CURD IN CANNED SALMON

I. Formation of Curd by Heating Flesh from Frozen Salmon

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Introduction

Since curd in canned products shows an inferior appearance and is a cause of grade down at the inspection, the difficulty concerns one of the technical problems which should be solved in fish canning industry. Curd is often found in canned salmon, mackerel, and other fish, soft white or sometimes stiff grey coagulation covering the surface of the flesh.

Curd has been investigated in canned salmon (Denstedt and Bailey, 1934; Matsuike, 1935; Stansby and Dassow, 1951; Dassow and Craven, 1955; Schmidt and Idler, 1955; Seagran, 1956), and canned mackerel (Tanikawa *et al.*, 1952; Konno *et al.*, 1953). The data in these papers have showed that heat coagulable proteins are a constituent of the curd. To prevent curd, fish was soaked into brine to remove causative matters prior to packing.

In relation to the formation of curd and frozen of fish, the amount of drip which contains heat coagulable proteins increases during freezing storage in fish flesh, hence the amount of curd from frozen materials is always more than that from raw fish (Konno *et al.*, 1953; Stansby and Dassow, 1951).

In this experiment, an attempt was made to observe the process of curd formation when using frozen salmon. The present paper reports on the formation of curd by heating salmon flesh which has been handled with different storing or thawing methods.

Experimental

Sample cans. Sample cans for determination of the amount of curd were prepared from raw, and frozen chum salmon (*Oncorhynchus keta*). Approximately 120 g of the flesh were packed in No. 3 can (a quarter pound size can, 77.0×36.26 mm) with 1g of table salt, sealed, and processed for 60 min at 10 lbs (115.2°C). For an examination of the thawing effect of curd formation, the round frozen material

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was divided into 3 portions which were treated in 3 respective different ways to obtain unthawed, half-thawed, and completely thawed fleshes. The sample being thawed only on the surface but still frozen inside was the half-thawed flesh, while the one being thawed both inside and outside was the completely thawed flesh. Thawing procedure was done by soaking the portions of the material into a water tank.

Samples for estimating curd from frozen salmon. Chum slamon fillet was wrapped up in polyethylene film and stored in a freezer at –25°C. Sample flesh blocks were taken from the fillet at definite intervals during the freezing storage. Two flesh blocks of 2.5 cm^3 size (about 15 g) were cut off from the back part of the salmon and were put into a test tube ($\phi 3.0 \times 12$ cm) with and without 15% sodium chloride solution brining for 25 min. The test tube was heated in a water-bath for 25 min at a definite temperature from 40° to 100°C.

Samples for estimating curd from injured flesh. Cutting 5 mm depth across on each area damaged the flesh block ($3.0 \times 3.0 \times 2.0$ cm, about 20 g) of raw and frozen chum salmon, after it had been stored for 40 days at –25°C. Meanwhile, another flesh was grinded in a motar to a slurry from which a clot was made similar in size as the flesh. The flesh and the clot were put into respective test tubes and were heated in a boiling bath for 20 min. The curd formed on the flesh was collected and placed with tweezers into a flask in order to determine nitrogen content by Kjeldhal method. Multiplying 6.25 to the per cents nitrogen was the amount of curd.

Determination of curd. On opening a sample can, the content was divided into solid and liquid portions. From solid portion, curd was collected from the surface and the cracks of the flesh with tweezers. Care had to be taken to remove small particles and pieces of the flesh or bones from the curd as much as possible. The liquid suspending curd was passed through a filter paper (Toyo filter paper No. 5 C) which was previously weighed. The curd on the filter paper was combined with the one from the solid, washed with water, and left in an oven until it became dried matter. A per cent weight of the dried crud resulted from the total weight of the canned content.

Results and discussion

Formation of curd by heating flesh from frozen salmon. Figs. 1 and 2 show the results on the formation of curd by heating flesh from frozen salmon. The amount of curd increases gradually by heating flesh from 40° to 70°C, decreases once at 70°~80°C, then increases again at 80° or 90°C. At higher temperature the amount of curd is smaller than that at lower one, because rapid coagulation of the surface flesh would prevent internal constituents of curd from coming out. Although a longer period of freezing storage was not a cause to form a larger amount

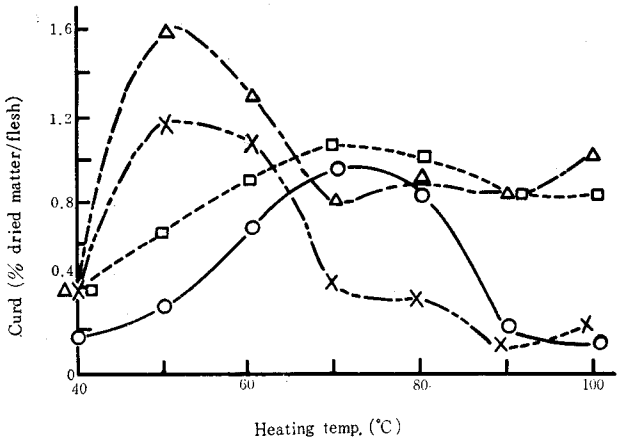

Fig. 1. Formation of curd by heating flesh from frozen salmon without brining
o —— o Raw salmon, △ — - — △ Frozen salmon for 1 week, □ - - - - - □ Frozen salmon for 3 weeks, × — - - — × Frozen salmon for 8 weeks.

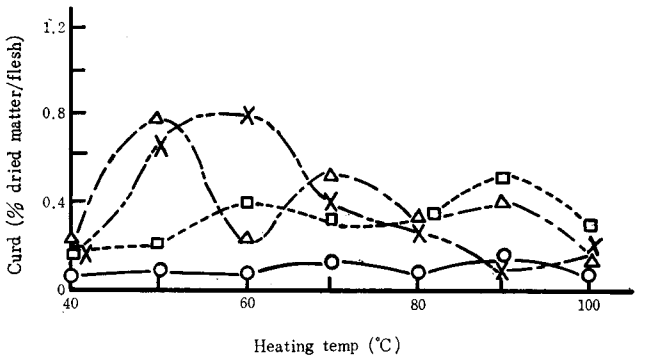

Fig. 2. Formation of curd by heating flesh from frozen salmon with brining
o —— o Raw salmon, △ — - — △ Frozen salmon for 1 week, □ - - - - - □ Frozen slamon for 3 weeks, × — - - — × Frozen slamon for 8 weeks.

of curd in this experiment, it is obvious that frozen materials tend to form a larger amount of curd than raw salmon. Brining could decrease the amount of curd from frozen flesh as well.

Curd from injured flesh. In general, forming and growing ice-crystals in fish muscle during freezing storage may also be a cause to injure the flesh (Tanikawa and Akiba, 1951). Curd in canned fish is formed on both surface and internal flesh. Constituents of curd in flesh move out from gaps made by heat shrinkage of muscle tissue itself (Denstedt and Bailey, 1934; Matsuike, 1935). A factor such as mechanical damage on frozen salmon should be taken into consideration regarding curd formation. As seen in Fig. 3, if the degree of injure to the

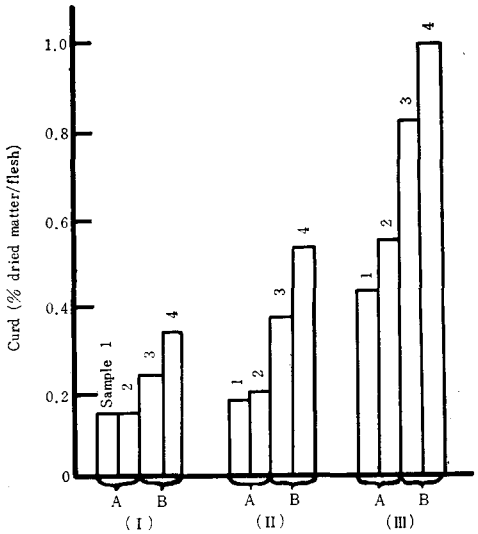

Fig. 3. Formation of curd by heating flesh from injured flesh
I. Flesh block, II. Cut flesh, 5 mm depth on each area of the flesh block, III. Brined flesh in same size of the block. (A) Raw salmon, (B) Frozen salmon.

flesh becomes worse, the amount of curd increases as well.

Influence of degrees of thawing on formation of curd. The results are summarized in Fig. 4. From these results, complete thawing may decrease the amounts of curd in canned products. The amounts of curd in the sample cans which were packed with completely thawed salmon were 0.46% (Sample 1) and 0.76%

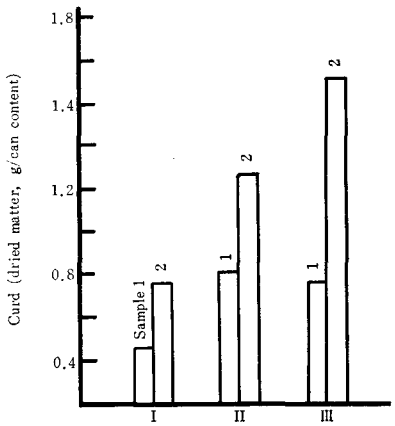

Fig. 4. Influence of thawing on curding with frozen salmon
I. Completely thawed, II. Half-thawed, III. Unthawed.

(Sample 2), respectively. The salmon used for the experiment were not subjected to brining; yet, if it had been done, the amount of curd would be decreased to the level of normal products (0.02～0.15%).

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Summary

Formation of curd by heating salmon (*Oncorhynchus keta*) flesh which had been subjected to freezing storage, and thawed to different degrees were studied. The amounts of curd from frozen salmon varied in accordance with heating temperatures, increased from 40° to 60°C, decreased at 70°～80°C, and again increased above 80°C. Sodium chloride brining prevented frozen flesh from curding. Complete thawing resulted in less amounts of curd in canned products than un- and half-thawing.

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