



Title	STUDIES ON THE MANUFACTURE OF CANNED MACKEREL. : PART . RELATIONS BETWEEN QUALITY OF CANNED MACKEREL AND THE LEAVING TIME BEFORE RETORTING (STERILIZATION) AFTER THE CANS HAVE BEEN SEAMED.
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## STUDIES ON THE MANUFACTURE OF CANNED MACKEREL.

### PART III. RELATIONS BETWEEN QUALITY OF CANNED MACKEREL AND THE LEAVING TIME BEFORE RETORTING (STERILIZATION) AFTER THE CANS HAVE BEEN SEAMED.

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It is desirable that the packed and seamed cans should be without delay transferred into the retort and sterilized directly.

For this reason, many canneries are equipped with an adequate sized retort corresponding to the operating rate. However, when raw material is brought in excess, or when the capacity of one retort is so large that to fill it requires a long time, the packed meat is left alone as half-boiled after being steam-exhausted, and the freshness of the raw material falls rapidly.

It is possible that because of engine trouble in canning the packed cans wait for a long time before being retorted. The writers have observed the relation between the leaving time before retorting (sterilization after being seamed) and the quality of canned mackerel. They used raw materials of mackerel of the Japan Sea Group and the Pacific Ocean Group, and have decided the possible leaving time without affecting the good quality of the canned mackerel.

#### EXPERIMENTS

##### 1. Samples.

Mackerel meat from fish of the Japan Sea Group and the Pacific Ocean Group was packed in 24 one-pound tall cans. Twelve cans were seamed after being exhausted by steam, and the other 12 were seamed by vacuum seamer. These cans were left alone a definite number of hours (0, 20, 40, 60, 80, 100 mins.) in front of the retort, and then they are sterilized respectively. As control, sample cans without sterilization were left for the same hours intervals.

##### 2. Experimental procedure

Sample cans which were directly sterilized after being seamed (leaving time is 0) and control cans were opened on the same day. The other left cans were allowed to remain for a month at room temperature (15°~25°C); the amount of volatile basic nitrogen, amino acid nitrogen, bacterial counts and pH value of the contents were estimated as described Report I of this series.

Liquid, colour and odour, freshness and the condition of the formation of the curd of the contents were also observed.

### 3. Results of Experiments.

The results obtained are shown in Tables 1 and 2. Those results may be interpreted as follows:

(1) In mackerel meat which was packed in cans and then left alone without sterilization (control sample), the amounts of volatile basic nitrogen, amino acid nitrogen, bacterial counts increased, and pH value became higher. These changes are due to the decrease in freshness as described in Report II.

(2) In mackerel meat which was packed and then left alone for definite hour intervals before the sterilization, the changes were like those just above described, but the increasing of the amount of volatile basic nitrogen was due to the heating for the sterilization, otherwise the decrease in the freshness accounted for the changes as described in Report II.

(3) With longer leaving time of the mackerel meat of the Pacific Ocean Group before sterilization, the change in the freshness proceeded faster than in the case of the meat of the Japan Sea Group mackerel. This is due to the differences of chemical components between the two Groups as described in Report I.

That is to say, in canned mackerel from the Japan Sea, packed and left alone for 80 minutes before sterilization, the bone separated from the meat in the part of belly tissue and the flesh became fragile. On the contrary, in the canned mackerel from the Pacific Ocean packed and left alone even for 40 minutes before sterilization, the fragility was merely noticeable. The juice of the content of the same sample left for 60 minutes was turbid. In the same sample which was left for 80 minutes, the belly tissue smelled stale, discoloration to pink was noticeable and the flesh became fragile. That is to say, when mackerel from the Pacific Ocean Group is left alone for 80 minutes before sterilization, and even if it has been sterilized the quality of the product is not good.

In the results Report II which show the relation between the freshness of raw material and the quality of canned mackerel it was stated that if the amount of volatile basic nitrogen reaches 15~16 mg% in raw material, that material does not make good quality canned mackerel.

In the case of leaving of the packed meat for some hours before sterilization, the relation between the leaving time and the quality of canned mackerel does not vary greatly.

However, in the case of above described, using raw material which has considerably less of volatile basic nitrogen than 15~16 mg%, one can not obtain good quality canned mackerel. For example, although raw material of the Japan Sea Group which was left for 100 minutes before sterilization and that of the Pacific Ocean Group which was left for 80 minutes before sterilization had respectively less than 15~16 mg% of volatile basic nitrogen, these raw

Table 1. Relation between the leaving time of mackerel between after canning and sterilization in retort and the quality of the products (for the Japan Sea).

Kinds		Leaving time (mins.)	0	20	40	60	80	100
Can contents packed after steam exhausting	Before retorting	Colour and Odour	good	"	"	"	"	"
		Curd	much	"	"	"	rather a great	"
		Quality of meat	good	"	"	"	"	"
		pH	6.0	6.2	6.2	6.2	6.4	6.4
		Volatile basic nitrogen (mg %)	3.22	4.92	6.25	7.45	8.72	13.10
		Amino acid nitrogen (mg %)	64.5	67.5	82.3	79.4	97.4	140.5
		Bacterial counts	$52 \times 10^3$	$80 \times 10^3$	$86 \times 10^3$	$108 \times 10^3$	$124 \times 10^3$	$140 \times 10^3$
	Canned product	Liquid	clear	"	"	turbid	"	"
		Colour and Odour	good	"	"	rather strange smell	light pink	"
		Curd	much	"	"	"	"	"
		Quality of meat	good	"	"	"	rather fragile	"
		pH	6.4	6.4	6.4	6.6	6.6	6.6
		Volatile basic nitrogen (mg %)	5.34	8.72	10.94	13.23	15.66	19.97
		Amino acid nitrogen (mg %)	62.3	71.4	79.5	97.8	101.4	125.7
Can contents packed with vacuum seamer	Before retorting	Colour and Odour	good	"	"	"	"	"
		Curd	none	"	"	"	"	"
		Quality of meat	good	"	"	"	"	"
		pH	6.0	6.0	6.0	6.2	6.2	6.2
		Volatile basic nitrogen (mg %)	3.22	6.74	7.68	8.84	10.11	11.21
		Amino acid nitrogen (mg %)	60.4	58.4	67.4	83.2	112.6	137.5
		Bacterial counts	$52 \times 10^3$	$86 \times 10^3$	$90 \times 10^3$	$120 \times 10^3$	$128 \times 10^3$	$132 \times 10^3$
	Canned product	Liquid	clear	"	"	rather turbid	turbid	"
		Colour and Odour	good	"	"	"	"	fairly light
		Curd	much	"	rather a great	"	inferior	"
		Quality of meat	good	"	"	"	rather fragile	"
		pH	6.4	6.4	6.5	6.6	6.6	6.6
		Volatile basic nitrogen (mg %)	5.74	12.98	14.14	16.21	18.20	19.10
		Amino acid nitrogen (mg %)	57.2	64.7	77.6	98.6	109.5	130.5

Table 2. Relation between the leaving time of mackerel between after canning and sterilization in retort and the quality of the products (for the Pacific Ocean).

Kinds		Leaving time (mins.)	0	20	40	60	80	100
Can contents packed after steam exhausting	Before retorting	Colour and Odour	good	"	"	"	"	"
		Curd	much	"	"	"	"	"
		Quality of meat	good	"	rather fragile	"	fragile	"
		pH	6.2	6.2	6.4	6.4	6.4	6.4
		Volatile basic nitrogen (mg %)	5.74	7.42	8.26	9.24	12.22	12.69
		Amino acid nitrogen (mg %)	80.44	87.52	92.55	99.41	118.4	110.6
		Bacterial counts	65 × 10 <sup>8</sup>	90 × 10 <sup>4</sup>	11 × 10 <sup>4</sup>	20 × 10 <sup>4</sup>	31 × 10 <sup>4</sup>	35 × 10 <sup>4</sup>
	Canned product	Liquid	clear	"	"	turbid	"	"
		Colour and Odour	good	"	"	"	light pink strange smell	strong smell
		Curd	much	"	"	"	"	"
		Quality of meat	good	"	"	"	rather fragile	"
		pH	6.4	6.6	6.6	6.6	6.6	6.6
		Volatile basic nitrogen (mg %)	11.12	15.02	15.31	15.00	19.15	20.27
		Amino acid nitrogen (mg %)	87.63	89.21	110.4	116.2	121.4	134.1
Can contents packed with vacuum seamer	Before retorting	Colour and Odour	good	"	"	"	"	"
		Curd	none	"	"	"	"	"
		Quality of meat	good	"	"	rather fragile	"	"
		pH	6.2	6.4	6.4	6.4	6.4	6.4
		Volatile basic nitrogen (mg %)	5.86	8.36	8.98	10.76	10.74	11.26
		Amino acid nitrogen (mg %)	81.23	89.44	97.62	98.2	107.6	108.8
		Bacterial counts	77 × 10 <sup>8</sup>	12 × 10 <sup>4</sup>	17 × 10 <sup>4</sup>	25 × 10 <sup>4</sup>	39 × 10 <sup>4</sup>	41 × 10 <sup>4</sup>
	Canned product	Liquid	clear	"	"	turbid	"	"
		Colour and Odour	good	"	"	"	light pink strange smell	"
		Curd	much	rather a deal	"	little	"	"
		Quality of meat	good	"	"	"	rather fragile	"
		pH	6.4	6.6	6.6	6.6	6.6	6.6
		Volatile basic nitrogen (mg %)	12.37	15.78	15.51	17.12	17.54	19.65
		Amino acid nitrogen (mg %)	87.47	91.42	90.7	93.8	110.1	112.5

materials could not produce good quality canned mackerel. This is for the reason that the raw material which was packed in cans, steam exhausted, seamed and then left some hours at warmer temperature before sterilization, is half boiled and becomes decomposable by bacterial action; the raw material which was packed in can, seamed by vacuum seamer, and was left some hours, is also autodigestible.

(4) When two kinds of canned mackerel produced from both the Japan Sea Group material and Pacific Ocean Group material by steam exhausting and seaming or vacuum seaming, were compared, in the case when leaving time was comparatively shorter, the amount of volatile basic nitrogen accumulated in the canned product which had been seamed by vacuum seamer was more than in the product steam exhausted and seamed; but when the leaving time was longer, the amount of volatile basic nitrogen accumulated in the steam exhausted and seamed product was larger than in the vacuum seamed product.

This is perhaps for the reason that in case the leaving time is longer, such as 80 minutes, the raw meat (the content of canned mackerel which was seamed by vacuum seamer) became more autodigestible and putrescible than half boiled meat (the content of canned mackerel which was steam exhausted and seamed).

(5) The limit of leaving time is 40 minutes before sterilization after seaming. At most, the leaving time should be less than 60 minutes. The longer the leaving time is, the worse the quality of the finished product becomes.

## CONCLUSION

From the experimental results above obtained, it is known that the limit of leaving time of the packed (before sterilization) which was seamed by vacuum seamer or steam exhausted is 40 minutes, and at most the leaving time should be less than 60 minutes.

When mackerel of the Pacific Ocean Group is used as raw material, care must be taken on this point.

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