al., 1993). In addition, effluent from the sponge affected metamorphosis and caused fate of *S. rustica* (Khalaman et al., 2008b) and *M. edulis* (Khalaman et al., 2009) larvae.

The data obtained instigated biochemical studies of allelopathic action of the principle species in the White Sea fouling communities. In the laboratory experiment, the most changes in mussels metabolism were observed in mollusks treated with SEPs of *A. rubens*, *S. rustica* and *H. panicea*. Water, conditioned with starfish, ascidia and sponge, caused activation of the same enzymes, but to different extend. Foremost among tested enzymes was increment of acid RNase andglycosidases activity in mussel tissues, especially, in the presence of starfish metabolites. But almost all of enzymatic activities tested returned to control level at the end of the experiment in mussel groups treated with SEPs of *A. rubens* and *S. rustica*. This fact could point to compensatory character of metabolic changes observed. In contrast with effect of starfish and ascidian effluents, sponge induced changes in mussel metabolisms were statistically significant at the end of experiment, pointing to slower or different character of biochemical response on *H. panicea* SEPs.

Summarizing results of field and laboratory experiments showed that at least two species pretended to possess allelopathic action. These are sponge *Halichondria panicea* and solitary ascidia *Styela rustica*. In the case of sponge, several known biological activities of chemicals, produced by *Porifera* themselves or their microbial symbionts, may speak well for this suggestion (Althoff et al., 1998; Engel, Pawlik, 2000; Belarbi et al., 2003; Devi at al., 2010; etc.). Ascidian metabolites are not studied as widely as sponge BAS, but there are some with promising clinical application (Kobayashi et al., 1991; McDonald et al., 1994; Ciufolini et al., 1995; Torres et al., 2002; etc.). Thereby, we suggest that *H. panicea* and *S. rustica* from the White Sea could be prospective objects for searching of novel BAS. Additionally, it should be underlined that, if some biologically active compounds with potential application are discovered in these species, they could be cultivated rather easy as they are fouling organisms.

The work was granted by the Russian Foundation for Basic Research (grant № 10-04-00310) and the Russian President's grant for support of distinguished scientific schools (NSh-3731.2010.4).

QUALITY PRESERVATION OF FROZEN SALMON OVARIES

A.K. Khamzina

Russian Federal Research Institute of Fisheries and Oceanography, Russia, Moscow
e-mail: vniro-test@vniro.ru

The salmon caviar refers to the gourmet product with high nutritional and biological value. Volumes of extraction and production of salmon caviar in Russia is enormous and reach 5–6 thousand tons per annum. The amount of caviar produced from frozen salmon ovary has increased in recent years.

As it is known, the quality of caviar products depends on the quality of salmon ovary raw material, processing technology, production sanitary state and conditions of transportation and storage of caviar products.

The preservation of quality is always one of the important issues, so the aim of the work is to study methods to preserve the quality and safety of raw materials.

According to the technical documentations, which serve as a basis for fish processing enterprises, storage life of frozen salmon ovary does not exceed 6 months.

At the present time, the waxed paper is used to preserve the salmon ovary quality with further packaging in waxed boxes and polymer film and bags made of polymer materials, in which salmon ovary are packed under suction or not.

There is another way to preserve the quality of frozen products – icing. We prepared the control samples of salmon ovary packed in waxed film and boxes, and the test samples iced with an antiseptic solution and antioxidants.

Throughout the storage period of the salmon ovary (9 months at the temperature of –18°C) the microbiological properties of the test samples were by an order lower than the properties of the control samples and met hygienic requirements of safety and nutritional value of food products. The content of toxicants – toxic elements, organochlorine pesticides, N-nitrosamines, histamine, in the control and test samples did not exceed the standardized values.

Besides the safety parameters, the parameters responsible for the hydrolytic and oxidative changes in proteins and fats, and also amino-acid composition of proteins and fatty acid composition of lipids were evaluated.

Fat content in the salmon ovary samples ranged from 9.5 to 12.0%. During storage there was a tendency of gradual increase in the value of acid number, while in the non-iced salmon ovary the tendency was expressed in a greater extent than in the iced ones. (Table 1). After 9 months of storage the acid number in the control samples was 9.57, and in the test samples – 7.01 mg KOH/g fat. At the same time the acid number of lipids extracted from the surface of the block of the test samples was higher by 3% than the acid number of lipids extracted from the middle of the block, while in the control samples, this difference was 15%.

Table 1. Acid number content in the control and test samples, mg KOH/g fat

Name	Storage life, months			
	1	5	7	9
control	4.64	6.44	7.19	9.57
test	3.88	6.74	6.92	7.01

We have indentified about 40 fatty acids in lipids of the frozen salmon ovaries (Table 2).

Table 2. The main fatty-acid composition of salmon ovary lipids,% to the amount

Name	Code	Storage life of the control samples, months		Storage life of the test samples, months	
		1	9	1	9
Myristic	14:0	6.39	6.48	3.34	3.99
Pentadecanoic	15:0	0.83	0.81	0.46	0.54
Palmitic	16:0	15.99	16.02	13.69	14.51
Heptadecanoic	17:0	0.47	0.57	0.43	0.44
Stearic	18:0	3.65	4.30	5.53	5.18
Nonadecanoic	19:0	0.34	0.24	0.30	0.33
Heneicosapentanoic	21:0	0.34	0.24	0.20	0.18
Docosanoic	22:0	0.29	0.22	0.31	0.31
Palmitooleic	16:1	10.79	10.82	7.96	8.51
Oleic	18:1	30.98	30.78	28.91	27.19
Eicosenoic	20:1	3.87	5.91	5.04	4.76
Erucic	22:1	2.43	2.55	3.00	2.86
Hexadecadienoic	16:2	0.78	0.58	0.59	0.61
Linoleic	18:2	2.27	2.24	2.23	2.09
Eicosandienoic	20:2	0.53	0.49	0.52	0.50
Docosadienoic	22:2	0.42	0.46	0.32	0.37
Linolenic	18:3	1.46	1.44	1.31	1.23
Eicosatrienoic	20:3	0.82	0.85	0.89	0.83
Octadecatetraenoic	18:4	1.49	1.31	1.30	1.20
Arachidonic	20:4	2.24	2.26	2.57	2.31
Eicosapentaenoic	20:5	7.20	6.99	10.70	9.47
Heneicosapentanoic	21:5	1.16	1.06	0.37	0.37
Docosapentanoic	22:5	1.38	1.28	2.44	2.38
Docosahexaenoic	22:6	2.91	2.67	5.98	5.42

A large proportion belongs to monounsaturated fatty acids – 45.27 – 48.37% to the amount of fatty acids. The following acids dominate among them oleic acid – about 30%, palmitoleic acid – about 10% and eicosane acid – 3.8–5.9%.

The amount of saturated fatty acids ranges from 24.5 to 28.6%. The main saturated acids are palmitic –13.7–15.9%, myristic – 3.3–6.3% and stearic –3.6–5.5%.

The content of polyunsaturated fatty acids in the lipids of salmon ovaries is rather high – from 45.2% to 48.3%, mainly due to two acids: eicosapentaenoic acid, the proportion of which varies from 7.2% to 10.7%, and docosahexaenoic acid, its proportion varies from 2.9% to 5.9%. The amount of essential fatty acids: linoleic, linolenic and arachidonic is approximately 6.0%.

The tendency of insignificant increase in the mass fraction of monounsaturated fatty acids in the non-iced salmon ovary is observed during storage, this fact was confirmed by several authors (Lovern et al., 1959; Olley et al., 1965; Rzhavskaya, 1976).

Despite the relatively high content of polyunsaturated fatty acids (20:5 and 22:6) in the salmon ovaries being initiators of the lipid peroxidation (Vladimirov et al, 1972, Kagan et al, 1983), the degree of hydrolytic changes in the lipids during storage of the control and test samples is expressed in a lesser degree. Apparently, the process of freezing stabilizes the lipids of the salmon ovary hindering the processes of its deterioration during storage, which to some extent can be explained by inactivation of salmon ovary lipases at minus 180C.

One of the nutritional value indices of the caviar is the amino acid composition of its proteins.

The results of study on amino acid composition of the salmon ovary proteins showed that they contain the essential amino acids: isoleucine, leucine, lysine, methionine, cystine, phenylalanine, tyrosine, valine and threonine, the total amount of which varies from 35.5g to 37.5g, which is more than 40% of the sum of all amino acids (Table 3).

Table 3. Amino acid composition of proteins of the control and test sample, g/100 g of protein.

Amino acids	Standard FAO/VOZ 1985	Control		Test	
		1 month	9 months	1 months	9 months
Essential					
Isoleucine	2.8	4.47	4.59	5.09	4.95
Leucine	6.6	8.27	8.48	8.97	8.16
Lysine	5.8	6.59	6.79	6.69	6.76
Methionine + cystine	2.5	2.53	2.65	2.56	2.78
Phenylalanine + tyrosine	6.3	4.26	4.52	4.32	4.45
Threonine	3.4	4.07	3.86	4.12	4.01
Valine	3.5	5.46	5.64	5.74	5.65
Tryptophan *	1.1				
Nonessential					
Glutamic acid		9.97	9.98	10.01	10.03
Tyrosine		3.87	3.96	3.79	3.85
Proline		4.91	5.10	4.85	4.98
Alanine		6.64	7.09	6.75	7.02
Glycine		2.38	2.32	2.42	2.45
Serene		4.52	4.85	4.57	4.71
Aspartic acid		9.52	7.11	9.45	8.36
Arginine		4.95	4.80	4.92	4.85
Histidine		2.11	2.16	2.15	2.24
∑ amino acids		84.52	83.9	86.4	85.25
∑ essential amino acids		35.65	36.53	37.49	36.76
% amounts of essential amino acids		43.4	43.5	43.4	43.1

* not determined

The comparison of amino acid composition of proteins of the control and test samples showed that no changes virtually occur in the amino acid composition of proteins. We note some variations in the content of individual essential amino acids, which occur without a noticeable downward trend. These data indicate the stability of the amino acid composition of proteins of the control and test samples.

As it is seen from the provided data the icing process does not affect the change in the fatty acid composition of lipids and amino acid composition of proteins. However, the icing with application of antioxidants inhibits hydrolytic processes during storage of frozen salmon ovary.

NUTRITIVE VALUE OF STERLET CAVIAR FROM OVULATED EGGS

Liliya Kopylenko

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), Moscow
e-mail: llkopylenko@mail.ru

Since mid nineties natural stock of sturgeons has been sharply reduced. Only one possibility to maintain the species is their breeding and keeping under control in aquaculture.