

THE CONTENT OF SOME COMPONENTS OF METABOLISM IN MUSCLE TISSUE OF BREAM *ABRAMIS BRAMA* (L.)

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ABSTRACT

Physiological condition is one of the most important characteristic used for evaluating single individuals, populations and fish stocks in general. The data on a number of physiological indicators of bream the Gorky water reservoir were presented. Amount of moisture, dry matter in the muscular tissue was determined of using two-stage determination of total moisture. Simple lipids were determined by extraction with petroleum-ether. The analysis of the results suggests that the indices of water, dry matter and simple lipids content in muscular tissue of mature males, females and juvenile individuals of bream were close. Decrease of water amount in the muscle tissue, increase of dry matter and lipids takes place along with bream ageing.

Keywords: bream, muscle, water, dry matter, simple lipids



INTRODUCTION

Development of commercial fisheries leads to the necessity of studying a number of physiological and biochemical characters of valuable commercial fish species. Physiological condition is the most important characteristic used for evaluating single individuals, populations and fish stocks in general. Relative body fat content serves as an indicator of physiological condition and characterizes the level of energetic reserves accumulation. This level both reflects the "degree of well-being" of the population (preparedness for migrations, spawning, wintering) and determines fish value to a large extent (Shulman *et al.*, 1989; Shulman, 1999).

Direct linear relation between content of fat and dry matter (or inverse – between lipid and water content) in fish body is known. There are data that fat reserves as well as content of water in fish organism are among the most variable

components of fish body due to high lability (Baydalinova and Yarzhombek, 2011).

We decided to determine age - and sex-associated variability of these parameters in mass fish species of commercial value. One of such species is bream *Abramis brama* (L.), as it has the highest fishing quotas in many commercial fisheries areas of Volga-Caspian basin. Therefore, study of bream's metabolism characteristics has a number of theoretical and practical aspects. More specifically, goal of our work was to study the ratio of water, fat and dry matter in bream's muscular tissue.

MATERIAL AND METHODS

Samples were taken from fish caught in the Gorky water reservoir in September-October of 2012 by trawl from the "Akademik Topchiev" research vessel (Fig 1).

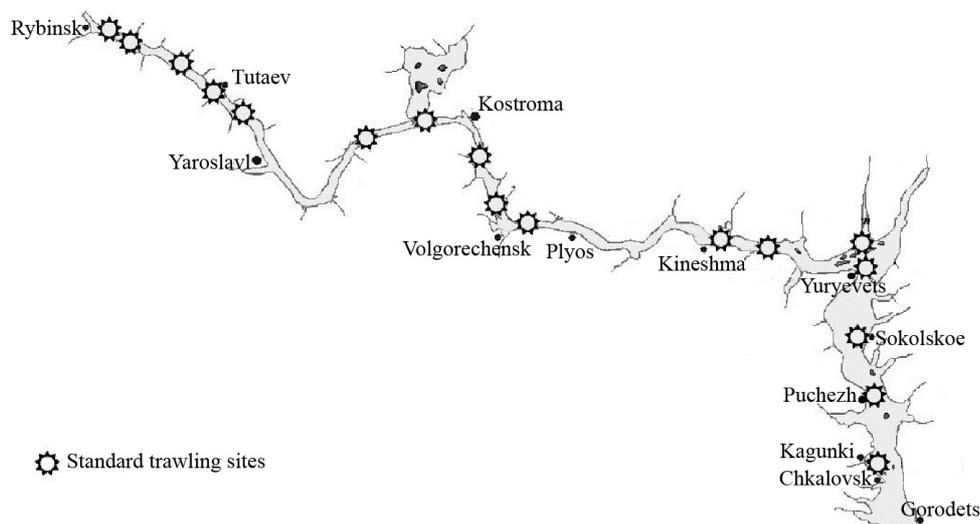


Figure 1 Standard trawling sites in the Gorky water reservoir

Immediately after catching fish underwent biological analysis (length, weight, sex and gonad development, gutted weight). Muscle tissues were cut off, weighed

and frozen at -8°C. A total of 22 males and 42 females and 20 juvenile individuals were studied (Tab 1).

Table 1 Morphological and physiological parameters of fish

Sex	N	Length, cm(M±m)	Weight, g(M±m)	Fulton's condition factor(M±m)	Clark's condition factor(M±m)
Males	22	25.96±0.953	409.95±47.397	2.13±0.026	1.88±0.021
Females	42	26.20±0.850	438.21±47.462	2.11±0.050	1.85±0.043
Juveniles	20	22.19±0.805	248.60±20.499	2.09±0.020	1.86±0.020

Legend: Mean and error of mean are given (M±m), N - number of such individuals

Amount of moisture and dry matter in the muscular tissue of bream was determined using two-stage determination of total moisture. Quantity of free water was determined in the following manner: sample was dried in the dry-air sterilizer at 60°C up to air-dry state. Mass share of free water X, % in the given sample was calculated using the following formula 1:

$$X = \frac{M_2 - M_3}{M_2 - M_1} \cdot 100$$

Where M₂ – mass of container with sample prior to drying, g; M₃ – mass of container with sample after drying, g; M₁ – mass of the container, g.

Quantity of bound water was determined by drying sample in weighing bottles at 105°C for 3 h until constant mass. Mass share of bound water was determined using formula 1.

Mass share of total amount of water X₁, % in the studied sample was calculated using formula 2:

$$X_1 = \frac{X_2(100 - X_2)}{100} + X_2$$

where X₃ – mass share of free water, %; X₂ – mass share of bound water, %. Mass share of dry matter Y, % in the studied sample was calculated using formula 3: Y=100-X₁.

Quantity of free (simple) lipids was determined using express-method. Method is based upon extraction of fat from the studied product by an organic solvent and fat mixture after removal of solvent. Fat quantity was determined by extraction with petroleum-ether (Soloveva et al., 2001).

Dry defatted residue is determined by the difference in dry matter quantity and quantity of obtained fat in the muscle tissue of fish.

Data were processed using Excel 2007 and given as men and the error of mean (M±m).

RESULTS AND DISCUSSION

Analysis of water content in bream's muscle tissue allowed finding peculiarities of its accumulation in fish irrespective of its age and gender. We found that mean value of total water content in the muscular tissue of all studied bream individuals is 78.8%.

This value is somewhat higher than mean values of water content in muscles of previously examined individuals of this species (Repnikov, 2007). It should be noted that mean value of water content in the studied tissue of bream is higher than that of other cyprinids 72.9%, herrings 69.7%, sturgeons 71.3%, catfishes 72.0%, but lower than that of gadids 80.6%, pikes 80.0%, percids 79.9% (Malyarevskaya, 1979; Hadjinikolova, 2008; Pirestani et al., 2009).

Share of dry matter, which is ultimately the sum of final products of metabolism, is 21.2%.

Simple lipids content in bream muscles is only 0.84% of the mean quantity of dry matter. Researchers have previously shown that mean lipid content in bream organism is 4.1% (Rodina, 2007; Rebah et al., 2010). The difference between our and literature data may be explained by the fact that cyprinids accumulate these compounds mostly in the connective tissue which is situated between skin and muscles as well as around internal organs in the form of visceral fat (Repnikov, 2007). Studied tissue contains a small amount of intramuscular triglycerides held be gel part of cells. In addition, fat in fish body is extremely labile and its quantity strongly fluctuates with age, in relation to season, changes in feeding as well as starvation and prolonged movement of fish (Rodina, 2007).

The following peculiarities of metabolism parameters in different groups of adult fish were found. Indices of water content, dry matter and simple lipids in muscles of different gender and age groups were close. Indices of free and bound water in compared groups differ by a small margin as well (Tab 2).

Table 2 Quantity of water, dry matter and simple lipids in the muscular tissue of bream of different gender and age

Index	Mature males (M±m)	Mature females (M±m)	Juveniles (M±m)
Free water, %	77.41±0.22	77.32±0.24	77.77±0.16
Bound water, %	6.05±0.31	5.99±0.21	5.35±0.13
Total amount of water, %	78.78±0.20	78.69±0.20	78.95±0.17
Dry matter, %	21.22±0.20	21.31±0.20	21.05±0.17
Simple lipids, %	0.82±0.05	0.85±0.07	0.82±0.06

Legend: Mean and error of mean are given (M±m)

These data allow concluding that there is a very small to none difference in water quantities in muscle tissues of males, females and juvenile individuals.

Therefore, it is safe to say that we cannot speak of any dependence between studied parameters and fish gender at this stage of our research.

Quantitative changes of parameters were found to be dependent of individuals' age to a larger degree. It was previously shown (Baydalinova and Yarzhombek, 2011) that water content in carp muscle tissue decreases with age. Our research is in accordance with these data (Tab 3).

Table 3 Changes in water content in bream age groups.

Age	Number of such individuals	Total water content, % (M±m)	Dry matter, % (M±m)
3+	3	80.42±0.68	19.58±0.68
4+	30	79.15±0.13	20.85±0.14
5+	15	79.14±0.13	20.86±0.13
6+	8	78.43±0.56	21.57±0.56
7+	13	78.69±0.21	21.31±0.21
8+	6	77.92±0.34	22.08±0.34
9+	5	78.23±0.41	21.77±0.41
10+	3	76.21±0.39	23.79±0.39
12+	1	76.56±0.00	23.44±0.00

Legend: Mean and error of mean are given (M±m)

Mean value of total water content reaches 80% in 3+ bream, in three years it drops by 2%, and by the age of 10 amount of water in the muscle tissue is only 76%. Amount of dry matter changes accordingly – from 20% in 3+ fish to 24% in 11+ fish.

Coefficient of correlation calculation shows negative relation (-0.59) between amount of water in the organism and fish age and positive relation (0.92) between amount of dry matter and age.

Previous studies on teleost metabolism showed that lipid content in bream muscles increases with age (Nikol'skiy, 1963), and this is supported by our results as well. Thus, 3+ bream have 0.82% mean lipid content in the muscle tissue, it grows up to 0.92% in four years and up to 1.76% in 11+ fish (Fig 2).

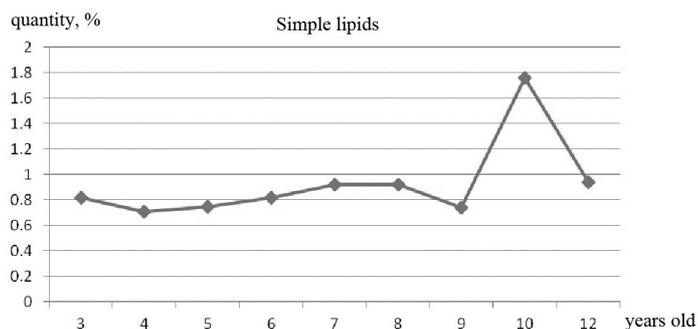


Figure 2 Age changes in simple lipids content in bream muscles

In addition to that, content of other final products of metabolism increases as well which is evidenced by the aforementioned increase of dry matter content. Thus, share of other metabolism components represented by dry defatted residue is 19.18% in 4+ fish, 21.16% in 8+ fish and 22.24% in 11+ fish.

CONCLUSION

1. Mean amount of water in the bream muscle tissue is 78.8%. It is higher than that of sturgeons, catfishes, herrings and some other cyprinids, but lower than that of gadids, salmon and percids.

2. Comparison of age and gender groups of bream has revealed only some minor, insignificant differences in the amount of water, dry matter and simple lipids between males, females and juvenile individuals.

3. Decrease of water amount in the muscle tissue, as well as increase of dry matter, lipids and other metabolism components takes place along with bream ageing. It should be noted that by the age of 10+ water amount decreases only by 4%, while the amount of lipids in the muscular tissue increases up 2 times.

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