On the Manufacture of Canned Crab from
Paralithodes camtschaticus (TILESIUS)*—I.
Velocity of Bacterial Decomposition of the
Meat of *Paralithodes camtschaticus*

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The authors have previously reported in detail their studies on several problems in the course of manufacture of canned crab from *Erimacrus isenbeckii*¹⁾. Here, the authors will discuss some problems in the case of *Paralithodes camtschaticus*. It is well known that the muscle tissue of *Paralithodes camtschaticus* is very fine and decomposable. When unfresh meat of *Paralithodes camtschaticus* is packed, the quality of the canned food is inferior without exception.

The authors have determined the velocity of bacterial decomposition of the meat of *Paralithodes camtschaticus* in order to compare with that of *Erimacrus isenbeckii*, when the meat is stored under various conditions.

Sample and Experimental method

Paralithodes camtschaticus caught off Usujiri, Kayabe district, Hokkaido, on April 8, 1954 was brought to the laboratory (the elapsed time was 9~12 hrs. after the catching). The catch was divided into 3 groups. After removing the crust, the shoulder meat and first leg meat were cut off in the first group and crushed homogeneously in a Waring Blendor. The crushed meat was divided furthermore into two parts. One of them was aerobically stored at $31^{\circ} \pm 1^{\circ}\text{C}$. and the other one was stored at $12^{\circ} \pm 1^{\circ}\text{C}$. The crab of the second group was also aerobically stored without any treatment, that is, with the crust, at $31^{\circ} \pm 1^{\circ}\text{C}$. and $12^{\circ} \pm 1^{\circ}\text{C}$., respectively. The crab of the last group was boiled with the crust in boiling water for 18 min. and cooled in cold 3% NaCl solution for 18 min. After the cooling, the shoulder and leg meats were taken off from the crust and were divided into two parts and stored aerobically at $31^{\circ} \pm 1^{\circ}\text{C}$. and $12^{\circ} \pm 1^{\circ}\text{C}$., respectively. The samples of those groups and parts were estimated for the pH value and the amounts of volatile basic nitrogen (V.B-N) and amino acid nitrogen (A.A-N). They were further observed organoleptically. The pH value was estimated by glass electrode pH meter. The amounts of V.B-N and A.A-N were measured by the same methods as in the case of *Erimacrus isenbeckii*¹⁾.

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Fig. 1. Variations in the pH value

Fig. 2. Variations in the amounts of volatile base nitrogen (V.B-N) (mg. %)

Experimental result

The experimental results obtained are shown in Fig. 1~Fig. 3.

As seen in Fig. 1, pH value increased with the lapse of time, and the higher the storing temperature is, the more the increase, but after a definite period, the increase became small. When the pH value of the sample becomes above 7, the meat is observed to have abnormal odor and to be unfresh. As seen in Fig. 2, remarkable difference in the amounts of V.B-N between samples stored at 12°C. and 31°C. was observed. The meat stored at 12°C. showed indications of spoilage after 50~60 hrs., and that at 31°C. after 10~20 hrs. The rapidity of the occurrence of the decomposition was raw and crushed meat, raw meat with the crust and the boiled meat in order. As seen in Fig. 3, the variation of the amounts of A.A-N was irregular as in the case of *Erimacrus isenbeckii* meat¹⁾.

Therefore it is difficult to determine the freshness of the crab meat by estimating the amount of A.A-N.

The estimation of the amount of V.B-N is considered to be the best way to determine the freshness of the crab meat.

Discussion

From the increase in the amount of V.B-N shown in Fig. 2, the velocity con-

Fig. 3. Variations in the amount of amino acid nitrogen (A.A-N) (mg. %)

stant of the bacterial decomposition was calculated after KIMATA²⁾ and YAMAMURA³⁾, using the equation (1) of monomolecular reaction.

$$\log y/A-y=Kt-C \quad \dots\dots\dots (1)$$

In equation (1), “y” is the increase in V.B-N, “A” is the maximum amount of V.B-N produced, “t” is time from the starting point until the estimation of the amount of V.B-N (hrs.), and “K” is V.B-N producing velocity constant. “C” is a constant.

By applying equation (1) the relation between the values of “log y/A-y” and time “t” calculated from each curve shown in Fig. 2 was ascertained to be manifested in each case by a straight line as shown in Fig. 4.

By measuring the inclination of the line, the value of “K” is determined as shown in the first and second column of Table 1.

Fig. 4. Relation between the values of “log y/A-y” and “t”

Table 1. Relation between the values of “1/T” and “log K”

(t) Temp. °C.		12°C.	31°C.	22°C.
(T) " °K.		235°K.	304°K.	295°K.
1/T		0.003508	0.003289	0.003389
Crushed crab meat	$K \times 10^3$	32.6	77.6	$Q_{10}=1.6$
	$\log K \times 10^3$	1.5132	1.8899	$A=7751$
Crab meat with the crust	$K \times 10^3$	39	73.7	$Q_{10}=1.55$
	$\log K \times 10^3$	1.5191	1.8675	$A=7332$
Boiled crab meat	$K \times 10^3$	21.8	69.8	$Q_{10}=1.87$
	$\log K \times 10^3$	1.3385	1.8439	$A=10428$

Next, by applying equation (3) which was derived from ARRHENIUS' equation (2) the relations between the reciprocal of the absolute temperature of each storing temperature, “1/T”, and the value of “log K” are shown as a, b, c curves of Fig. 5⁴⁾. Here, a is crushed crab meat, b is crab meat with the crust, and c is boiled crab meat.

Then the temperature constant “A” was calculated from equation (3).

The value of the temperature coefficient “ Q_{10} ” was calculated from equation (4). These values “A” and “ Q_{10} ” are shown in the third column of Table 1.

$$Ke^{\frac{A}{R} \cdot \frac{1}{T}} = \text{const.} \quad \dots\dots\dots (2)$$

$$\log K + \frac{A}{R} \log e \frac{1}{T} = \text{const.} \quad \dots\dots\dots (3)$$

In equations (2) and (3), “A” is the temperature constant of *Paralithodes cam-*

tschaticus meat and "R" is gas constant.

$$Q_{10} = \frac{K_t + 10}{K_t} = e^{\frac{A}{R}} \left(\frac{1}{T} - \frac{1}{T+10} \right) \dots\dots (4)$$

In equation (4), K_t is the bacterial decomposition velocity constant, and $K_t + 10$ is that at temperature of $(t+10)^\circ\text{C}$. or $(T+10)^\circ\text{K}$.

As seen in Table 1, the values of the bacterial decomposition velocity constant ($K \times 10^3$) were 22~39 and 70~78 at 12°C . and 31°C . for each sample respectively.

Comparing with the result¹⁾ obtained on *Erimacrus isenbeckii* meat, in which the value of the velocity constants were about 50 at 4°C . and above 100 at 35°C ., respectively, the *Paralithodes camtschaticus* meat is considered to be less decomposable than *Erimacrus isenbeckii* meat.

As indicated in Table 1, the boiled crab meat is clearly the least decomposable.

The values of " Q_{10} " and " A " were about 1.6 and 7,500 respectively for the raw crushed meat and raw meat in the crust of *Paralithodes camtschaticus*, while those of the boiled crab meat were about 1.9 and 10,000 respectively.

Comparing with *Erimacrus isenbeckii* meat, in which the values of " Q_{10} " and " A " were 1.2 and 2,910 respectively for the raw meat and 1.4 and 6,000 respectively for the boiled meat, *Paralithodes camtschaticus* meat samples have clearly larger values. That is to say, the latter is less decomposable than the former, but the increase rate of bacterial decomposition velocity with the rise of temperature was larger in the former than in the latter.

Summary

Comparing with the velocity of bacterial decomposition of the meat of *Erimacrus isenbeckii*, the authors have estimated the amounts of volatile basic nitrogen in raw crushed meat, raw meat with the crust and boiled meat of *Paralithodes camtschaticus* stored at 12° and 31°C .

The following results were obtained :

Fig. 5. Relation between the values of " $1/T$ " and " $\log K$ ". (a) : Crushed crab meat, (b) : Crab meat with the crust, (c) : Boiled crab meat.

(1) When the amount of the volatile basic nitrogen rises above 20 mg. % in *Paralithodes camtschaticus* meat, the meat becomes undesirable as does *Erimacrus isenbeckii* meat also. The authors have called this amount of V.B-N, that is 20 mg. %, the limit of freshness of crab meat suitable for use as the raw material for canned food.

(2) *Paralithodes camtschaticus* meat shows less value of the bacterial decomposition velocity ($K \times 10^3$) than *Erimacrus isenbeckii*, that is to say, the former is less decomposable than the latter.

(3) The values of " Q_{10} " and " A " were about 1.6 and 7,500 respectively for the raw meat and 1.9 and 10,000 for the boiled meat of *Paralithodes camtschaticus*. Those values are larger than those of *Erimacrus isenbeckii* meat.

References

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