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NUTRITIONAL VALUE OF CAVIAR OF SIBERIAN STURGEON IN UKRAINE

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Aim. The purpose of the work was to study the nutritional value of *Acipenser baerii* siberian sturgeon caviar, grown in aquaculture conditions in the Dnieper reservoirs of Ukraine, and to compare its quality indicators with this one of the products produced abroad.

Methods. There are identified organoleptic properties of siberian sturgeon caviar, and its energetic value, composition of amino acids in albumens and content of fatty acids in lipids of the product. The data obtained in the research were compared with the same indices of quality of caviar of sturgeons bred abroad.

Results. The organoleptic properties of Siberian sturgeon caviar bred in Ukraine (appearance, color, consistency, taste and aroma) conformed to its standardized indices of quality. The caviar contained all eight essential amino acids and belonged to category of products rich by albumen (21.54±2.13%), and fats (13.20±0.93%) eicosapentaenoic and docosahexaenoic ω-3 acids (3.46% and 11.2%, respectively) (13.20±0.93%). The big content of fat, especially of polyunsaturated fatty acids and ω3 acids (the eicosapentaenoic and docosahexaenoic ones — 3.46% and 11.2%, respectively) is one more factor, which enables to identify the siberian sturgeon caviar as the product of high biological value. It was shown that the caviar of siberian sturgeon produced in Ukraine is in close coincidence with those that were produced in other countries.

Conclusions The totality of studied characteristics of caviar of siberian sturgeon produced in Ukraine witnesses its high nutritional value. Therefore this product may be recommended in prophylactics of numerous illnesses and strengthening of state of health.

Key words: Siberian sturgeon caviar; nutritional value; organoleptic properties essential amino acids; fatty acids.

The nutritional value of caviar of hydrobiontes was defined by their unique composition, and balanced content of substances necessary for live organisms in their growing, development and resistivity to influence of negative factors of environment [1–3]. It was shown that composition of metabolites of caviar of sturgeons is three time better of respective characteristics of constitutes of muscles tissue. However the number of sturgeons in wild nature continuously decreases, what called the need of cutting down of norms of their catching, and the Convention on International Trade by Species of Wild Fauna and Flora, Which are Under the Treat of disappearance of 1997 claims to limit volumes of trade by caviar of all of sturgeons [4]. This statement called the need of theoretical substantiation and development of norms of work in sphere of aquaculture, especially development of norms of industrial breeding of sturgeons.

To reach the economic effectiveness of sturgeons breeding, there were developed and introduced in practice the technology of reusable (up to ten times) taking of caviar during the whole reproductive life of sturgeons of 10 and more years [5], as well as optimized the technology of preservation of frozen sperm [6]. The quantity of caviar produced annually by this technology is now of 350-450 tons [7]. The biggest quantity of sturgeons caviar taken in the world belongs to races of siberian sturgeon of A*cipenser baerii* (31% of total volume of production) and russian sturgeon of A*cipenser gueldenstaedtii* (20%).

The nutritional and biological values is now the object of extensive research [2, 3, 8–11].

It was shown that chemical composition and biochemical properties of sturgeon's caviar differed by all indices of quality and depended of climatic conditions of fish breeding, its age and kind of nutrition. The bigger caloricity and biological value have the sturgeons caviar, which live in natural conditions, as compared with those that are bred by men because of their balanced ration [8]. Presently, Ukrainian businessmen actively breed sturgeons too [12]. However, the nutritional and biological values, as well as safety of caviar produced at fish farms is not studied comprehensively [2, 3]. Meantime, the demand for sturgeons caviar as the product of prophylactic and medicinal prescription increases each year because of its delicious taste and richness by biologically active substances — irreplaceable amino acids, ω3 polyunsaturated fatty acids, vitamins, micro- and macroelements. Therefore there exist the crucial need for studying of nutritional value of siberian caviar sturgeon produced in Ukraine in conditions of aquaculture and its comparing with the analogous index of caviar in other conditions of breeding.

Purpose of the work was to studying the organoleptic properties, determination of energetic value and indices of biological value of albuminous and lipidic components of siberian caviar sturgeon bred in conditions of aquaculture in water of Dnieper in Ukraine, as well as comparing of said characteristics with those ones of sturgeons caviar bred abroad.

Materials and Methods

The object of research was siberian caviar sturgeon of A*cipenser baerii* kind. The samples of siberian caviar sturgeon were taken in fish-breeding complex fed by water taken from the Dnieper river. The caviar was taken by method of "Cesarean section" of 9 years old female of siberian sturgeon. The taken samples, was rinsed during 30 seconds to remove grumes, crushed berries and pieces of films by water cooled to 5–10 °C in ratio of caviar and water of 1:2. The rinsed caviar was placed then onto the sieve to remove residues of water, treated 3 minutes by water heated to 60 °C, added 5 % of kitchen salt, mixed carefully, packed into 50 cm^3 glass flakes, and hermetically packed.

The organoleptic properties of the caviar was evaluated by expert commission of 5 persons by norms of standard of DSTU GOST 7442-2004 [13].

The mass parts of lipids and albumens were determined in the specialized laboratory of National University of Life and Environmental Sciences of Ukraine. The content of lipids was determined by the extracting and weighing method of Soxhlet in use of apparatus of "Soxtex SOX 406 Fat Analyzer" ("Hanon Instruments", China). It was taken 20 grams of caviar weighed with precision of ±0.001 g, mixed with 60 g of waterless Na_2SO_4 and carefully grinded in porcelain mortar. The milled mix was put in pack of filter paper, weighed with precision of ±0.001 g, placed in the Soxhlet extractor and treated in it by ethyl ether during 5–6 hours. The pack with deprived of fat material was placed then onto the glass plate for preliminary evaporation of ether and dried finally to constant weight in weighed flask at 100–105 °C. The content of fat in the caviar (on dry substance) was determined by difference of masses of pack before and after extraction in taking into consideration of mass of empty pack.

The content of albumen was determined by Kjeldahl method, which consists in preliminary mineralization of amides contained in the sample at 360–370 °C in digester in form of $(NH_4)_2SO_4$ in presence of concentrated H_2SO_4. To speed up the process, it was added into the mix the catalyst consisted of mix of $CuSO_4$, K_2SO_4 and Se. The content of mineral salt of $(NH_4)_2SO_4$ obtained in this process was determined by titration of resulting solution, and the total quantity of albumens in the sample was recalculated in use of obtained result with coefficient of 6.25.

The content and composition of fatty acids were determined by the method of liquid chromatography in the Palladin Institute of biochemistry of the National Academy of Sciences of Ukraine in use of the instrument of HRGC 5300. The extract of lipids prepared by the method described in article [14] treated as follows. The extract dissolved in benzene, placed into the flask closed by glass cork, and stored at temperature of minus 18 °C. The aliquot of 0.5 cm^3 of extract of lipids placed in glassy ampoule, added 1.5–2.0 cm^3 of 1N solution of HCl on methyl alcohol, sealed the ampoule hermetically and boiled it 50 minutes at water bath. After finishing of heat treatment opened the ampoule added the same volume of water, extracted the organic component by distilled hexane, cleansed by water, and dried by waterless sodium sulfate. The dried extracts were evaporated at rotary evaporator, dissolved the obtained methyl esters of fatty acids in benzene putted the preparation on glassy plates covered by KSK silica gel and evaporated the solvent. The layer of purified esters was taken off the glassy plate and rinsed

by hexane at the No. 4 Shott filter. To obtain pure mix of esters, the residues of solvent were secondly removed out from the preparation at rotary evaporator, dissolved in hexane and analyzed in use of chromatographic columns of 3.5 meters long filled by sorbent of Chromosorb W/HP impregnated by liquid phase of Silar 5CP at chromatograph HRGC 5300 (Italy) at 140–250 °C in rising of temperature in speed of rising of temperature by 2 °C in a minute. Identification of individual fatty acids was carried out in accordance with the standards of Sigma-Aldrich firm. The content of each fatty acid was expressed in dimensionality of percent of its total quantity.

The mass parts of essential amino acids were determined by liquid chromatography at automatic analyzer of T-339 (Czech republic) in Palladin Institute of biochemistry. There was carried out hydrolysis at 110 °C during 24–36 hours of samples of siberian sturgeon caviar of 1–5 milligrams mass mixed with 6 N hydrochloric acid. Identification of individual amino acids was carried out in accordance with the standards of Sigma-Aldrich firm. Determining of content of amino acid of tryptophan was done in Dokuchayev Kharkov national university using GOST 13496.21-2015 standard method [15].

The content of table salt was found by the method of [16]. 10 grams of milled Sturgeon caviar was placed into 100 cm^3 volumetric flask, and added to it 75 cm^3 of water, stirred the mix and heat at water bath at 80 °C during 30 minutes and cooled it at periodical stirring to room temperature. Then there was added water into the flask to the mark, mixed the solution and filtered it through the paper filter. The final operation was adding to 20 cm^3 of filtrate of 1 cm^3 of solution of $KMnO_4$ and titration of resulting solution by 0.1 N solution of $AgNO_3$ till reaching by it of nonvanishing coloration. The mass part of sodium chloride was calculated by known formula.

Results and Discussion

The organoleptic properties of siberian caviar sturgeon bred in Ukraine conform to norms of DSTU 7442-2004 standard [13] (Table 1).

It could be seen from the Table 1 that all indices of quality of caviar bred in Ukraine conform to norms of DSTU 7442-2004 standard "Grain sturgeon caviar. Specifications".

The chemical composition and energetic value of siberian caviar sturgeon compared with those ones of caviar produced abroad are given in Table 2.

The energetic value of Ukrainian caviar of 210.94 ccal/100 g differs of this parameter of caviar produced in other counties. The biggest caloricity of 271.45 ccal/100 g has the sturgeon caviar of *A. gueldenstaedti* from Rumanian [8], and the lowest — of 202.94 ccal/100 g — the caviar of *A. baerii* from of French. According to the protein content (from 21.54±2.13 to 29.32±0.92 g/100 g), sturgeon caviar species belongs to high-protein and high-fat products [17].

The biological value of albuminous component of the product is determined by correspondence of their parameters of quality and quantities of essential amino acids to norms of FAO/WHO standard of ideal albumen [18], and recommendations of the European Food Safety Authority (EFSA) [19]. Results of evaluation of conformity of quality of sturgeons caviar produced in different countries to recommended FAO/WHO parameters are given in Table 3.

It is clear that albumen of caviar produced in Ukraine contains all essential amino acids, which contents sum is sufficiently bigger of recommended by FAO/WHO level, and of quantities that meets human needs: 43.90±0.50% as compared with 36.00% and 26.20%, correspondingly. At the same time the content of essential amino acids in caviar of

Table 1

Results of evaluation of conformity of organoleptic properties of siberian caviar sturgeon bred in Ukraine to norms of standard of DSTU 7442-2004

Index	Norms of DSTU 7442-2004	Characteristic
Appearance	Uniform size and shape	Conforms
Color	Uniform, proper to caviar of this kind fish, varies from light grey to gray	Conforms
Consistency and state	Grains are safe and separate one of other	Conforms
Aroma and taste	Proper to caviar of this kind fish. Absence of foreign smell and flavor	Conforms
Mass of table salt, %	2.5–5.0	3.60
Presence of foreign particles	Absence	Absent

Table 2

The characteristics of chemical composition and energetic value of caviar of sturgeons produced in Ukraine and abroad

Object	Content, g/100 g of the product		Energetic value, ccal/100 g
	albumen	fat	
A. baerii, (Ukraine)*	21. 54±2.13	13.20±0.93	210.94
A. ruthenus, (Korea) [9]	25.43	13.21	220.61
A. baerii, (France) [9]	26.21±1.14	10.90±0.07	202.94
A. gueldenstaedti, (Romania) [9]	29.32±0.92	17.13±0.76	271.45
A. baerii, (China) [10]	23.98±0.78	14.23±0.71	223.99

* — results of own investigation

Table 3

The content of essential amino acids in sturgeon siberian caviar produced in Ukraine and abroad (g/100 g of albumen) and their correspondence to parameters of ideal albumen

Amino acid	Race of sturgeon			Ideal albumen parameter [18]	EFSA recommended content [18]
	A. baerii, Ukraine *	*A. baerii*, China [11]	*A. baerii*, Korea [10]		
Valine	4.28±0.95	2.95±0.06	5.7	5.00	3.90
Isoleucinele	3.92±0.05	2.62±0.07	5.5	4.00	3.00
Leucine	8.52±0.23	4.57±0.11	9.6	7.00	5.90
Lysine	8.04±0.54	4.43±0.14	11.3	5.50	4.50
Metphionine + Cysteine	4.88±0.89	2.57±0.26	6.0	3.50	2.20
Threonine	5.44±0.32	2.58±0.12	3.9	4.00	2.30
Phenylalanine + Tyrosine	7.76±0.97	4.18±0.08	16.80	6.00	3.80
Tryptophan	1.06±0.09	0.49±0.03	-	1.00	0.60
In total	43.90±0.50	24.39±0.09	58.8	36.00	26.20

* — results of own investigation.

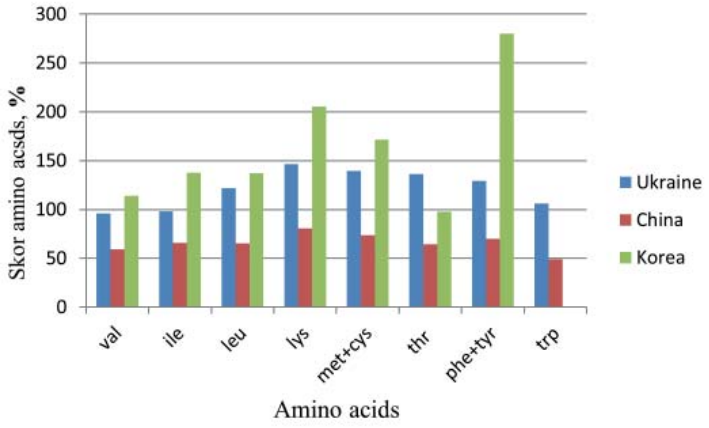

Fig. **Scores of essential amino acids in roes of siberian sturgeons bred in Ukraine and abroad**

this race sturgeon is the least in sturgeons bred in China (24.39±0.09%) and the biggest — in Korea (58.8%).

The analysis of scores of essential amino acids in roes produced in said countries is given in Figure.

The results we obtained show that the albumen of siberian sturgeon bred in Ukraine has two limiting amino acids, namely valine and isoleucine, which score is 96 % and 98%, respectively. At the same time, all irreversible amine acids contained in caviar produced in China are of limiting character, and the Korean caviar contains only treonine as the limiting one. At the same time, albumen of siberain sturgeon caviar produced in Ukraine contains all essential amino acids in quantities that are bigger of those ones recommended by the European Food Safety Authority [19].

The composition of lipids in analyzed samples of siberian sturgeon caviar, is represented by saturated (26.19%), monounsaturated (34.05%), and polyunsaturated (38.92%) fatty acids (Table 4).

The quota of saturated fatty acids in lipids recommended by FAO/WHO is 20.00 %, what

Table 4

The content of fatty acids in Siberian sturgeon roes produced in Ukraine and abroad (% of their total quantity)

Code of the acid	Place of breeding of a sturgeon				Recommended quantity [18]
	Ukraine*	Korea [8]	China [9]	France [7]	
1	2	3	4	5	6
Saturated fatty acids					
14:0	0.66	1.59	0.86	–	–
15:0	0.17	0.29	0.15	–	–
16:0	16.19	22.46	20.80	–	–
17:0	0.40	0.44	0.11	–	–
18:0	3.82	0.19	2.82	–	–
20:0	0.69	0.22–	–	–	–
21:0	3.27	–	–	–	–
22:0	0.84	0.41	–	–	–
22:3	–	1.82	–	–	–
24:0	0.15	–	–	–	–
In total	26.19	27.42	24.74	–	20.00
Monounsaturated fatty acids					
16:1ω7	5.81	7.51	4.39	–	–
17:1	0.39	0.81	0.16	–	–
18:1 ω9	23.59	33.67	33.19	32.9±3.2	–
20:1 ω7	3.83	1.15	–	–	–
20:1 ω9	–	–	1.19	–	–
In total	34.05	43.14	38.93	–	35.00
Polyunsaturated fatty acids					
18:2 ω6	11.65	10.19	13.13	5.4±0.1	–
18:2 ω7	1.71	–	–	–	–
18:3 ω3	1.99	0.85	–	–	–
18:3 ω6	–	–	1.31	–	–
20:2 ω9	1.46	0.26	–	–	–
20:2 ω6	–	–	0.25	–	–
20:3 ω6	1.68	0.40	0.31	–	–
20:4 ω6	4.91	–	1.66	1.1±0.4	–

Table 4 (End)

1	2	3	4	5	6
20:5 ω3	3.46	4.69	4.63	4.9±1.1	–
22:2	0.01	–	0.34	–	–
22:3	0.07	–	–	–	–
22:5 ω3	0.61	1.83	1.21	–	–
22:6 ω3	11.20	11.39	12.78	13.1±2.6	–
In total	38.92	29.66	35.62	–	6.00
The sum of ω6 fatty acids	18.24	10.59	16.66	7.4±0.8	–
The sum of ω3 fatty acids	17.26	17.91	18.62	20.7±5.2	–
The ω6:ω3 ratio [18]	1.05 : 1.00	1.00 : 1.69	1.00 : 1. 14	1.00:3.98	10 : 1-5

* — results of own investigation.

is less of their real content in siberian caviar sturgeon bred in different world regions (24.74% to 27.42%). The most abundant in this group acids is the 16:0 palmitic one. However, its minimal content in the caviar produced in Ukraine is of 16.19%, what is less of respective parameter in caviar produced in China (20.80 %), and Korea (22.46 %).

The quota of monounsaturated fatty acids in the siberian sturgeon caviar produced in all studied cases differs of its recommended value (35.00 %) and constitutes 34.05 % in Ukrainian, 38.93 % in Chinese, and 43.14 % in Korean products. The most abundant one in this group of acids is irreplaceable ω9 oleic acid, which physiological value consists in regulation of variations of composition of cell membranes, activity of receptors on their surfaces, and normalization of metabolic processes [21].

The quota of polyunsaturated fatty acids in analyzed caviar is sufficiently greater of recommended FAO/WHO value (6.0%), and is of 38.92 % for Ukraine, 29.61% for Korea, and 35.62 % for China.

The last time valuable parameter is the ratio of ω3:ω6 fatty acids, and as it was shown in this investigation, the quantity of polyunsaturated fatty acids of ω3 group in the caviar produced in Ukraine is of 17.26 %, what is less of respective value for Korea (17.91%), and China (18.62 %). It was found that their ratio optimal in support of normal state of organism is about of 1.0 : 1–5 [20]. At the same time it was shown (Table 4) that the real ratio of such acids is too less for all kinds of studied Siberian surgeon caviar (1.05:1.00; 1.00:1.69 and 1.00:1.14 for Ukraine, China and Korea, respectively), what witnesses that the real content of ω3 in these caviar lipids is too bigger of recommended parameter.

It was shown also that the men's ration is too scarce by essential docosahexaenoic (22:6 ω3) and eicosapentaenoic (22:5 ω3) fatty acids critically necessary in normalization of metabolism of lipids in the organism as substances that support the immune system in normal state, assist in medical treating of cancer, and treating of cardiovascular diseases [21]. Nevertheless, lipids of all studied siberian sturgeon caviar are rich by ω3 and ω6 fatty acids, so are too valuable from the viewpoint of their biological activity.

The siberian sturgeon caviar of *A. baerii* produced kind in the Dnieper river water in borders of Kyiv region by indices of appearance, color, consistency, taste and aroma conforms to norms of the national standard [13].

It was found that the energetic value of siberian caviar sturgeon bred in Ukraine and other countries differs of this one of sturgeon caviar bred in nature [8]. The caviar obtained in natural conditions contained 31.10% of albumens and 19.40% of fat, what gave in sum 299.0 ccal/100 g [8]. At the same time the energetic value of caviar produced in Ukraine was 210.94 ccal/100 g, and reached the maximum value of 271.45 for caviar bred industrially in the product bred in Rumania [8]. Such differences may be explained as consequence of influence of numerous factors, especially age of female sturgeons, type and quality of forage, and quality of water in places of their breeding

The caviar relates to category of products rich by albumens and fat, what conforms

the results we obtained previously [2, 3]. As compared with the FAO/WHO and European commission by food safety recommendations, the siberian caviar sturgeon from Ukraine contains more albumens – 43.0 against of 36.0 and 26.2% correspondingly [18]. However, the albumen of caviar produced in Ukraine is character by insufficient quantities of essential valine and isoleucine as compared with content of ideal albumen. It differs its content of composition of albumen of caviar from Chinese deficit by all irreplaceable amino acids, and Korean one, where all essential amino acids are present in quantities character for ideal albumen [10].

However composition of ideal albumen is the conventional characteristic of albuminous component of foodstuffs. So this characteristic is often by notion of "adequate" and "maximally permissible" contents of essential amino acids in albumens capable to satisfy in its consumption optimal conditions of biosynthesis of albumens in the organism [19]. Taking this notion into consideration, one may affirm that content of all essential amino acids in siberian sturgeon caviar produced in Ukraine is bigger of recommended levels [19], what permits to consider it as the biologically valuable capable to ensure proper conditions synthesis of albumen in the human body. It [s seen in use of these criteria that albumen of caviar produced in Ukraine contains the limiting amino acids as well (valine 2.95% against of normalized content of 3.9%, isoleucine — 2.62% and 3.00%, leucine 4.57% and 5.90%, lysine 4.43% and 4.50%, and threonine 0.49% and 0.60%). At the same time it is clear that albumen of caviar produced in Korea satisfies to all norms established by the European Food Safety Authority.

The amino acids obtained by organism with foods were classified until the very recent times as essential and replaceable ones. The key element in this classification was supposition that the men's organism is capable to synthesize all essential amino acids in quantities capable to satisfy its needs in synthesis of own albumens only [22, 23], in ignoring of their regulatory functions. Meantime the set of data obtained last time enable to formulate new conception of role of functional amino acids in regulation of key metabolic processes directed on bettering of state of health, surviving, development and reproduction of live organisms. Therefore, the concept of "ideal albumen" has to be amended from viewpoint of taking into consideration of content in albumen of both type amino acids.

The lipids contained in siberian caviar sturgeon ensure more of half of its energy value independently of conditions of breeding of sturgeons. The dominating part of fatty acids in lipids of siberian caviar sturgeon, same as in lipids of other types of organisms, which live in water, belongs to long-chain (more of C_{20}) substances. The distinctive feature of lipids of siberian caviar sturgeon is its richness by palmitic acid (16.19–22.46%) active in regulation of physical properties of cell' membranes and state of skin, as well as means of prophylactics of metabolic syndrome. The approved norm of its consumption is about of 10 % of general caloricity of foods [20]. So lipids of siberian caviar sturgeon are one of known sources of consumption of palmitic acid.

The big part of monounsaturated acids contained in siberian caviar sturgeon constitutes oleic acid C 18:1ω9 (23.59–33.67%), which physiological role in men's organisms consists in regulation of composition of cell membranes, activity of their receptors, and normalization of metabolic processes [24].

The lipids of siberian caviar sturgeon are the source of long-chain essential ω3 and ω6 eicosapentaenoic, and docosahexaenoic fatty acids, which play the key role in normalization of metabolism of lipids, optimization of functioning of cardiovascular and immune systems, as well as decreasing of probability of beginnings of cancer [25–27]. The results of our research agree with the data obtained in earlier studying of composition of lipids of organisms, which live in water and witness their big biological value.

There exist differences in chemical composition, content of amino acids in albumens, and content of lipids of siberian caviar sturgeon produced in different countries, what may be explained, probably, by differences in age of female sturgeons, climatic conditions of their breeding, and type of feeding.

Conclusions

It was studied the nutritional and energetic values, composition and indices of quality of siberian caviar sturgeon of *Acipenser baerii* kind bred in Dnieper water in borders of Kyiv province. The comparative analysis of content in it of essential amino acids and fatty acids showed only minor differences of these parameters of the same of caviar produced in other countries. The principal conclusion made in it is those that the siberian caviar sturgeon bred in Ukraine is the valuable

foodstuff, which can be recommended for the prevention of many diseases and health promotion. The results obtained in this work are important in progress of trade by this product internationally and confirming of its competitiveness with analogous products produced abroad.

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ХАРЧОВА ЦІННІСТЬ ІКРИ СИБІРСЬКОГО ОСЕТРА ЗА УМОВ АКВАКУЛЬТУРИ УКРАЇНИ

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Мета. Дослідити харчову цінність ікри сибірського осетра *Acipenser baerii*, вирощеного за умов аквакультури України, та порівняти отримані результати з даними літератури щодо виробництва цієї продукції в аквакультурі інших країн.

Методи. Використано органолептична оцінка якості ікри, визначено загальний хімічний склад та енергетичну цінність, склад незамінних амінокислот протеїну та жирнокислотний склад ліпідів ікри сибірського осетра за умов аквакультури України. Проведено порівняне результатів досліджень з даними джерел літератури цих показників ікри осетрових за умов інших країн.

Результати. Органолептичні показники ікри сибірського осетра, вирощеного з виведеної в умовах аквакультури в Україні (зовнішній вигляд, колір, консистенція, смак і аромат), відповідали її стандартизованим показникам якості. Ікра містила всі вісім незамінних амінокислот і належала до категорії продуктів, багатих протеїном (21,54±2,13%), а також жирами ейкозапентаєновою та докозагексаєновою ω3–кислотами (3,46 та 11,2% відповідно) (13,20±0,93%). Великий вміст жиру, особливо поліненасичених жирних кислот та ω3 кислот є ще одним фактором, що дозволяє ідентифікувати ікру сибірського осетра як продукт високої біологічної цінності. Показано, що вироблена в Україні ікра сибірського осетра дуже збігається з ікрою, виробленою в інших країнах.

Висновки. Сукупність досліджених характеристик в умовах аквакультури України ікри сибірського осетра свідчить про її високу харчову цінність. Тому цей продукт можна рекомендувати для профілактики багатьох захворювань і зміцнення самопочуття.

Ключові слова: ікра сибірського осетра; харчова цінність; органолептичні властивості; незамінні амінокислоти; жирні кислоти.