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Nutritional and Biological Value of Siberian whitefish (CoregonussardinellaValenciennes) in the Republic of Sakha (Yakutia)

ABSTRACT

The article presents results of studies of nutritional and biological value of the Siberian Indigirka population whitefish of autumn-winter catchof the Republic Sakha (Yakutia). It is found that by the number of protein the Siberian whitefish refers to average protein, and by fat content – to particularly fatty types of fish and high-caloric foods.

Keywords: Siberian whitefish, nutritional and biological value, Yakutia.

INTRODUCTION

The Siberian whitefish in the rivers of Yakutia conducting semi-anadromous life can be found in all the rivers flowing into the Laptev Sea (Anabar River, Olenek), the East Siberian Sea (Lena River, Yana, Indigirka, Kolyma). For feeding period it uses shelves of the rivers. In the fourth year of life reaches sexual maturity. First spawning run occurs in July-August, the second - in September and October months. Fishing for whitefish starts from age 4 + to 9 + years, the size of the fishing whitefish length is from 220 to 360 mm, weight 150 to 330 g [5].

The Siberian whitefish in the Republic of Sakha (Yakutia) is one of the main commercial fish; its stocks are in satisfactory condition (Table. 1) [5].

Table 1

The main indicators of whitefish in the river basins of the Sakha Republic

Year	In the Republic of Sakha (Yakutia)	The basins of major rivers				
		The Anabar	The Lena	The Yana	The Indigirka	The Kolyma
1990	2200.7	6.0	385.3	-	587.4	1141.5
1994	461.7	5.5	246.7	110.5	25.7	79.4
2000	876.5	13.5	183.6	247.4	155.3	276.7

Nutritional and biological value of the Siberian whitefish in Yakutia is studied a little. For example, some studies of the chemical composition including mineral content were investigated [1. 8. 5].

Considering the fact that the Siberian whitefish in a diet of theYakuts is one of the first places we have to develop advanced technologies for production of fish products from whitefish goal - to explore the food and biological value of the Siberian whitefish.

METHODS AND MATERIALS

For the research we selected autumn-winter fish of Indigirka population of the Republic of Sakha (Yakutia) for 2013, frozen at a temperature not higher than -30 °C in a modular unit for freezing products (MUZ 07-10) and then stored in glaciers and freezers at a temperature not higher than -15 °C.

For the analysis of samples 3 fish samples were selected for fillets and belly division prepared according to standard GOST procedures 31339-2006 "Fish and non-fish objects and products. Acceptance rules and methods of sampling".

Nutritional and biological value was determined by results of the study of the biochemical composition by infrared spectroscopy on the infrared analyzer SpectraStar (model 2200, “Unity Scientific USA” firm), calibrated on the basis of generally accepted standard chemical methods in the laboratory processing of agricultural products and biochemistry analysis of the Yakut Scientific Research Institute of Agriculture.

Amino-acid scorewas calculated by the formula: (mg AA per 1 g test protein)/(mg AA per 1 g protein of the ideal x 100) [6].

RESULTS AND RESEARCH

Morphological composition. Live weight averaged 366.8±11.00 g, 202.3±5.40 g of fillet weight (55.13%), waste of 164.50±2.70 g (44.97%), 20.4±1.10 g (12.4%) viscera, 32.0±2.10 g (19.5%) head, 48.4±3.00 g (29.4%) fins, scales 21.7±1.60 g (13.2%), skin 19.7±1.50 g (12.0%), bones 22.2±1.80 g (13.5%).

Chemical composition and energy value. Chemical composition and energy value was determined on the basis of the study of the biochemical composition. The result of studies (Table. 2) fillet and belly of Siberian whitefish on the amount of protein refers to average protein (10-15%). Thus, the protein content in the fillet was 15.37 ± 0.007, in belly 14.88 ± 0.004%. By fat content in belly (25.25 ± 0.049%) whitefish is particularly fatty types of fish (more than 15%). As a result of the high content of protein and fat whitefish refers to high-calorie food (200-300 kcal).

Table 2

Chemical composition and energy value of whitefish fillets and bellies, wet weight

Indicators	Unitofmeasure	Quantity	
		In fillet	In belly
Water	%	74.61±0.015	80.25±0.049
Proteins	- «» -	15.37±0.007	14.88±0.044
Fats	- «» -	9.08±0.010	25.25±0.049
Ash	- «» -	2.37±0.003	0.78±0.001
Energy value	kcal/100 g	143	286

The content of macro-and micronutrients.Research results and their analysis showed that the highest content of macro-and micronutrients was observed in bellies (Table. 3).

The content of heavy metals in the fillet does not exceed the maximum permissible concentration (MPC), and in belly plumbum content is of 0.7 times, 0.5 times hydrargyrum, cadmium 0.1 times more the maximum permissible concentration (Table. 3).

Exceeding the maximum permissible concentrations of heavy metals may depend on their propagation in the environment, including in water bodies.

Table 3

The content of macro-and micronutrients in the whitefish fillets and belly, wet weight

Indicators	Unit of measure	Quantity	
		In fillet	In belly
Macronutrients			
Calcium	mg/100 g	37.38±0.036	49.73±0.207
Phosphorus	- «» -	198.07±0.113	236.65±0.647
Magnesium	- «» -	43.40±0.036	55.36±0.199
Potassium	- «» -	223.55±0.083	252.49±0.484
Micronutrients			
Fe	mg/100 g	13.49±0.012	18.61±0.088
Mn	- «» -	0.79±0.002	0.98±0.003
Zn	- «» -	14.24±0.015	19.45±0.088
Cu	- «» -	0.35±0.001	0.48±0.003
F	mkg/100 g	2.00±0.003	2.76±0.012
Cr	- «» -	34.52±0.030	44.16±0.160
Mo	- «» -	10.83±0.009	14.30±0.059
Co	- «» -	108.26± 0.102	142.99±0.583
I	- «» -	12.36±0.009	15.25±0.049
Se	- «» -	33.04±0.027	42.11±0.155
Heavy metals			
Plumbum	mg/kg	1.02±0.001	1.39±0.006
Hydrargyrum	- «» -	0.11±0.009	1.14±0.005
Cadmium	- «» -	0.11±0,009	1.14±0.004

Note: MPC: plumbum - 1.0 mg/kg; hydrargyrum - 0.6; cadmium - 0.2 mg/kg (Sanitary Norms and Rules 2.3.2.560-96).

Amino-acid composition.Studies of amino acid composition showed that Siberian whitefish contains all the essential amino-acids (Table. 4). Predominate the essential amino-acids such as leucine, lysine. Wherein the total level in their belly is above (28.56 g/100 g) as compared with fish fillet (26.83 g/100 g).

Analysis of amino-acids shows that by quantitative content dominated alanine, cystine, arginine. They accounted for from 80.03 to 93.75 g/100 g in fish fillets and belly of the total amino-acids, respectively.

Table 4 shows that the whitefish has a high biological value - the amount of amino-acid score is above the benchmark (over 100%).

Table 4

Amino-acid score of whitefish fillets and belly, wet weight

Indicators	Fillet		Belly		Ideal protein (Food Committee of the World Health Organization) g/100 g of protein
	g/100 g of protein	SCORE, %	g/100 g of protein	SCORE, %	
Valine	7.14	142.8	5.48	109.56	5.0
Isoleucine	6.81	170.25	7.19	179.75	4.0
Leucine	13.88	198.28	15.39	219.86	7.0
Lysine	12.95	235.45	13.17	239.45	5.5
Methionine	4.18	418.0	5.07	507.0	1.0
Methionine + cystine	7.06	201.71	9.06	258.86	3.5
Threonine	8.37	209.25	10.12	253.0	4.0
Tryptophan	2.09	209.0	1.09	109.0	1.0
Phenylalanine	7.56	252.0	9.25	308.0	3.0
Phenylalanine + tyrosine	7.87	131.17	9.82	163.67	6.0
Alanine	13.21	440.33	15.81	527	3.0
Glycine	4.62	92.4	5.66	113.2	5.0
Proline	8.59	122.71	10.67	152.43	7.0
Serine	8.07	269.0	10.28	342.67	3.0
Tyrosine	7.22	240.67	9.50	316.67	3.0
Cystine	18.35	917.5	23.16	1158.0	2.0
Arginine	48.47	969.4	54.78	1095.6	5.0

Fatty acid composition. Results of fatty acid analysis shows that the samples are dominated monounsaturated acids, the ratio of which is polyunsaturated 2:1 (Table. 5). The total content in the samples of linoleic and linolenic acids is (0.37 and 0.53 g/100 g of lipids) relating to biologically active polyunsaturated fatty acids forming part of the vitamin F (essential fatty acids), which plays an important role in biochemical processes within the organism.

Bellies by content of fatty acids are different from the fillets. In whitefish belly a higher ratio of polyunsaturated to saturated fatty acids (more than one) was detected, indicating the good biological effectiveness (Table. 5).

Table 5

The content of fatty acids in whitefish fillets and belly, g/100 g wet weight

Indicators	Quantity	
	In fillets	In belly
Fattyacid, total	10.35±0.012	16.54±0.042
Saturated, total	2.30±0.023	3.39±0.012
Monounsaturated, total	5.29±0.007	9.10±0.021
includingoleicacid	1.99±0.003	3.05±0.009
Polyunsaturated, total	2.76±0.003	4.05±0.009
– linoleic $C_{18:2}$	0.19±0.0002	0.27±0.001
– linolenic $C_{18:3}$	0.18±0.0002	0.26±0.001
– arachidonic $C_{20:4}$	0.17±0.001	0.12±0.0003
The ratio of polyunsaturated to saturated fatty acids	3.50	3.87

Vitamin content. Except substances that provide the body with energy, the advantage of foodstuff comprise physiologically active substances, especially vitamins.

Vitamin composition in whitefish is diverse (Table. 6). So, first of all whitefish fillets and belly are rich in set of fat- and water-soluble vitamins. Established that the content of the fat-soluble vitamin D in whitefish belly is slightly higher (20.97 mg/kg) compared with a fillet portion (15.47 g/100 g). Similar differences are observed at personal comparison. They have quite a lot of B vitamins, low vitamin D and B9 compared with literature data [2.3].

The presented data also shows that the highest vitamin content was observed in belly.

Table 6

The vitamin content of whitefish fillets and belly, wet weight

Indicators	Units of measure	Quantity	
		In fillet	In belly
Fat-soluble			
A	mkg/100 g	78.84±0.068	101.99±0.388
D	- «» -	15.47±0.018	20.97±0.090
E	mg/100 g	1.06±0.003	1.42±0.007
Water-soluble			
B_1(thiamine)	mg/100 g	6,43±0,009	8,91±0,041
B_2(riboflavin)	- «» -	2.01±0.003	2.76±0.015
B_3 (pantothenicacid)	- «» -	6.55±0.007	8.99±0.041
B_6(pyridoxine)	- «» -	4.28±0.006	5.69±0.023
B_{12} (cobalamin)	mkg/kg	6.38±0.006	8.77±0.041
Vitamin C	- «» -	9.05±0.009	12.06±0.050
H (biotin)	- «» -	5.48±0.007	7.57±0.035
PP (niacin)	mg/100 g	5.18±0.007	7.01±0.029
B_9(folacin)	mkg/100 g	10.36±0.009	13.25±0.049

CONCLUSION

It was found that Siberian autumn-winter whitefish of Indigirka population of the Republic of Sakha (Yakutia) by the protein content it relates to average protein, by fat to particularly fatty types of fish and high-calorie food, the content of macro-and micronutrients and vitamins whitefish has the high biological value .

High nutritional and biological value of the Siberian whitefish makes it a valuable food product for the organism of the northern regions inhabitants with the necessary amount of nutrients, including a biologically active substance, during severe and long winters.

This study was completed at the Yakut Scientific Research Institute of Agriculture (Yakutsk, Russia).

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