leg meat which was treated by fresh water which was added with salt falls more easily than that which was treated with fresh water. On the contrary the hardness of the meat which was treated by fresh water plus salt, is better than that treated with fresh water because of the salting out of the meat protein of crab.

The present authors' experimental results with *Erimacrus isenbeckii* do not necessarily agree with KANEKO's results with *Paralithodes camtschatica*.

According to the authors' results in the treating of meat of *Erimacrus isenbeckii*, sea water or fresh water added with salt give better quality to the canned crab than the fresh water. "Blue meat" generated less in the meat which was treated with fresh water added with salt than in that which was treated with fresh water.

Further studies need to be made on the problem of "blue meat". As conclusion it may be stated that, in the processing of canned crab (*Erimacrus isenbeckii*), in respect to the boiling water, sea water or fresh water, and the number of times of boiling with the same water must be limited to twice.

4. Summary

In crab canning (*Erimacrus isenbeckii*), the influences of the kind of boiling water and number of times of boiling with the same water upon the quality of the canned crab were studied.

Conclusions reached as results of the experiments are as follows:

(1) Rather than fresh water, it is better to use sea water or fresh water added with salt

(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.

Literature cited

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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.