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Biochemical Composition of Artemia Cysts Used as Food for Juvenile Fish from Different Hypersaline Lakes of the Altai Territory

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Abstract

Artemia it is widely used as a launching feedstuff for the cultivation of fish larvae and Crustaceans. We studied the biochemical composition of cysts from different hyperhaline [do mean hypersaline] reservoirs, small lakes (Dushnoe, Malinovoe) as well as in the large Bolshoe and Maloe Jarovoe lakes, Kulundinsky, district located in the territory of Western Siberia in the Altai region. The relative quantitative analysis of interchangeable and essential amino acids, fatty acid contents, mineral substances and vitamins was carried out. Nonessential amino acids were dominant in most of the cysts from lake Maloe Jarovoe and Dushnoe. In lake Dushnoe, Bolshoe Jarovoe and Kulundinsky, lysine was the dominant amino acid.The dimension of lakes and their salinity authentically did not influence the composition of amino acids in the cysts.

Keywords: cysts, hypersaline lake, live feed, biochemical composition, amino acids, fatty acids

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INTRODUCTION

In South Western Siberia, Altai region, a number of hyperhaline lakes are located (Vesnina 2015). These produce cysts of the brine shrimp *Artemia salina* (?) that are an excellent food for a wide range of marine and freshwater organisms (Abatzopoulos et al. 2013, Alikin et al. 2016, Han et al. 2000). Aquaculture farms are always in need of quality starter feeds (Gerasimov 2003, Lavens and Sorgeloos 2000, Moiseenko 2013, Seenivasan et al. 2012). Sturgeon and other valuable fish, together with some crustaceans require live feed at the early stages of their life. Essential amino acids, fatty acids and vitamins that are essential for the development of these organisms are not found in sufficient amounts in commercial feeds (Vasudevan 2012) while the biochemical composition of the artemia cysts matches the high-quality of starter feeds aquaculture needs while organisms. artemia cysts contain a number of essential and nonessential amino acids in that are necessary for larval and juvenile fish in their early stages of development.

My review of this article was discontinued at this point because of the poor English text and syntax. The authors should note that it is not the reviewer's task to correct these but only assess the scistific values of articles.

Starting feed for fish to satisfy needs of juveniles primarily in unsaturated fatty acids. For example, in the feed for salmon species must be present in unsaturated fatty acids - linoleic and linolenic (Alikin et al. 2016, Moiseenko 2013).

Minerals for life of fish is essential in small amounts, but some physiological processes can occur only in their presence. Artemia cysts contain these elements and can Fund the required need for these substances (Alikin et al. 2016, Gerasimov 2003).

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Table 1. Geographic coordinates of lakes, which is located in the southern zone of the West Siberian Plain (Russia)

Lake	Geographical coordinates	Area, km²	Mineralization (medium-long-term), g / l	Class / group
Large Jrovoe	52°50´N-78°41´E	65	162,1	chloride class of the sodium group
Little Jrovoe	53°04´N-79°10´E	35,2	228,2	chloride class of the sodium group
Kulundinskoe	53°10´N-79°30´E	720	111,5	chloride-sulfate class of the sodium group
Malinovoe (Raspberry)	51°44´N-79°44´E	11,4	240,0	chloride class of the sodium group
Dushnoe (Sultry)	52°53´N-81°01´E	1,4	110,0	chloride class of the sodium group

The content of vitamins in the feed increases its value. In fish, the lack of vitamins can disrupt metabolism (Han et al., 2000). The value of Artemia cysts Soto that their composition is retinol (A) and tocopherol (E).

On hypersaline lakes of the Altai territory are monitored Altai branch of Gosrybcenter for 45 years (Seenivasan et al. 2012, Vesnina 2015)13. We have made assessment of the biochemical composition of Artemia cysts of different types hypersaline lakes of the Altai territory.

MATERIALS AND METHODS

The material was samples of Artemia cysts hyperhaline small lakes of the Altai territory (the lake Dushnoe, the lake Malinovoe), and also large lakes Bolshoe Jarovoe, Maloe Jarovoe and Kulundinsky served. Lakes are located in the southern zone of the West Siberian Plain (Russia).

Geographic coordinates of lakes in **Table 1**.

The salinity level ranges from 100 to 160 g / l, an average of 162.1 g / l (**Table 1**). Oz. Big Jrovoe- water chloride-sulphate-sodium-magnesium, is a brine, the mineralization is more than 100 ‰. The brine is colorless, odorless, bitter-salty, and characterized by a high bromine content - up to 325 mg / l. The composition of the brine also includes elements of sodium, chlorine, magnesium, a small amount of calcium, lead, copper, zinc, cadmium. Up to 110-120 g / l. A small Jrovoe chloride-sulphate-sodium lake with a salinity level of 110 -240 g / l and Kulundinskoe. In small lakes Dushnoe (Sugnoye) and Malinovoe (Raspberry) this indicator is - 110 and 240 mg / l, respectively. In the turnip of Lake Malinovoe, the level of potassium is higher than in other lakes.

Cysts have been prepared in September-October, 2012-2016 exsiccated to an air-dry state. For study of biological chemistry of artemia cysts the most important parametres which presence is the requirement shown highly valued to live feed have been chosen. To these parametres concerns: water, dry matter, composition of amino acids, fatty acids, vitamins, mineral substances.

Preparation of samples for analysis was carried out as follows: samples were dried at 65 ° C to determine initial moisture, then dried at 105 ° C to determine hygroscopic moisture, thus determining the total moisture content of the sample. Sample **Table 1** Characteristics of lakes milled using laboratory mills. The prepared sample was placed in a cuvette and placed in the receiving chamber of the device. The device provides data on the contents of individual components in an air-dry state. By calculation, using the original moisture, we calculate the chemical composition for natural moisture.

The data was statistically processed using the Microsoft Excel 2010 software package.

RESULTS

In the study, all the test samples were identified contents as replaceable and essential amino acids. Of all the investigated essential amino acids marked the most content of Proline: to 4.59% and 4.51% in samples from lakes (**Table 2**) The cysts from the Dushnoe lake had the highest content of essential (serine – 1.92%; glycine – 2.04%) and non-essential amino acids (arginine of 2.84%; lysine – 4.43%).

The greatest number of lysine was in the samples of Lake Dushnoe (4.43%), Bolshoe Jarovoe (4.28 %) and Kulundinsky (to 4.01%).

In general, reliable minor differences in amino acid content were available for 6 amino acids: asparagine, serine, tyrosine, leucine, isoleucine, and arginine.

Table 2. The content and composition of amino acids (%) of Artemia cysts

Index	Lakes						
	small			big			
	Dushnoe	Malinovoe	M±m	Bolshoe Jarovoe	Maloe Jarovoe	Kulundinsky	M±m
Essential amino acids:							
Aspartic	4.08 ± 0.01	4.00	4.06 ± 0.02	3.95	3.81 ± 0.12	3.83	**3.81** ± 0.01
Serine	1.92 ± 0.02	1.92	1.4 ± 0.29	1.85	1.79 ± 0.02	1.78	**1.79** ± 0.01
Glutamic acid	4.38 ± 0.03	3.47	4.16 ± 0.23	5.01	4.36 ± 0.04	4.56	4.36 ± 0.02
Proline	4.51 ± 0.07	4.23	4.44 ± 0.07	4.46	4.59 ± 0.02	4.44	4.59 ± 0.01
Glycine	2.04 ± 0.04	1.3	1.86 ± 0.19	1.94	1.9 ± 0.01	2.01	1.9 ± 0.00
Alanine	2.36 ± 0.03	1.3	2.08 ± 0.26	1.76	2.2 ± 0.02	1.98	2.2 ± 0.01
Tyrosine	1.53 ± 0.03	1.6	1.55 ± 0.02	1.85	1.34 ± 0.03	2.15	1.34 ± 0.01
Nonessential amino acids:							
Threonine	1.85 ± 0.04	1.84	1.85 ± 0.01	2.38±0.0.3	1.74 ± 0.03	2.1±0.01	1.97 ± 0.13
Valine	2.23 ± 0.02	1.06	1.86 ± 0.19		2.11 ± 0.01		2.11 ± 0.004
Methionine +cystein	2.05 ± 0.02	1.17	1.83 ± 0.22	2.43±0.02	1.9 ± 0.01	2.09±0.02	2.05 ± 0.1
Leucine	3.12 ± 0.03	3.98	3.34 ± 0.21		2.6 ± 0.03		2.6 ± 0.02
Isoleucine	1.6 ± 0.01	1.62	1.6 ± 0.01		1.5 ± 0.02		1.5 ± 0.01
Phenyl alanine	2.54 ± 0.02	0.8	2.1 ± 0.43		2.34 ± 0.03		2.34 ± 0.01
Histidine	2.39 ± 0.03	-	2.39 ± 0.01		2.22 ± 0.02		2.22 ± 0.01
Lysine	4.43 ± 0.03	3.18	4.13 ± 0.32	4.28±0.03	3.76 ± 0.04	4.01±0.03	3.93 ± 0.01
Arginine	2.84 ± 0.01	2.85	2.84 ± 0.01		2.71 ± 0.03		2.71 ± 0.01
Indole amino-propionic acid	0.67 ± 0.01	0.4	0.6 ± 0.07		0.63 ± 0.03		0.63 ± 0.01

Table 3. Content of nonessential amino acids (%) of cysts Artemia sp.

Index	Small lake		big lake		
	Dushnoe	Dushnoe	Bolshoe Jarovoe	Maloe Jarovoe	Kulundinsky
Oleinic	1,61	0,42	1,50	1,23	1,40
Linolic	0,62	0,85	0,45	0,93	0,11
Linolenic	0,06	1,8	0,07	0,07	0,06

Study of nonessential amino acids has been made on three components: to oleinic, linolic and linolenic acids (**Table 3**).

During research it is positioned that oleinic acid in the greatest quantity contains in samples from Lake Dushnoe (1.61 %), linolic of the lake Bolshoe Jarovoe (0.93 %), linolenic in samples Malinovoe and compound 1.8 % of the lake accordingly.

In samples of Lake Kulundinsky installed a higher content of calcium (of 7.43%), copper (1.88%) and zinc (13.1 percent) than in cysts of other lakes. Phosphorus in its greatest quantity contains in samples of Lake Maloe Jarovoe – 6.9%; manganese in samples of the lake is a Maloe Jarovoe and Dushnoe and is about 3.79% and 3.93% respectively. Vitamins E and B_1 in all the examined samples the amount of vitamin E varies in the limit of 0.1-0.117 mg%, B_1 – 0.173 – of 2.06 mg%

Table 4. The content of mineral substances and vitamins in Artemia cysts

Index	Lakes				
	Maloe Jarovoe	Dushnoe	Malinovoe	Bolshoe Jarovoe	Kulundinsky
Phosphorus, %	6,9	5,0	2,2	1,74	1,76
Calcium, %	3,3	2,8	4	6,9	7,43
Copper, mg%	1,93	1,85	1,64	1,71	1,88
Zinc, mg%	11,1	10,3	11,5	10,2	13,1
Manganese, mg%	3,79	3,93	3,48	3,34	3,25
Cobalt, mg%	0,17	0,14	0,18	0,16	0,14
Vitamin E, mg%	0,112	0,117	0,101	0,100	0,108
Vitamin B_1, mg%	0,187	0,206	0,173	0,175	0,206
Vitamin B_3, mg%	1,55	1,03	1,85	2,60	1,71
Vitamin B_{12}, ág%	3,50	3,50	3,50	3,50	3,58

(tab.4). The amount of B_{12} in all samples equally 3.5 - 3.58 mg%.

DISCUSSIONS

In the postembryonic period of development of the juvenile fish, it is necessary to provide a full and balanced diet. This is most often achieved by using decapsulated artemia cysts or disappeared nauplii as feed (Abatzopoulos et al. 2013, Moorhead and Zeng 2017, Sura and Belovsky 2016).

Cysts were harvested in small lakes - Sultry, Crimson, and in large - Large and Small Spring, Kulunda. These lakes have different salinity values and differ in chemical composition. The study of the biochemical composition of artemia cysts on the number of interchangeable and essential amino acids, fatty acids, minerals and vitamins did not reveal significant differences. In the samples studied, the substitutable amino acids were larger in the cysts from Lake Maloe Jarovoye and Dushnoe. Among the essential amino acids, the greatest amount of lysine was found in the samples from the Dushnoye Lakes (4.43%), Big Spring (4.28%) and Kulunda (4.01%). Cysts from Lake Sushne have the largest content of substitutes (serine - 1.92%, glycine - 2.04%, proline - 4.51%) and essential amino acids (methionine - 2.23%, lysine - 4.44%), t .e. are a more complete starting feed. Perhaps this is due to the increased content of potassium in the brine of this lake.

Unsaturated fatty acids play a huge role in the metabolism of fish (Libralato, 2014). The comparative analysis revealed that the oleic fatty acid in the largest amount is contained in the samples of Lake Dushnoye (1.61%), linoleic lakes Bolshoy Jarovoye (0.93%), linolenic in the samples of Lake Malinovoe and is 1.8%.

The study of mineral composition and vitamins showed that in the samples from Lake Kulunda maximum content: calcium (7.43%), copper (1.88%) and zinc (13.1%). Phosphorus in its greatest quantity is

contained in the samples of Lake Maloe Jarovoye - 6.9%; Manganese in the samples of Lake Maloe Jarovoye and Dushnoe - 3.79% and 3.93% respectively. The vitamin E content ranges between 0.1-0.117 mg% and B_1 in all test samples of 0.173 - 2.06 mg%. The amount of B12 in all samples is the same 3.5 - 3.58 mg%.

We have not established a correlation between the total salt composition of lakes and the biochemical composition of Artemia cysts.

The study of the biochemical composition of artemia cysts collected in the lakes of the Altai Territory showed that they are a biologically valuable food for fish and other aquaculture objects. They can be used to grow fish (sturgeon, carp, herbivorous and crustaceans) in the first stages of postembryonal development in many farms in Russia and a number of adjacent countries (China, Vietnam, Thailand, Turkey).

In the course of the study, it was found in the studied samples of essential amino acids most often in the cysts from Lake Maloe Yarovoe and Dushnoe. The highest values among essential amino acids is lysine in samples of Lake Dushnoe (4.43%), Big spring (4.28 %) and salted (to 4.01%). The cysts from the lake is Sweltering have the highest content interchangeable (serine – 1.92%; glycine – 2.04%; Proline – 4.51%) and essential amino acids (methionine, at 2.23%; lysine – 4.44%). However, the size of the lakes and the salinity did not significantly affect the amino acid composition of Artemia.

Oleinic fatty acid in the greatest quantity contains in samples of Lake Dushnoe (1.61 %), linolic lakes Bolshoe Jarovoe (0.93 %), linolenic in samples of Lake Malinovoe and compound 1.8 % accordingly.

In samples of Lake Kulunda installed a higher content of calcium (of 7.43%), copper (1.88%) and zinc (13.1 %). Phosphorus in the greatest quantity contains in samples of Lake Maloe Jarovoe – 6.9%; manganese in samples of Lake Maloe Jarovoe and Dushnoe also compounds 3.79% and 3.93% respectively. 4. The content of vitamin E varies in the limit of 0.1-0.117 mg% and B_1 all the test samples 0.173 is 2.06 mg%. The amount of B_{12} in all samples equally 3.5 - 3.58 mg%.

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