

Department of the Environment
Fisheries and Marine Service
Research and Development Directorate

Ministère de l'Environnement
Services des Pêches et des Sciences de
la mer Direction de la Recherche et
Développement

TECHNICAL REPORT NO. 604

RAPPORT TECHNIQUE N^o. 604

(Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. The series name was changed with report number 457)

(Les numéros 1-456 dans cette série furent utilisés comme Rapports Techniques de l'office des recherches sur les pêcheries du Canada. Le nom de la série fut changé avec le rapport numéro 457)

Roe Herring Processing:
Effect of Freezing and Thawing Rates and
Duration of Frozen Storage on "Spongy"
Roe Development

By

J. Wong, E.G. Baker and M. Yamamoto

This is the thirtieth Technical Report from the Research and Development Directorate Vancouver Laboratory Vancouver, B.C.

Ceci est le trentième Rapport de la Direction de la Recherche et Développement, Laboratoire de Vancouver, Vancouver, (C.-B.)

1976

TABLE OF CONTENTS

	<u>Page No.</u>
ABSTRACT	iii
INTRODUCTION	1
EXPERIMENTAL	2
RESULTS AND DISCUSSION	3
TABLE I Yield of roe obtained and incidence of damaged herring	5
TABLE II Firmness of roe obtained	6
ADDITIONAL READING	7

ABSTRACT

A significant proportion of roe herring that is caught in British Columbia waters is frozen and subsequently thawed for roe extraction. The retrieved roe is then hardened and preserved for export by brining.

Much concern has been expressed by B. C. herring roe processors relating to the apparently high incidence of "sponginess" in roes which were processed from frozen herring; suggestions were frequently made that the slow rate of freezing of the fish may have largely contributed to the development of this condition.

Accordingly, we examined this possibility using commercially obtained samples of herring which were less than one day old, and concluded that the rate of freezing (or thawing) per se does not lead to the formation of "spongy" roe.

RESUME

Une proportion importante du hareng rogué, pêché dans les eaux de la Colombie-Britannique, est congelée et par la suite décongelée afin d'en extraire les oeufs. Ces derniers sont ensuite pressés et conservés par saumurage avant leur exportation.

Les producteurs d'oeufs de harengs de la Colombie-Britannique ont exprimé une grande inquiétude relativement à la consistance molle, fréquemment constatée, des oeufs extraits de harengs congelés; on a souvent laissé entendre que cet état était dû à la congélation lente du poisson.

En conséquence, nous avons étudié cette possibilité à l'aide d'échantillons de harengs recueillis sur le marché et morts depuis moins d'une journée, et nous en sommes venus à la conclusion que la vitesse de congélation (ou de décongélation) ne peut en soi être la cause de la consistance molle des oeufs.

INTRODUCTION

The Japanese market for Canadian herring roe which developed suddenly in 1971 now represents a substantial annual source of revenue (about \$30 million) to the B.C. fishing community.

However, in spite of the experience gained by the fishing industry during these past few years, some technical problems still exist. One of these is the serious problem of herring carcass utilization (or disposal) after the roes have been retrieved. Another is the problem of maximizing the production of top-grade roe to satisfy the luxury market in Japan.

A problem brought to our attention related to the apparently high incidence of "spongy" roe obtained from once-frozen herring. The question was raised whether this condition resulted from the fairly common industrial practice of freezing part of the herring catch and subsequently thawing them to retrieve the much firmer roe. Since there is about a 4- to 5-fold difference in the selling price of top-grade No. 1 roe and lower grade No. 5 roe (which includes "spongy" roe), this fact clearly indicates the economic significance of preventing or at least reducing the incidence of this condition. Therefore, we examined the possibility that slow freezing of roe herring, followed by slow thawing might have resulted in the formation of sponginess in the extracted and processed roe.

EXPERIMENTAL

Herring used in these experiments were caught by commercial gillnetters in Burke Channel, B.C. on June 3, 1975 and transported in chilled seawater to a processing plant within 10 hours. Off-loading of the catch at the plant was accomplished by means of a centrifugal capsule-type pump previously used for off-loading herring intended for reduction purposes.

A randomly selected lot of herring from the catch was divided and placed into 15 polyethylene bags, each bag containing 22.7 Kg (50 lb.) of herring. The dimensions of the bags were approximately 7 cm x 30 cm x 60 cm (about 3" x 12" x 24").

To prepare samples of "fast-frozen" herring, 7 of these bags of herring were placed unstacked on metal shelves in an air-blast freezer room held at -35°C (-30°F). Examination of the herring indicated that they were completely frozen within 16 hours.

"Slow-frozen" samples were prepared by placing 7 similar bags of herring in heavy carton boxes, then storing these in the -35°C freezer room. Periodic examination indicated that the herring were not frozen at 16 hours, but were completely frozen at 48 hours.

Roes were carefully retrieved from 22.7 Kg of unfrozen herring and brined immediately to serve as control.

The frozen bagged herring samples were transferred by air to the Vancouver Laboratory and stored at about -21°C . These were removed at 1, 2, 3, 5, 7, 13, and at 15 weeks for processing. "Fast-frozen" samples were thawed in 5 hours by immersing the frozen herring blocks in lukewarm water (initial temperature 33°C). "Slow-frozen" samples were air-thawed in about 16 hours by allowing the frozen herring blocks to sit overnight at ambient temperature (20°C).

Roes retrieved from thawed herring at the indicated intervals were weighed, immersed first in 30% saturated brine for 20 hours, then immersed in 100% saturated brine for 24 hours, drained for 4.5 hours and finally examined individually for incidence of sponginess.

Since spongy roe cannot be readily differentiated from firm roe by sight only, it was necessary to squeeze each processed roe very carefully between the thumb and fingers to observe signs of free brine oozing near the applied pressure. Samples of "spongy" roe obtained from a commercial processor were used as reference for assessment of sponginess.

RESULTS AND DISCUSSION

In addition to the quantitative aspects of the experiment, we documented the quantity of roe retrieved and the ratio of male to female herring in all of the samples. Due to the unexpected high incidence of damaged fish found in the samples, we also recorded and assessed the number of fish with damaged roe and those which were completely severed into two or more sections. The data obtained are presented in Table I.

Two rather striking observations emerge from the data given in Table I. One is the extraordinarily high ratio of females to male herring in all of the samples. There were roughly 3 females to 1 male, which might possibly indicate that some segregation of herring schools, based on sex, occurs on the spawning grounds. A rather unlikely possibility is that the technique of gillnetting tends to be more selective for female herring. The high incidence of females in the catch is reflected in the very high total yield of roe obtained (about 21%) which is about twice the expected commercial yield.

The other interesting but rather disturbing observation is the very high incidence of damaged fish seen throughout the entire sampling program. The data clearly shows that about 8% of the fish were so badly damaged as to affect both yield and quality. We believe that a large part of the damage probably occurred during the pumping of the herring from the vessel into the plant and during translocation within the plant. Additionally, the high percentage of females (which tended to be much more susceptible to physical damage than males) was a contributing factor.

The experimental data dealing with the question of roe sponginess arising as a result of freezing and thawing rates, and duration in cold storage are given in Table II.

It is readily seen that no spongy roe was obtained in any of the herring samples held up to 7 weeks in cold storage, regardless of the manner by which they were frozen or thawed.

During the 13th and 15th week of storage however, some incidence of sponginess appears to have arisen, but we find it rather difficult to accept the idea that an additional 6 weeks in cold storage would suddenly result in the development of sponginess. It is more likely that the seeming development of sponginess observed was more apparent than real, and that it resulted from discrepancies which are inherent in all subjective assessment procedures. This question notwithstanding, the significance of the data given in Table II is that sponginess does not arise in roe obtained from good quality herring as a result of freezing or thawing rates. We believe that if quick-freezing or slow-freezing (or the duration in cold storage) were critical factors leading to the development of sponginess in the extracted and brine-processed roe, the proportion of spongy roe found would have been substantially higher. No such clear differences were found.

Factors which might contribute to the formation of spongy herring roe could be :

- (a) the incomplete freezing of roe herring, or
- (b) repeated freezing and thawing of herring, or
- (c) the freezing of poor quality herring.

If the roe sponginess problem should continue to be a major problem to processors, we recommend that these conditions be investigated, particularly the first one indicated.

TABLE I. Yield of Roe Obtained and Incidence of Damaged Herring.

Weeks Frozen	Method of Freezing and Thawing	No. of Fish (includes damaged fish)	% Female	No. of damaged fish	% Yield of Unprocessed Roe
0	(Not frozen)	158	73	"several", not counted	20
1	S*	163	74	" "	23
1	F*	161	69	" "	21
2	S	148	80	12 (8%)	23
2	F	153	74	14 (9%)	21
3	S	159	84	20 (12%)	23
3	F	163	74	14 (9%)	21
5	S	154	80	11 (7%)	21
5	F	161	84	11 (7%)	24
7	S	165	77	8 (5%)	21
7	F	160	80	11 (7%)	22
13	S	155	81	13 (8%)	22
13	F	163	77	10 (6%)	22
15	S	154	74	14 (9%)	19
15	F	159	80	11 (7%)	23

* "S" = slowly frozen and slowly thawed.

"F" = quickly frozen and quickly thawed.

TABLE II. Firmness of Roe Processed from "Slow-Frozen", "Slow-Thawed" and "Fast-Frozen", "Fast-Thawed" Herring.

Weeks in Cold Storage	Method of Freezing and Thawing	Total Wt. of Roe After Brining (Kg)	WT. & % of ROE OBTAINED					
			Firm (Kg)	Spongy (Kg)	Immature (Kg)	%		
0	Not Frozen	4.350	3.910	90%	0	0	0.440	10%
1	S*	5.525	5.225	95%	0	0	0.300	5%
	F*	4.845	4.565	94%	0	0	0.280	6%
2	S	5.615	5.340	95%	0	0	0.275	5%
	F	5.400	5.150	95%	0	0	0.250	5%
3	S	4.873	4.423	91%	0	0	0.450	9%
	F	N.D.**	N.D.	--	N.D.	N.D.	0.680	--
5	S	5.155	4.695	91%	0	0	0.460	9%
	F	6.070	5.470	90%	0	0	0.600	10%
7	S	4.980	4.420	89%	0	0	0.560	11%
	F	5.726	5.456	95%	0	0	0.270	5%
13	S	5.625	4.789	85%	0.386	7%	0.450	8%
	F	5.452	5.087	93%	0	--	0.365	7%
15	S	4.400	3.999	91%	0.111	2%	0.290	7%
	F	5.735	5.110	89%	0.045	1%	0.580	10%

* "S" = slowly frozen, slowly thawed.
 "F" = quickly frozen, quickly thawed.
 ** N.D. = not determined.

ADDITIONAL SOURCES OF INFORMATION ON ROE HERRING PROCESSING

1. Boyd, J.W., Geiger, S.E. and Southcott, B.A.
1972. Herring Roe Retrieval and Processing.
Fisheries Research Board of Canada,
Technical Report No. 336.

2. Tomlinson, N., Gibbard, G.A., Geiger, S.E., and Baker, E.G.
1975. Storage of Roe Herring at Sea.
Fisheries and Marine Service,
Technical Report No. 536.

3. Bilinski, E., ter Borg, L., Smith, D., Yamamoto, M. and Zimmerman, J.
1975. Quality and Quantity of Roe Obtained from Pacific Coast
Herring Under Industrial Processing Conditions.
Fisheries and Marine Service,
Technical Report No. 569.