

TECHNOLOGICAL AND NUTRITIONAL QUALITY OF BROOK TROUT

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Abstract

The research was carried out on a batch of 50 specimens of brook trout, the fish coming from a salmonid exploitation from Suceava County. The studied trout's were sacrificed, measured and then samples (lateral muscles) were taken, which were subjected to determinations for chemical composition, content in collagen, histological studies and the rate of losses in different processes (frying and frying preceded by flouring).

Following the analysis of the results we can conclude that the analyzed fish material has shown a good maintenance status, the trout fillets having a balanced chemical composition, with a very strong correlation between the meat content in amino acids and the protein content, as well as a good manufacturing and superior capitalization.

Key words: brook trout, chemical composition, superior capitalisation

INTRODUCTION

Trout meat has outstanding sensory features a high biological and nutritional value, due to significant protein content, slightly digestible, which doesn't produce adverse side effects on human health. In addition, fish meat also has a strong quantitative valence and plays an important role in ensuring daily protein requirements [21-23], [25], [27], [35].

Chemical composition of trout meat is influenced by a number of factors such as breed, age, nutrition, fishing season, environment, salinity and water temperature[8], [15], [25], [28], [34], [36].

The aim of the present study was to identify chemical composition, content in collagen, histological studies and the rate of losses in different processes (frying and frying preceded by flouring).

MATERIAL AND METHOD

The research was carried out on a batch of 50 specimens of brook trout, the fish coming from a salmonid exploitation in

Suceava County. Fish samples were kept on ice in isothermal box, until they arrived to the laboratory and immediately frozen and stored at -18°C until analyses.

In order to calculate growth indexes and coefficients, were determined several parameters, namely: total length, standard length, head length, caudal peduncle length, body height and thickness of the body

Based, on somatic measurements can be calculated several corporal indexes, which provides information regarding maintenance status as well as their adaptability to the assured environmental conditions [19], [29].

Biometric data are used to determine growth in length of fish and to determine the general physiological condition and is obtained by measurements taken with special instruments (ihtyometers) or other measuring instruments (ruler, callipers) [29].

These measurements are:

- ✓ body weight (M) – established through weighting;
- ✓ total length of body (L) – it is measured from the top of the snout till the top of the lobes of caudal fin;
- ✓ standard length of body (l) – also named standard length or length without the caudal fin, it is measured from the top of snout till the base of caudal fin;

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- ✓ maximum height of body (H) - it is measured in the highest area of body, from ventral line to the dorsal line;
- ✓ maximum circumference of body (C) – it is measured at the level of maximum thickness and maximum height, respectively before dorsal fin;
- ✓ length of the head (lc) - represents the distance from top of snout to the posterior edge of operculum bone;
- ✓ length of caudal peduncle (lp) – it is measured from the posterior extremity of anal fin to the base of caudal fin;
- ✓ maximum thickness of body (G) – it is measured in the area where body have the greatest thickness;

Based on the somatic measurements could be calculated a series of corporal indexes which offers information regarding fishes maintenance state and corporal shape of body (profile index, thickness index, Fulton coefficient, Kiselev index, fleshy index I and II, [19], [29].

Meat technological features refers to: water retaining capacity, meat hydration capacity, retaining or releasing capacity of juice, losses rate by maturation and storage, losses rate by boiling or frying, meat resistance, those ones being influenced by physical-chemical and morph-structural proprieties [30].

For determination of collagen content from trout meat was utilised a Food-Check meat automatic analyser.

Muscle fibre diameter was determined by inclusion technique in paraffin and staining with haematoxylin-eosin [29]. Histological examination and interpretation of data was performed using Leica DM 750 microscope equipped with Leica Las Software Version V4.2 2012, equipped with microphotography system.

To determine the physical-chemical composition of trout meat were gathered samples from side musculature of fishes.

Determination of water and dry matter was realized through the method of drying in oven, which is the most used indirect method and suppose the drying of sample in oven at +105°C, till reaching a constant weight, in according to SR ISO 1442:2010.

Protein determination consists in decomposing the analyzed sample by heating with sulphuric acid in the presence of catalysts to reduce organic nitrogen to ammonium ions which can be determined by distillation/titration.

Determination of lipids content was realized using Soxhlet method, which consists in fat extraction from the analyzed sample using petrol ether according to SR ISO 1443:2008.

Ash was determined by calcinations at 550°C in calcinations oven according to SR ISO 936:2009.

Quantitative determination of amino acids was carried out in two stages in agreement with SR EN ISO 13903/2005 and AOAC Official Methods of Analysis (2019).

Amino acids were separated by high performance liquid chromatography using the HPLC Surveyor Plus Thermo Electron chromatographic system on a reversed-phase Hypersil BDS C18 (Thermo Electron) column, the reading being in the ultra-violet (338 nm). A Hypersil BDS (Base Deactivated Silica) C18 column with silica gel, with dimensions of 4.6 mm and a particle size of 5 µm. A gradient elution method is used, the chromatographic conditions being the following flow rate: 1 mL/min; injected volume: 25 µL; wavelength to be read: 336 nm; column temperature: 25°C.

The software used for statistical analysis was SPSS. We calculated the average, standard deviation and coefficient of variation.

RESULTS AND DISCUSSIONS

Research has debuted with biometric determinations: body weight (M), body length (standard length) (ls), maximum body height (H), maximum body circumference (C), length of the head (lc), caudal peduncle length (lp), and maximum thickness of body (G) (table 1).

Based on data obtained by measurements and weightings' for brook trout specimens, were obtained values close to those presented in the literature [4], [19], which shows that the studied specimens had adequate development.

Table 1 Biometric measurements at brook trout (*Salvelinus fontinalis*)

Specification	<i>Salvelinus fontinalis</i> (n=10)	
	$\bar{X} \pm s_{\bar{x}}$	V%
Body weight – M (g)	264.80±10.33	8.12
Standard length– ls (cm)	24.87±0.11	4.68
Maximum height – H (cm)	7.06±0.11	6.67
Heads' length – lc (cm)	5.41±0.14	8.82
Maximum circumference – C (cm)	16.93±0.22	6.88
Length of caudal peduncle – lp (cm)	5.08±0.11	7.14
Maximum thickness of body (G) (cm)	2.97±0.09	6.88

Values obtained by calculating indexes and growth coefficients (table 2) are similar with those from the literature, resulting that the analyzed specimens had a good maintenance condition [4], [19].

Table 2 Indices and coefficients of fish maintenance

Specification	$\bar{X} \pm s_{\bar{x}}$	V%
Profile index	3.53±0.06	6.16
Thickness index	41.55±1.49	11.33
Kiselev index	1.48±0.03	5.30
Fulton coefficient	1.72±0.05	10.23
Fleshy index I	21.77±0.74	8.02
Fleshy index II	20.43±0.33	5.18

For the analysed breed, it was observed that the highest collagen percentage was found in costal hip axial muscles (table 3), confirming the data from literature regarding the low proportion of collagen in fish meat, fact which makes that this one to be easier to be cooked [31].

Table 3 Collagen content of the studied muscles gathered from the studied trout

Breed	n	Analysed muscles	Collagen %	
			$\bar{X} \pm s_{\bar{x}}$	V%
Brook trout	10	EC	3.95±0.92	2.01
	10	HC	4.16±0.41	2.21

Histological structure of meat is illustrated by a series of specific indicators such as: large diameter (DM), small diameter (Dm), mean diameter, ratio between diameters (DM/Dm), and also square area per transversal section. The obtained values fall into the limits mentioned in the literature (table 4).

Table 4 Thickness of the muscular fibre in side muscles from brook trout

Breed	Large diameter (μ)	Small diameter (μ)	Mean diameter (μ)	Ratio DM/Dm (x/1)	Square area per transversal section of muscular fibre (μ ²)
Brook trout	80.72±6.56	70.16±5.63	75.44±3.42	1.14/1	4886.49±8.66

The chemical composition of brook trout meat, is influenced by genetic and environmental factors such as water quality and temperature its pH, oxygen content, technological factors such as feeding, type of food used, season, age and size of the fish [3], [9], [11], [13], [15], [17-18], [25], [33-35], [38-39].

Water content of fillet had an average value (Table 5) of 73.22% for brook trout

samples values which fall within the limits [24-26], [33], [37-39].
from literature [1], [4-7], [9], [12], [14], [17],

Table 5 Proximate composition of brook trout meat

Specification		Brook trout
Water (%)	$\bar{X} \pm s_{\bar{x}}$	73.22±0.31
	V%	1.04
Dry matter (%)	$\bar{X} \pm s_{\bar{x}}$	26.78±0.31
	V%	4.22
Proteins (%)	$\bar{X} \pm s_{\bar{x}}$	19.98±0.27
	V%	5.69
Fats (%)	$\bar{X} \pm s_{\bar{x}}$	5.60±0.23
	V%	13.39
Ash (%)	$\bar{X} \pm s_{\bar{x}}$	1.20±0.01
	V%	4.01

As it can be observed from these data the dry matter content had an average value of 26.78% for brook trout samples.

Protein content had an average value of 19.98% for brook trout, values similar to those mentioned in the specialty literature [1], [4-7], [9], [12], [14], [17], [20-21], [24-26], [33], [37], [39].

The fat content of the analyzed trout's fillet was 5.60%, values that places them in the category of fish with a medium lipid

content (4–8%), the obtained data being within the limits mentioned in the specialty literature [1],[4-5], [7], [9], [12], [14], [17], [20], [24-25], [33], [37-39].

Regarding the ash content we obtain an average value of 1.20% for brook trout samples, values similar to those mentioned in literature.

Amino acid composition of the brook trout meat is given in Table 6.

Table 6 Amino acid composition of trout meat (% from dry sample)

Amino acid	Brook trout
Aspartic acid (Asp)	6.77±1.25
Glutamic acid (Glu) *	9.24±0.44
Serine (Ser)	3.06±1.34
Glycine (Gly) *	4.38±2.14
Threonine (Thr) ^E	3.56±0.48
Arginine (Arg) *	5.60±2.35
Alanine (Ala) *	4.65±1.12
Tyrosine (Tyr)	2.85±2.68
Valine (Val) ^E	3.65±1.69
Phenylalanine (Phe) ^E	3.34±0.34
Isoleucine (Iso) ^E	3.60±0.54
Leucine (Leu) ^E	6.56±1.88
Lysine (Lys) ^E	5.81±2.64
Cysteine (Cys)	0.74±1.48
Methionine (Met) ^E	0.79±0.28
Essential amino acids \sum_{EAA}	27.31±1.45
Delicious amino acids \sum_{DAA}	23.87±0.54
Non essential amino acids \sum_{NEAA}	37.28±1.25
Total amino acids \sum_{TAA}	64.59±1.89
$\frac{\sum_{EAA}}{\sum_{TAA}}$	0.42±1.28
$\frac{\sum_{EAA}}{\sum_{NEAA}}$	0.73±1.94
$\frac{\sum_{DAA}}{\sum_{TAA}}$	0.36±1.65

*denotes delicious amino acids; EAA – essential amino acids; NEAA – non-essential amino acids; TAA – total amino acids; Histidine and Tryptophan were not determined

The protein compositions of the examined trout samples contain high levels of glutamic acid (9.24%), followed by aspartic acid, leucine and lysine results in according with those obtained by Iwasaki, and Harada, (1985); Farmanfarmaian and Sun, (1999); Beklevik et. al., (2005), Sabetian, Mryam et. al., (2012), Kaya et. al., (2014), Sirakov (2015), Simeanu Cristina et. al., 2017, Wang and Han (2017). The lowest level in decreasing amounts was registered in the case of cysteine (0.74%).

The ratio between EAA and TAA had an average value of 0.73. These results showed

that the EAA/TAA and EAA/NEAA ratios were comparable to the reference values of nearly 40% and above 60%, respectively, recommended by the FAO/WHO, which indicates that brook trout meat may be considered a high-quality source of protein.

The muscle protein, suggests that brook trout is an ideal nutritional food source.

Losses resulted by frying

Regarding losses resulted by frying, could be remarked that at meat gathered from brook trout specimens was a losses percentage rate of 25.69% (table 7).

Table 7 Losses recorded by frying the trout's meat

Specification		Brook trout
Initial weight of samples (g)	$\bar{X} \pm S_{\bar{x}}$	230.42±4.34
	V%	7.69
Final weight of samples (g)	$\bar{X} \pm S_{\bar{x}}$	171.22±3.48
	V%	6.67
Losses (g)	$\bar{X} \pm S_{\bar{x}}$	59,2±4.42
	V%	2.78
Losses (%)	$\bar{X} \pm S_{\bar{x}}$	25.69±6.29
	V%	2.27

Losses resulted by frying preceded by flouring

Through flouring and frying of trout meat were recorded mean losses of 20.89%. Flour

consumption for this operation was of 2.34 % (table 8) from the total weight of processed meat.

Table 8 Losses recorded by frying the trout's flouring meat

Specification		Brook trout
Initial weight of the floured samples (g)	$\bar{X} \pm S_{\bar{x}}$	234.57±3.24
	V%	3.13
Flower consumption (g)	$\bar{X} \pm S_{\bar{x}}$	5.51±0.73
Final weight of samples (g)	$\bar{X} \pm S_{\bar{x}}$	189.92±2.23
	V%	4.25
Losses (g)	$\bar{X} \pm S_{\bar{x}}$	50.16±2.12
	V%	3.41
Losses (%)	$\bar{X} \pm S_{\bar{x}}$	20.89±0.59
	V%	2.17

Processing of trout meat by frying preceded by flouring recorded average losses with 4.8% less than in the case of frying (without flouring).

CONCLUSIONS

The values of the calculated main indexes reflect a corresponding increase, a better use of nutrition, correlated with good

maintenance and health of the studied specimens.

For the analysed breed, it was observed that the highest collagen percentage was found in costal hip axial muscles.

The values obtained after chemical analysis fall into the limits cited in the literature, highlighted that brook trout has a good nutritional value.



The protein compositions of the examined trout samples contain high levels of glutamic acid, followed by aspartic acid, leucine and lysine.

The ratio between EAA and TAA had an average value of 0.73. These results showed that the EAA/TAA and EAA/NEAA ratios were comparable to the reference values of nearly 40% and above 60%, respectively, recommended by the FAO/WHO, which indicates that brook trout meat may be considered a high-quality source of protein.

Processing of trout meat by frying preceded by flouring recorded average losses with 4.8% less than in the case of frying (without flouring).

The present study demonstrate that brook trout meat is a highly source of protein and contains essential amino acids for promoting good health.

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