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# STUDIES ON THE MANUFACTURE OF CANNED MACKEREL.

## PART Ⅳ. STUDIES ON DEFORMATION OF SHAPE OF THE CONTENT IN THE CANNED MACKEREL.

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When canned mackerel of good quality is opened and removed onto a dish, content should stand without deformation (crumbling) of shape. However, for various causes the shape of content of the meat is often broken when the can is opened. For example, the canned mackerel which was produced carefully packed without deformation at the time may have become broken because of the use of unfresh raw material, or by loose packing, or because of other factors, rough handling during transpotation from producer to consumer.

The writers have studied the conditions of the crumbling of the canned mackerel meat by intentional dropping the wooden box, in which the cans were packed, various numbers of times, from the shoulder of the adult to the ground. Those canned mackerel were manufactured by the usual methods or other further devised methods. The writers have further studied the cause and prevention of breaking up of the shape of the meat.

## EXPERIMENTS

1. Samples:

Mackerel of the Japan Sea Group and Pacific Ocean Group were transported to the laboratory in ice and were then packed by the following procedures.

(1) Usual method: After the raw material was dressed, the meat was steeped in brine of Bé 17° for 25 minutes, packed in can, exhausted by steam at 100°C, sterilized at the pressure of 10 lbs. for 1⅔ hrs. -------Sample A.

(2) Instead of steam exhausting used in method (1), the vacuum seamer was employed. -------- Sample A′.

(3) After the raw material was dressed, it was packed in cans and dehydrated by steaming (at 100°C for 20 minutes), poured with brine of Bé 3°, seamed by vacuum seamer, sterilized at the pressure of 10 lbs. for 1⅔ hrs. -------- Sample B.

(4) After the raw mackerel was slivered from both sides of the body and the back bone removed, the material was steeped in brine of Bé 17° for 20 mins., packed in can, seamed by vacuum seamer, and sterilized at the pressure of 10 lbs. for 1⅓ hrs. (The shortening of processing time is possible because of the removing of the back-bone) -------- Sample C.

Table 1. Result of experiment for preservation from deforming of meat contained in canned mackerel (for the Group from Japan Sea).

| Sample No. | Frequency of falling | Vacuum (inch) | Head space (inch) | Curd | Liquid | | Toughness of meat | Skin | Odour | Crumbling of meat | Inner part of meat | Shape | Taste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Content | Condition | | | | | | | |
| 0A | 0 | 8 | 1/4 | ++ | much | clear | ++ | good | good | none | good | ordinary | good |
| 5A | 5 | 2 | 1/4 | + | little | turbid | + | 〃 | 〃 | 〃 | 〃 | 〃 | 〃 |
| 10A | 10 | 11 | 5/16 | + | 〃 | 〃 | + | flayed | 〃 | rather crumbled | fairly fragile | 〃 | 〃 |
| 0A′ | 0 | 12 | 3/8 | ++ | much | clear | ++ | good | 〃 | none | good | 〃 | 〃 |
| 5A′ | 5 | 12 | 1/4 | + | little | turbid | + | 〃 | 〃 | 〃 | rather fragile | 〃 | 〃 |
| 10A′ | 10 | 1 | 3/8 | + | medium | 〃 | + | 〃 | 〃 | crumbled in upper part | 〃 | 〃 | 〃 |
| 0B | 0 | 15 | 3/8 | − | much | clear | ++ | 〃 | 〃 | none | good | 〃 | 〃 |
| 5B | 5 | 1 | 1/4 | ± | 〃 | turbid | + | 〃 | 〃 | 〃 | rather fragile | 〃 | 〃 |
| 10B | 10 | 1 | 1/2 | + | little | 〃 | − | 〃 | 〃 | 〃 | 〃 | 〃 | 〃 |
| 0C | 0 | 11 | 3/8 | + | much | clear | ++ | 〃 | 〃 | 〃 | excellent | good | 〃 |
| 5C | 5 | 1.5 | 1/8 | + | little | turbid | ++ | 〃 | 〃 | 〃 | good | 〃 | 〃 |
| 10C | 10 | 13 | 1/4 | ± | 〃 | 〃 | ++ | 〃 | 〃 | 〃 | rather fragile | 〃 | 〃 |
| 0D | 0 | 14 | 3/8 | − | much | 〃 | + | 〃 | 〃 | 〃 | good | 〃 | 〃 |
| 5D | 5 | 15 | 1/4 | − | little | 〃 | + | flayed | 〃 | 〃 | 〃 | inferior | rather inferior |
| 0D′ | 0 | 1.4 | 3/8 | − | much | clear | + | good | 〃 | 〃 | 〃 | 〃 | 〃 |
| 5D′ | 5 | 15 | 3/8 | ± | little | turbid | + | 〃 | 〃 | 〃 | 〃 | 〃 | 〃 |
| 10D′ | 10 | 0 | 9/16 | ± | 〃 | 〃 | + | 〃 | 〃 | rather crumbled | 〃 | 〃 | 〃 |

Note; The numbers marked before sample show the numbers of falling of wooden box.

Table 2. Result of experiment for preservation from deforming of meat contained in canned mackerel (for the Group from Pacific Ocean).

| Sample No. | Method of processing | Ferquency of falling | Vacuum (inch) | Head space (inch) | Curd | Liquid | | Toughness of meat | Skin | Odour | Crumbling of meat | Inner part of meat | Shape | Taste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | content | condition | | | | | | | |
| 0A | Standard method, (Used vacuum seamer) | 0 | 15 | 1/4 | + | medium | clear | ## | good | good | none | good | ordinary | good |
| 5A | | 5 | 14 | 3/8 | ± | 〃 | turbid | # | rather flayed | 〃 | 〃 | 〃 | 〃 | 〃 |
| 10A | | 10 | 0 | 3/8 | ± | 〃 | significantly turbid | + | 〃 | 〃 | significantly crumbled in upper part | 〃 | 〃 | 〃 |
| 0B | After boling and dehydration, standard method was used. (Bé 3° NaCl solution was poured.) | 0 | 16 | 3/16 | ± | 〃 | clear | ## | good | good | none | good | good | good |
| 5B | | 5 | 16 | 7/16 | — | 〃 | turbid | # | fairly flayed | 〃 | 〃 | 〃 | 〃 | 〃 |
| 10B | | 10 | 16 | 1/4 | ± | 〃 | significantly turbid | + | good | 〃 | 〃 | 〃 | 〃 | 〃 |
| 0C | After handling of fish, standard method was used. (Steeping time in Bé 7° brine was 20 mins. Retorting time was 80 mins at 10 Lbs.) | 0 | 14 | 1/8 | ## | 〃 | rather turbid | ## | good | good | nore | good | ordinary | good |
| 5C | | 5 | 0 | 3/8 | ± | 〃 | turbid | # | rather flayed | 〃 | 〃 | 〃 | 〃 | 〃 |
| 10C | | 10 | 0 | 7/16 | ± | 〃 | significantly turbid | + | 〃 | 〃 | 〃 | 〃 | 〃 | 〃 |
| 0D | After roasting of fish, standard method was used. | 0 | 16 | 3/16 | ± | 〃 | clear | ## | rather flayed | good | none | inferior | rather inferior | rather inferior |
| 5D | | 5 | — | 3/8 | ± | 〃 | significantly turbid | ## | significantly flayed | 〃 | 〃 | rather inferior | 〃 | 〃 |
| 10D | | 10 | 14 | 3/8 | ± | 〃 | rather turbid | + | rather flayed | 〃 | crumbled in upper part | 〃 | 〃 | 〃 |

Note: Curd ## great quantity, # fairly great quantity, + medium quantity, ± small quantity, — none.
Toughness of meat, ## rather toughness, + ordinary.

Table 3. Relation between the freshness of raw mackerel meat caught in the Pacific Ocean before processing for canning and the result of experiment on preservation for deforming of meat.

| Kinds \ Items | | Volatile basic nitrogen in raw material (mg %) | Deforming of meat | Odour | Skin | Curd | Liquid | Quality of meat | Inner part of meat (colour) |
|---|---|---|---|---|---|---|---|---|---|
| E | Can contents packed after steam exhausting | 11.21 | none | good | good | large quantity | turbid | good | good |
| | | 26.24 | rather crumbled in upper part | rather acid odour | 〃 | 〃 | 〃 | rather fragile | light pink |
| | | 33.42 | fairly deformed in upper part | strange smell | 〃 | 〃 | 〃 | fragile | 〃 |
| | | 54.76 | significantly deformed in all the part | putrefied odour | 〃 | small quantity | significantly turbid | sifnificantly fragile | yellow brown in several parts |
| E′ | Can contents packed with vacuum seamer | 11.21 | none | good | good | large quantity | turbid | good | good |
| | | 26.24 | rather crumbled in upper part | rather acid odour | 〃 | 〃 | 〃 | rather fragile | light pink |
| | | 33.42 | fairly crumbled in upper part | strange smell | flayed | small quantity | 〃 | fragile | pink |
| | | 54.76 | significantly crumbled in all the part | putrefied odour | significantly flayed | 〃 | significantly fragile | significantly fragile | yellow brown in several parts |

(5) After the raw mackerel was dressed, it was steeped in brine of Bé 17° for 25 mins., packed in can, exhausted by steaming at 100°C for 30 mins., seamed, and sterilized at the pressure of 10 lbs. for 1⅔ hrs. --------- Sample D.

(6) Instead of steam exhausting in method (5), the vacuum seamer was employed -------- Sample D′.

(7) Raw material of varying degrees of freshness resulting from by leaving it at room temperature was handled in the manner of method (1) -------- Sample E.

(8) The same material as (7) was handled in the manner of method (2) ---------- Sample E′.

2. Experimental procedures.

After leaving the samples of canned mackerel prepared as above described for 1 month, the wooden boxes packed as usual for shipment were dropped from the height of 120 cm to the ground 5 times or 10 times. As control, some boxes were not dropped. Then the cans were opened and the conditions of deformation, skinning, frangileness and juice were observed.

3. Results of Experiments

The results of these experiments are shown as in Tables 1, 2 and 3. From those tables, the results may be summarized as follows:

(1) The frangileness of mackerel of the Pacific Ocean Group was greater than that of the Japan Sea Group, as described in the previous Reports. When cans packed with material from both groups have been left alone without shaking, no deformation of the shape of the meat was observed.

(2) However, when those cans were subjected to the shock of falling, the contents showed fragility, the juice became turbid and the meat was deformed in the cans which were produced by the usual method (method 1.) and by the roasting method (method 5.).

(3) When cans were dropped 10 times those packed with the Pacific Ocean Group by the usual method (method 1) showed more remarkable deformation of their meat contents than those packed with Japan Sea mackerel.

(4) As for method of manufacturing, methods (3) and (4) are better than the usual method (method 1). For example, the cans of Japan Sea mackerel produced by method (4), and those of Pacific Ocean catch produced by method (3) were better than those produced by the other methods.

(5) Roasted mackerel meat is difficult to pack, and the color, flavour, and the appearance are worse than the other.

(6) The cans which were produced with unfresh raw mackerel were worse than the cans produced with fresh raw material.

## CONCLUSION

The deformation and breaking of shape of the meat in the canned product depends upon the freshness of the raw mackerel material. When unfresh raw material was used, the quality of product was worse, and it was easy to break or deform the shape of the meat by shock. The procedures which did not destroy the shape of the meat and did produce samples which withstood shock were those described as methods (3) and (4), above. By method (4) canners are able to obtain a good quality by shortening the sterilizing time is required for slivering fish. The writers wish to recommend this method for the production of canned mackerel.

(水產科學研究所業績 第102號)