The prospect of creating new assortment lines of fish products based on the multicultural development of pond fish

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Abstract. In the work, studies of fat, moisture, ash, protein of fish meat and paddlefish liver were carried out. The functional - technological and structural - mechanical properties of fish raw materials have been determined. Organoleptic characteristics, fractional composition of proteins, amino acid composition of fish products, fatty acid composition were studied. Amino acid balance and biological value were calculated using N.N. Lipatov's method .

Keywords: paddlefish, fish products, pond fish, biological value, fatty acid composition

The development of the domestic fish market is an object of close attention of the Russian government at the federal and regional levels. At the same time, special attention is paid to the breeding and processing of fish in inland waters through the introduction of new technologies for increasing the volume of raw materials, improving the quality of raw materials, ensuring guaranteed safety and stabilizing consumer demand. Despite a fairly wide variety of fish species in inland water bodies, most of which are occupied by ponds, the problem of developing new fish species based on rationalizing fish farming and introducing new processing technologies remains relevant [1, 2].

Scientists and specialists have developed technologies for breeding inland fish in a mixed culture. There is a positive experience of this method of fish farming in certain regions of Russia, including on the basis of the fishery complex in the Voronezh Oblast of Pavlovsk. On the basis of the enterprise, silver carp, carp, grass carp and paddlefish are bred. The latter type has not been sufficiently studied, the scientific substantiation of approaches to the formation of assortment lines of products to meet the physiological norms of nutrition and consumer demand at the current level has been poorly developed. It is now known that pond fish serve as a source

of not only food and biologically active substances, but also successfully correct and serve as a preventive means of ensuring human health. However, the range of inland fish meat products is extremely limited and consists mainly of fresh and smoked products. Their properties provide a basis for expanding the assortment line, primarily on the basis of minced meat and its raw material combinations, as well as the most food-grade cuttings (liver, milk, caviar, etc.).

Paddlefish — is one of the species of domestic and world ichthyofauna, which is a promising object of aquaculture cultivation in temperate, subtropical and tropical water bodies.

At home, paddlefish is well known as a kind of symbol of the Mississippi - a river that is no less important to the USA than Bora is to Russia. As an object of fishing, paddlefish has been known in the USA since the end of the XIX century, when, after a sharp drop in catches of lake and Atlantic sturgeon, it became the main source of black caviar production. The maximum catch of paddlefish was at the beginning of the XX century, the harvest at that time was more than 1100 tons. Back in the 30s of the XX century, up to 4 tons of paddlefish caviar were sold annually in the USA [3].

The paddlefish range has declined over the past century. The major rivers of the Mississippi Basin are experiencing significant population declines. The increase in fishing has significantly undermined natural reproduction, and the deterioration of the ecological situation and hydraulic construction contributed to the reduction of spawning grounds and the number of paddlefish populations. In the USA, paddlefish is essentially a kind of national symbol, while in Russia it is just one of the interesting acclimatization sites. However, it is possible that due to the peculiarities of its biology, it can become one of the most important objects of the fishery of our inland waters. And first of all, not because it has high gastronomic qualities and has black caviar, but because it is the only representative of sturgeons feeding on zooplankton, which forms the basis of the food base and productivity of many of our inland water bodies [4].

The objects of the study were: live and chilled fish of inland waters - carp (lat. Cyprinus carpio carpio), silver carp (lat. Hypophthalmichthys) and American paddlefish (lat. Polyodon spathula) according to GOST 24896-81 "Live fish. Specifications", GOST 814-96 "Chilled fish. Specifications". Raw materials were accepted in accordance with the requirements of regulatory documents, the standard for the rules for the reception of fish, as well as instructions № 5 "On the procedure for the reception of live fish, raw fish and chilled fish at processing plants and vessels." The main fish cutting products (fillets, liver), including chilled ones, obtained according to technological instruction № 1 for cutting and washing fish. Raw materials were delivered from JSC "Pavlovskrybkhoz" (Voronezh Oblast, Pavlovsky district, Gavrilsk village). The transportation of live fish was carried out in live fish machines in accordance with the rules

for the transportation of perishable goods, subject to the appropriate temperature regimes and oxygen conditions equal to 4 mg O2 per 1 liter of water.

If necessary, the main and by-products of fish cutting obtained in accordance with the instructions for cutting were stored chilled (at temperatures ranging from -1 to + 5°C for 10 days) or frozen (in specially equipped refrigerating chambers at a temperature of minus 18°C). more than 1 month from the moment of cutting). The choice of these research objects is related to the current situation in the Russian fish products market. The criteria for the selection of raw materials were the data known from the literature on the nutritional and biological value of different fish species and information on the actual volumes of their catch.

When analyzing fish raw materials and products, modern physicochemical, including instrumental research methods were used, including: the mass fraction of protein - by the Kjeldahl method in the preliminary mineralization of the sample, moisture according to GOST R 52421-2005, fat - refractometric after extraction of fat from a dried sample sample with a low-volatile solvent and in accordance with the recommendations, ash - according to GOST 151138-77. Functional - technological and structural - mechanical properties of fish raw materials: the moisture binding capacity of model food systems (MBC,%) was assessed by the method of Grau and Ham modified by V.P. Volovinskaya and B.I. Kelman according to the ratio of mass fractions of free and bound moisture, water-holding capacity - according to recommendations, stickiness - on a laboratory installation for determining stickiness (according to S. Tyshkevich), fat-holding capacity - according to recommendations, emulsion stability - according to recommendations, emulsifying ability - according to recommendations, Fractional protein composition - by biuret method, amino acid composition of fish products - by ion-exchange chromatography on an AAA-TZZZ analyzer (Czech Republic). Amino acids were separated on an analytical column filled with "0stion LGFA" cation exchange resin with step elution with three sodium citrate buffers with different pH values (3.50; 4.25; 9.50), amino acid balance and biological value of the products were evaluated by calculation using N. N. Lipatov using computer modeling methods for the following indicators: amino acid rate, biological value, coefficient of difference between amino acid rate, coefficient of utility. Fatty acid composition - by GLC method according to GOST R 51484-99, organoleptic tests - were carried out according to GOST 28283 - 89, GOST 8756.1-79, GOST 28188 - 89. The digestibility of proteins of the obtained products by digestive enzymes was determined by the Pokrovsky-Ertanov method using the pepsin-trypsin system. The accumulation of hydrolysis products was determined by the color Lowry reaction. [5, 6]

In the experimental studies, the comparative chemical composition of fish from an inland reservoir (a pond with a polyculture) was established. It has been shown that fillets and liver have the highest yield when cutting fish. Interestingly, the song yield is 4 times that of the popular cod among the population. In this regard, along with fish meat, the properties of paddlefish song were studied (table 1). An analysis of the general chemical composition of pond fish meat revealed that the fish are close in terms of the mass fraction of fat - 5.7-8.4% and protein - 17.2 -25.8%.

Table 1 – Comparative chemical composition of fish meat and paddlefish liver

Sample	Moisture, %	Fat, %	Ash, %	Protein, %	EV, kcal/100g
Paddlefish	63.3±3.33*	8.4±2.48*	2.5±0.50*	25.8±1.02*	178.80
*-P≤0.05 – to the indicator for carp					

Attention is drawn to the high mass fraction of proteins in paddlefish meat (25.8%), the general deficiency and functionality of which in food systems are known worldwide. The fat: protein ratio for the studied fish species differs insignificantly. So, for example, for the muscle tissue of carp this ratio is 0.33:1, for silver carp - 0.37:1, for paddlefish - 0.3:1 (at a rate of 1:1).

The properties of food raw materials and products determine the presence and ratio of various proteins. Proteins are concentrated in muscle, epithelial, connective tissues, as well as in the types of adipose and nervous. In the proteins of the muscle tissue of pond fish, three fractions were isolated: water-soluble (albumin), salt-soluble (globulins) and alkali-soluble (stromal proteins) (figure 1).

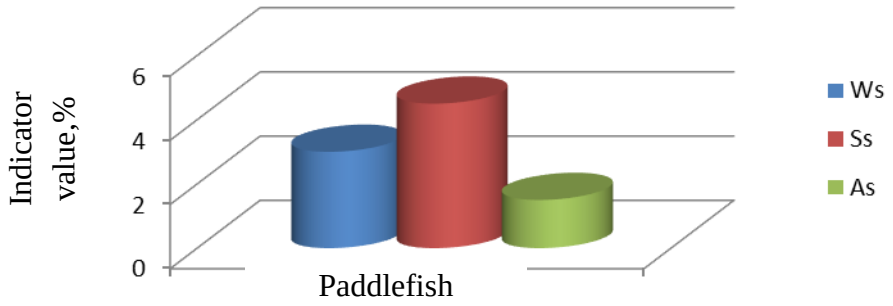

Figure 1 - Comparative fractional composition of fish meat proteins and paddlefish liver

Thus, the assessment of the fractional composition of paddlefish meat proteins is of interest in connection with the possibility of their further use in industrial production, since the formation of stable systems is impossible without the participation of such protein fractions as salt- and water-soluble. The total content of protein and fat in fish meat does not fully characterize its nutritional value, since along with complete proteins, which include all essential amino acids,

Name of fatty acids	FA Index	Carp fillet	Silver carp fillet	Paddlefish fillet

without which protein synthesis in the body is impossible, meat contains defective proteins (collagen, elastin). Therefore, the nutritional value of fish meat is determined not only by its high protein content, but also by the composition and ratio of essential amino acids. The content of essential amino acids in meat is possibly about 35% higher than that of silver carp and 11% higher than that of carp. Consequently, meat proteins are more complete, which must be taken into account when designing recipe-component solutions for new fish products. Particular attention should be paid to the methionine content. This amino acid stimulates an intense growth rate. The content of this particular acid is 2.5 times higher in paddlefish meat. Of the nonessential amino acids, the main attention should be paid to the content of glutamic acid, since it acts as a donor of amino groups and actively participates in the biosynthesis of other amino acids. As our research has shown, its content in paddlefish meat is higher by 13.05% in relation to silver carp and carp meat, but lower by 2.3% than in paddlefish liver. Since, in addition, this amino acid is responsible for the taste and aromatic characteristics of fish meat, we note that paddlefish meat contains a large amount (22.13 g/100 g of protein), which explains a somewhat peculiar taste, rather reminiscent of meat [6, 7].

The fatty acid composition of the studied objects is characterized by a high content of saturated and polyunsaturated fatty acids (table 2).

The results of studies of fatty acid composition show that in terms of fat content, fish of inland waters do not belong to products of high biological value, which is compensated by a high protein content. However, this characteristic can be significantly improved by designing recipes for various culinary products based on them. At the same time, as a positive fact, it should be noted the presence in the fillet of carp, silver carp and paddlefish of essential nutritional factors linolenic (0-6), as well as the presence of polyunsaturated fatty acids (PUFA).

Myristic	14:0	0.75±0.02	2.41±0.01	0.09±0.01
Palmitic	16:0	16.05±0.04	24.60±0.03	16.6±0.03
Stearic	18:0	7.22±0.02	5.12±0.02	1.37±0.02
Arachinic	20:0	0.13±0.01	0.11±0.01	0.07±0.01
The amount of saturated acids		**24.15**±0.02	**34.24**±0.02	**18.13**±0.02
Palmitoleic	16:1 9-*cis*	4.76±0.02	8.19±0.02	5.58±0.02
Oleinovaya	18:1 9-*cis*	46.74±0.05	26.06±0.03	27.67±0.03
Linoleic	18:2	9.68±0.02	11.55±0.02	20.36±0.02
γ- linolenic	18:3 ω-6	0.28±0.01	0.14±0.01	0.77±0.01
The sum of unsaturated acids		**61.46**±0.02	**45.94**±0.02	**54.38**±0.02
The ratio of unsaturated to saturated		**2.5**	**1.4**	**2.9**

Table 2 - fatty acid composition of lipids of the test objects (content of fatty acids in%)

The high biological value of pond fish meat is confirmed by calculations (table 3) and the digestibility of proteins in in vitro experiments (figure 2) [8, 9].

Indicator name	Carp	Silver carp	Paddlefish	Paddlefish liver
SCORmin, %	65.0	52.0	63	54.0
KRAS , %	38.4	36.0	57.1	65.7
BV, %	61.6	64.0	42.9	34.3
U, cu.	0.62	0.61	0.55	0.5
$\sigma_{c,\%}$	21.1	23.3	29.2	39.6

Table 3 - indicators of the biological value of research objects (in% to dry matter)

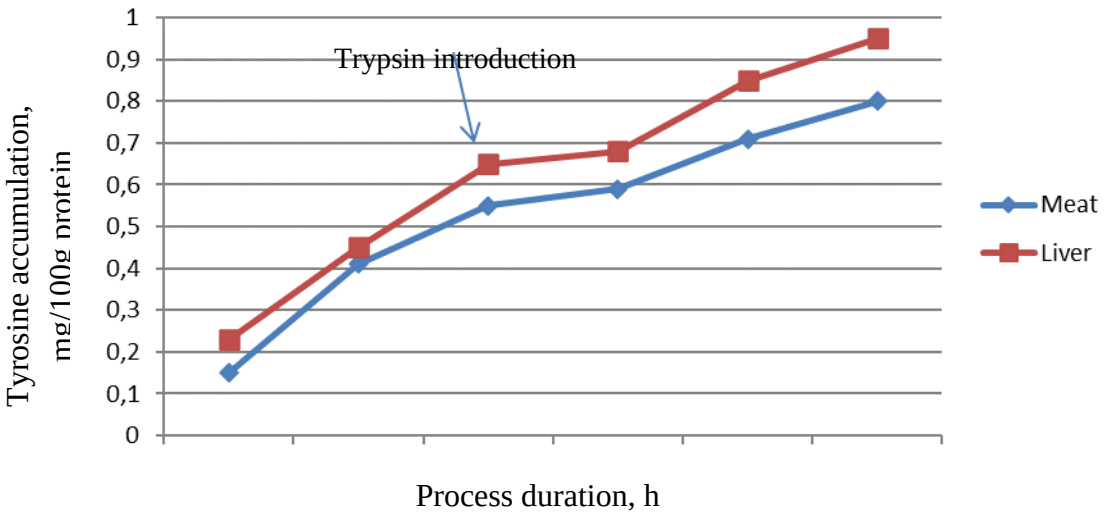

Figure 2 - Digestibility of paddlefish meat and liver by the "pepsin-trypsin" digestive enzyme system (invitro)

The possibility and prospects of using paddlefish as a source of raw materials for the formation of various assortment lines of fish food products are proved by the results of the analysis of the functional and technological properties of raw objects (figure 3), since the levels of moisture-binding, emulsifying and moisture-holding capacity determine the quality indicators and product yield.

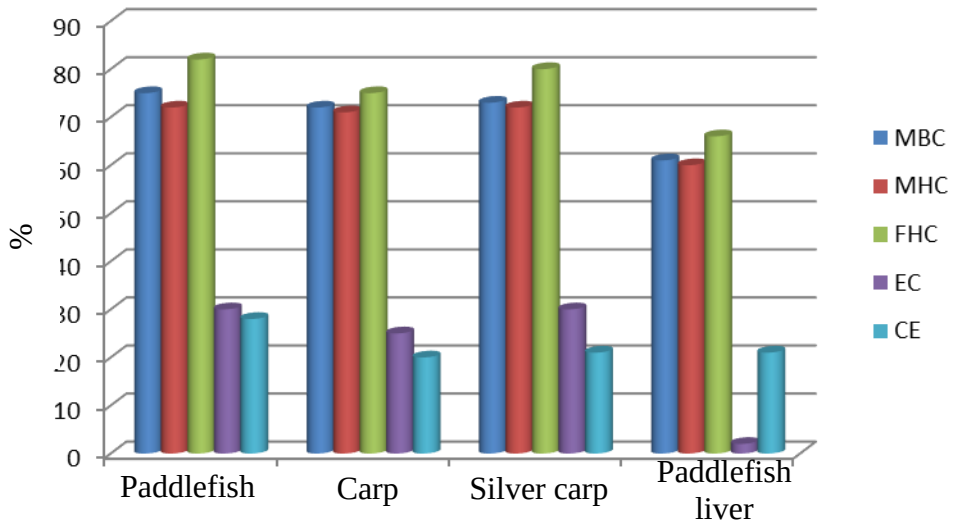

Figure 3 - functional and technological properties of raw materials

At present, recipes have been developed and technological modes have been substantiated within the framework of the experimental laboratory regulations, and the approbation and tasting of products have been carried out: pate, canned food, semi-finished products, sausages for frying [10].

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