RAINBOW TROUT (*SALMO IRIDEUS*) PRODUCED IN FINLAND

VII. CHANGES IN THE ORGANOLEPTIC QUALITY AND FETTY ACID COMPOSITION DURING FROZEN STORAGE

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Received May 13, 1969

Until now freezing has been one of the most important means of storing fish. Several investigators have tried to solve the problems connected with the changes in the fish protein during frozen storage (COWIE et al. 1966 and 1967, OLLEY et al. 1967).

Changes in the lipid fraction of the fish may be of equal importance in lowering the quality of the fish, especially fatty fish, during frozen storage. The purpose of this study was to examine the effect of two different storage temperatures and two different means of packaging upon the organoleptic quality and the fatty acid composition of frozen rainbow trout.

Material and methods

The experiments were carried out with second-summer rainbow trout fed with Clark dry food for rainbow trout. The average weight of the fishes was 130 grams (from 85 to 201 grams) and the control fishes were transported to the laboratory alive. The rest of the fishes were killed and gutted and frozen rapidly at —40° C. One half of the fishes were glazed with water while the second half was individually packed in vacuum sealed polyethylene bags. The fishes were then transported to the laboratory in styrox containers into which CO_2-ice had been added. The fish arrived at the laboratory 18 hours after gutting. At the laboratory the samples were divided again into two halves with storage temperatures of — 18 and — 32° C. For the organoleptic evaluation samples were taken from the control fish after 1 day, 1 week, 1 month and 3 months, and for the fatty acid analyses from the control fish after 1 day, 1 week, 1 month and 7 months.

The organoleptic evaluation was performed according to NIINIVAARA et al. 1966, and the fatty acid analyses in accordance with the methods used in the previous study (VARESMAA et al. 1968).

Results

Organoleptic evaluation. The results obtained in the organoleptic evaluation are presented in Table 1. They indicate that already after three months of storage the fish was uneatable. At — 32° C the fish kept their organoleptic quality somewhat better than at — 18° C. No marked differences existed between the glazed and the vacuum-packed fish.

Fatty acid composition of lipids. The results from the fatty acid analyses are presented in Table 2. No marked differences during the storage, nor any correlations between the types of packing and storage temperatures, could be noticed.

Discussion

According to the results obtained in this examination, the possibilities of applying freezing in the storage of rainbow trout are limited. In organoleptic evaluation the fishes were judged uneatable after three months of storage. In this respect the results are different from results obtained by other investigators. BRAMSNAES et al. (1960) found that rainbow trout began to go rancid only after 9 months. NELSON (1959) indicated that trout glazed with water kept their quality for 18 months at — 18° C but unglazed trout became rancid and uneatable in 4 months. On the other hand it is obvious that the keeping quality of rainbow trout during frozen storage depends upon many factors such as the age of the fish, the condition of the fish before killing, the catching time, the freezing temperature and the method of handling before freezing. Many investigations have proved that these factors affect the quality of the fish and the extent of the storage time (BANKS 1952, NELSON 1959, PISKAREV 1959, BRAMSNAES et al. 1960. ANDERSON et al. 1961, LANE 1964, LILJEMARK 1964).

There were no marked differences in the total fatty acid composition of lipids during storage, nor any greater differences between the storage temperatures and packing types used. Obviously the reason for the short shelf life does not lie in the fatty acids alone. According to earlier investigations, the free fatty acids formed when the lipids are hydrolyzed may, however, react with proteins and cause primary changes in the structure (FRAZER et al. 1959, ACKMAN 1967). It is therefore probable that changes in the proteins during frozen storage are more significant than in the lipids causing a rapid lowering in the quality of frozen rainbow trout.

Summary

Rainbow trouts were frozen at — 40° C and stored either glazed with water or vacuum packed in polyethylene bags at — 18° and — 32° C. During the storage time the quality of the fish was tested both organoleptically and by determining the fatty acid composition of the lipids.

It was found that the fish were organoleptically uneatable after three months of storage. At — 32° C the fish kept their organoleptic quality somewhat better than at — 18° C. There were no important differences between the two packing systems used.

The fatty acid analyses gave comparable results in all instances and probably changes in the proteins during frozen storage are more significant than changes in the lipids and are mostly responsible for the lowering in quality of frozen rainbow trout.

Table 1. Organoleptic quality of gutted trout during storage.

Date	Appearance	Structure	Colour	Odour	Flavour	Total score
Control: fresh	4	3.5	3 +	2	5	18 —
June 1, 67:						
Frozen, glazed	3 +	3	2 +	2	4 +	15 —
frozen, vacuum-packed	3.5	3	3	2	5 —	14 +
June 8, 67:						
— 18° C, vacuum-packed	3 +	3 —	2.5	2	3.5	14
— 18° C, glazed	4 —	3 +	3 —	2	3.5	15 +
— 32° C, vacuum-packed	3 +	3 —	2	2	3 +	13 +
— 32° C, glazed	3.5	3 +	3	2	4 —	15 +
July 1, 67:						
— 18° C, vacuum-packed	3	3	3	2	3	14
— 18° C, glazed	3 +	3	2.5	2	3.5	14 +
— 32° C, vacuum-packed	2.5	2 +	3	2	3 —	12,5
— 32° C, glazed	3.5	3	3	2	4 —	13 +
Sept. 1, 67:						
— 18° C, vacuum-packed	2 +	3 —	2.5	1.5	2 +	11 +
— 18° C, glazed	2 +	3 —	2.5	1	1.5	10
— 32° C, vacuum-packed	2.5	2 +	2.5	1.5	2	11 —
— 32° C, glazed	2.5	2 +	2.5	1 +	3 —	11 +

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Table 2. Fatty acid composition of gutted trout during storage.[1])

	Fresh	June 1st, 67		June 8th, 67				July 1st, 67				February 7th, 68			
		vac.	glaz.	vac 18	glaz 18	vac 32	glaz 32	vac 18	glaz 18	vac 32	glaz 32	vac 18	glaz 18	vac 32	glaz 32
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
C14:0	1.5	1.5	1.5	2.6	2.1	1.4	1.8	2.6	1.7	1.3	1.8	2.7	2.7	2.7	2.8
C15:0	0.6	0.7	1.1	1.7	0.5	0.9	0.5	1.9	0.7	0.4	0.7	0.4	0.7	0.6	0.5
C16:0	16.8	14.2	11.0	14.4	15.7	15.0	15.1	12.9	7.8	8.5	12.6	15.7	14.5	14.9	13.1
C16:1	4.2	3.8	2.9	3.6	5.3	3.8	4.5	3.3	3.1	4.0	3.3	4.4	4.7	4.4	4.2
C17:0	0.9	1.1	1.3	2.8	0.9	1.4	0.8	3.1	0.9	0.7	0.9	0.9	0.9	0.9	0.9
C17:1	0.6	0.8	1.2		0.6	1.0	0.6	2.2	2.1	1.0	0.5	0.8	0.8	0.7	0.5
C18:0	6.7	6.2	8.5	6.9	6.3	5.0	6.1	9.6	4.6	4.2	5.6	24.7	25.3	23.1	22.07
C18:1	23.6	22.1	19.4	19.6	19.2	22.9	20.1	15.8	13.7	15.6	17.8				
C18:2	11.5	11.0	8.5	18.5	14.7	12.4	14.3	8.3	11.3	10.3	11.8	14.9	16.7	15.1	15.7
C18:3	0.5	1.3	1.4	0.4	0.7	1.4	0.7	2.0		1.5	2.4	2.0	2.4	1.3	2.4
C18:4	1.1	1.1	1.6	1.7	2.1	1.3	1.7	2.2		0.8	0.8	1.3	1.5	2.1	1.6
C20:1	8.3	8.1	6.2	8.4	6.2	6.1	6.5	4.9	8.4	5.2	7.0	6.4	6.9	6.5	6.3
C20:2	0.9	1.3	2.1	2.7	1.1	1.8	1.2	2.0	2.1	1.4	1.3	0.7	0.8	0.9	1.1
C20:3	0.8	1.1	1.0		1.2	1.6	1.3	1.5	1.5	1.2	1.4	1.1	1.2	1.4	1.4
C20:4	0.6	0.5	0.8		1.0	1.1	1.2		1.0	1.0	0.6	0.6	0.7	0.6	0.8
C21:0	1.4	1.8	1.8	2.6	1.5	1.9	1.6	1.9	1.4	1.4	1.3	1.4	1.4	1.8	1.8
C22:1	9.1	7.7	5.9	7.1	7.2	5.2	7.1	5.2	5.4	6.5	7.4	8.0	7.3	8.4	9.7
C22:5	2.1	2.6	2.1		2.6	3.0	2.5		2.8	2.8	2.2	1.0	1.1	1.1	0.9
C22:6	9.5	7.6	5.5	7.5	11.5	8.9	10.2	5.4	6.4	9.0	7.9	11.4	11.8	10.9	10.3

[1]) Values expressed as fatty acid methylester.

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SELOSTUS

TUTKIMUKSIA SUOMESSA KASVATETUSTA KIRJOLOHESTA *(Salmo irideus)*

VII. Kirjolohen organoleptisen laadun ja rasvahappokoostumuksen muutokset pakkasvarastoinnin aikana.

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Helsingin Yliopisto, Lihateknologian laitos

Suoritetussa tutkimuksessa kirjolohet pakastettiin — 40° C:ssa, jonka jälkeen puolet glaseerattiin vedellä ja toinen puoli vakuumissa pakattiin polyethyleenipusseihin. Näytteitä säilytettiin — 18° ja — 32° C:n lämpötiloissa. Varastoinnin aikana kalojen laatua seurattiin organoleptisin arvosteluin ja määrittämällä lipidien rasvahappokoostumus kaasukromatograafisesti.

Organoleptinen arvostelu osoitti, että kalojen säilyvyys oli ainoastaan 3 kk:tta ja että laatu oli hieman parempi — 32° C:ssa kuin — 18° C:ssa säilytetyissä kaloissa. Pakkaustapojen välillä sensijaan ei esiintynyt suurempia eroja.

Rasvahappokoostumuksissa ei havaittu minkäänlaisia suurempia eroja varastoinnin aikana eikä korrelaatioita esiintynyt myöskään pakkaustapojen ja varastointilämpötilojen välillä. Todennäköistä onkin, että valkuaisaineissa tapahtuvat muutokset ovat pakkasvarastoinnin aikana lipideissä ilmeneviä muutoksia huomattavasti merkittävämmät.

Tämän tutkimustehtävän nyt päättyessä pyydämme saada esittää Suomen Luonnonvaraintutkimussäätiölle parhaat kiitoksemme siitä taloudellisesta tuesta, jonka turvin tutkimustyö on suoritettu. Tutkimus on ollut meille erittäin mielenkiintoinen, ja toivomme, että siinä saavutetut tulokset tulisivat hyödyttämään Suomen kalatalouden kehittymistä.