RESEARCH REGARDING THE INFLUENCE OF AGE AND CORPORAL WEIGHT ON EFFICIENCY AT SMOKING AND CHEMICAL COMPOSITION OF SMOKED RAINBOW TROUT

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Abstract

Smoking, as a traditional method for trout preservation, is one of the oldest methods utilised to increase the storage time and to improve the taste of fish meat. Due to its quite small dimensions, rainbow trout is a perfect fish for being processed by warm smoking, process which allow its consumption without any additional preparation. To realize the current study were smoked at warm a number of 60 individuals of Oncorhynchus mykiss breed, 20 individuals for each age group (second summer, third summer and fourth summer), determine the efficiency at smoking, dry matter, ash, content in proteins and content in lipids for all three batches of smoked rainbow trout (L1, L2 and L3). By weighting of the smoked carcasses, gathered from the all three experimental batches of rainbow trout, were obtained efficiency for smoking between 51.28% and 60.97%. Regarding the chemical composition the obtained values were between 36.72 and 41.15% for dry matter, the maximum value being recorded at second summer rainbow trout individuals. Content in proteins recorded the best values (30.42%) at individuals from batch L1, content in lipids was between 6.84% and 9.16%, and content in ash was in interval 1.40-1.59%.

Key words: warm smoking, rainbow trout, efficiency, chemical composition

INTRODUCTION

Smoking, as a traditional preservation method for trout, is one of the oldest methods used to increase the storage period and to improve the taste of fish meat, existing proves that this preservation method was used since ancient times [5].

Smoked fish is widely spread nowadays due to its taste and flavour and also due to the prolonged shelf-life, obtained as a consequence of combined effects of dehydration, anti-microbial and anti-oxidant of the smoke components (carboxylic acids, formaldehyde and phenols) [4].

In this context smoking represent the technological operation of fish exposure to smoke action aiming to assure preservation, flavouring and formation of specific colour. This is one of the most used capitalization methods for trout and allows not only long time preservation but also an easier manipulation and transportation. Romanian national tradition has a large variety of products which could be considered local, being consumed with great pleasure, and among them a special place is reserved to smoked trout. Man uses smoke for conservation and processing of animal alimentary products from ancient times [6].

Warm smoking is practiced usually for small trout, which are partially roasted during technological process. Fishes with large dimensions could be sectioned along backbone and subjected to a cold smoking.

Rainbow trout is a fish with a low waist, in Romania could reach during the third year of growing a weight of 350-500 g [3, 8, 9].

During warm smoking, in fish muscular tissue took place a series of physical and chemical processes, which affect, mainly, water percent and protein component of meat [5].

Water content, in the case of trout subjected to smoking, id decreasing being influenced by the smoking method, fish breed and waist and could be between 45% and 72% [1, 10].

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This decreasing is not only a weight decreasing but represents, at the same time, an increasing of nutritive value, because proteins form meat are concentrated during smoking process [10].

MATERIAL AND METHOD

Biological material used for our study was represented by 60 individuals of rainbow trout *(Oncorhynchus mykiss)*, with different ages (2^{nd} summer, 3^{rd} summer and 4^{th} summer), reared into a semi-intensive system at a trout fish farm from Neamț county. To fulfil our aims, from studied biological material were established three experimental batches L1, L2 and L3, each having a number of 20 individuals of rainbow trout from each age category.

During our research, trout in the analysed batches were reared in same environmental and feeding conditions.

Smoked trout was obtained by impregnation with natural smoke, made by burning of wood with tough texture (beech) and wet sawdust. Warm smoking is a often utilised method for small sized trout.

After gathering, sorting and slaughtering, trout was subjected to many processes to be able to be smoked, as follows:

Evisceration is the operation by which was removed the visceral mass and internal organs, and have the role to increase the trout preservation period.

Washing took place just immediately after removal of blood and mucus.

Drying is realised to create necessary conditions for submission of smoke constituents of fish surface and for coagulation of proteins in the superficial layer of fish meat, for limiting the evaporation of water from rainbow trout meat [11].

Trout placing on grids was made function of its size, large trout were placed on the lower grids, which were situated more close to smoke source while the small one3s were placed on superior grids.

Roasting was realised at temperatures between +80 ÷ +100°C. After roasting fish, could be consummated, without any other future gastronomic preparation.

Smoking was realised at temperatures of smoking mixture lower than +80°C. Chilling of fish took place, in a first stage, up to a temperature of +15 ÷ +18°C, and its storage was realised at a temperature between 0 ÷ +2°C.

Technological losses at warm smoking of rainbow trout vary 25-30 % from initial mass [5].

To calculate smoking efficiency is utilised the following formula:

$$RA(\%)=\frac{\text{Weight of carcass after smoking}}{\text{Weight before slaughtering}}\times 100$$

In the case of trout breed *Oncorhynchus mykiss*, carcass is represented by fish body which was eviscerated and were removed gills and kidneys [7].

To determine the chemical composition of smoked rainbow trout meat were gathered samples from side musculature of fishes' bodies.

Gathered samples were subjected to chemical analysis, in according with laboratory methodological norms, respecting all the recommendations imposed by them and in according with the nowadays standards [13, 14, 15, 16].

Proteins were identified by using the Kjeldahl method, which consists in heating of nitrogen from organic combinations and its' transforming in ammonium sulphate, with the help of concentrate sulphuric acid in the presence of a catalyser. By adding a strong alkaline, ammonium is released, and by distillation could be caught into a certain quantity of acid with a well-known normality. Excess of acid it is titrates with an alkaline solution of same normality and, through difference is established the quantity of total nitrogen [12, 13].

Determination of lipids content was realised using Soxhlet method, which consists in fat extraction from the analysed sample using petrol ether.

Were made envelopes from filter paper, which were previous dried in oven at +105°C temperature, for one hour, after that were chilled in desiccators and weighted. After that in each envelope was placed a quantity 3-5 g of meat. The envelopes with samples were placed in oven for drying, for 2 hours, and after chilling in desiccators were weighted again [14].

The ash was determined by calcinations at a temperature of 550±20ºC in calcinations oven.

Determination of dry matter was realised through the method of drying in oven, which is the most used indirect method and suppose the drying of sample in oven at +100 - +105°C, till reaching a constant weight. It is a standardized method in all countries because it is characterized by a very good precision.

RESULTS AND DISCUSSIONS

Fish exposure to smoke action, represent a special stage, determined by the characteristics of raw material. Trout is subjected to some inter-relations with environment, which are decisive regarding its meat quality.

Determination of smoking efficiency was realised for each batch, after a previous chilling of rainbow trout smoked carcasses (table 1).

Table 1 Smoking efficiency at rainbow trout

Specification	Batch	n	Live weight (g) $\bar{X} \pm s_{\bar{X}}$	Smoking efficiency (%) $\bar{X} \pm s_{\bar{X}}$	V%	Min.(%)	Max.(%)
Oncorhynchus mykiss 2nd summer	L1	20	177.91±4.89	51.28±0.24	2.06	49.45	53.17
Oncorhynchus mykiss 3rd summer	L2	20	291.09±6.31	54.91±0.23	1.91	52.44	56.55
Oncorhynchus mykiss 4th summer	L3	20	516.20±15.15	60.97±0.21	1.54	59.30	62.58
Significance of differences between batches' means	L1 vs. L2 = ***; pt. 1:38 GL L1 vs. L3 = ***; pt. 1:38 GL L2 vs. L3 = ***; pt. 1:38 GL						

Analysing the data presented in table 1 are observed some differences in evolution of mean values for smoking efficiency, function of trout waist. So, the mean values of corporal mass were 177.91±4.89 g for batch L1, 291.09±6.31 g at trout individuals from batch L2 respectively 516.20±15.15 g for batch L3.

As regarding the smoking efficiency for the studied individuals of rainbow trout, this one have a mean value of 51.28±0.24% for trout of 2nd summer, 54.91±0.23% at rainbow trout individuals of 3rd from batch L2 and respectively 60.97±0.21% as was recorded in the case of 4th summer trout from batch.

Variation coefficient had values under 10% (V%=1.54-2.06), from which results a very good homogeneity of the studied character inside all three batches.

Analysing statistically the obtained mean values for smoking efficiency at all three batches we observed very significant statistical differences.

In our research, regarding the dry matter content from analysed samples, we obtained values between 36.72 %-41.15%. The highest values were obtained at individuals from 2nd summer (table 2). The obtained values for variation coefficient didn't pass over the limit of 10%, which enlightened a high homogeneity inside the three batches of studied smoked rainbow trout.

Table 2 Dry matter content of smoked rainbow trout meat

Specification	Batch	n	D.M. (%) $\bar{X} \pm s_{\bar{X}}$	V%	Min.(%)	Max.(%)
Oncorhynchus mykiss 2nd summer	L1	20	41.15±0.54	5.90	37.89	46.51
Oncorhynchus mykiss 3rd summer	L2	20	39.86±0.37	4.20	36.85	42.85
Oncorhynchus mykiss 4th summer	L3	20	36.72±0.30	3.60	34.11	39.14
Significance of differences between batches' means	L1 vs. L2 = n.s.; pt. 1:38 GL L1 vs. L3 = ***; pt. 1:38 GL L2 vs. L3 = ***; pt. 1:38 GL					

Statistical differences recorded between batches L1 and L2 were insignificant and the ones recorded between batches L1 and L3, respectively L2 and L3 were very significant.

In according with the data from table 3 the content of smoked rainbow trout meat in proteins is between 28.39±0.18% and 30.42±0.23%, with the highest value (30.42%), recorded at individuals of smoked rainbow trout of 2nd summer.

The studied character is very homogenous, this thing being enlightened by the low values of variation coefficient which not passed over the value of 10%.

Very significant statistical differences were enlightened at individuals from batches L1 and L2 respectively between the individuals from batches L1 and L3, and between batches L2 and L3 recorded differences were insignificant.

Table 3 Protein content of smoked rainbow trout meat

Specification	Batch	n	Proteins (%) $\bar{X} \pm s_{\bar{X}}$	V%	Min.(%)	Max.(%)
Oncorhynchus mykiss 2nd summer	L1	20	30.42±0.23	3.38	29.18	32.83
Oncorhynchus mykiss 3rd summer	L2	20	28.79±0.19	3.03	27.54	30.53
Oncorhynchus mykiss 4th summer	L3	20	28.39±0.18	2.87	26.98	29.84
Significance of differences between batches' means	L1 vs. L2 =***; pt. 1:38 GL L1 vs. L3 = ***; pt. 1:38 GL L2 vs. L3 = n.s.; pt. 1:38 GL					

The effectuated analysis on smoked rainbow trout meat to determine lipids percent enlightened mean values for this character of 9.16±0.19% for batch L1, 8.43±0.32% for batch L2, minimum value (6.84±0.19%) being recorded at batch L3 (table 4).

The studied character is very homogenous, this thing being enlightened by the low values of variation coefficient which under the limit of 10%. Were recorded very significant statistical differences between individuals from batches L1 and L3 respectively between the individuals from batches L2 and L3, and between batches L1 and L2 differences are insignificant.

Table 4 Lipids content of smoked rainbow trout meat

Specification	Batch	n	Lipids (%) $\bar{X} \pm s_{\bar{X}}$	V%	Min.(%)	Max.(%)
Oncorhynchus mykiss 2nd summer	L1	20	9.16±0.23	11.09	7.42	10.71
Oncorhynchus mykiss 3rd summer	L2	20	8.43±0.32	16.94	5.94	8.43
Oncorhynchus mykiss 4th summer	L3	20	6.84±0.19	12.47	5.16	8.37
Significance of differences between batches' means	L1 vs. L2 = n.s.; pt. 1:38 GL L1 vs. L3 = ***; pt. 1:38 GL L2 vs. L3 =***; pt. 1:38 GL					

In the current case ash content of smoked rainbow trout recorded quite low values for all the three studied batches, the lowest value (1.40±0.03%) for this character was determined at batch L3, and the maximal one (1.59±0.01%)was recorded for batch L2.

The studied character was homogenous, aspect proved by low values of variation coefficient which didn't get over the limit of 10%.

Statistical interpretation of the obtained values didn't show the existence of some significant statistical differences between batches L1 and L2. Very significant statistical differences were recorded between batches L1 and L3 respectively L2 and L3 (table 5).

Table 5 Ash content of smoked rainbow trout meat

Specification	Batch	n	Ash (%) $\overline{X} \pm s_{\overline{X}}$	V%	Min.(%)	Max.(%)
Oncorhynchus mykiss 2nd summer	L1	20	1.53±0.03	7.92	1.32	1.77
Oncorhynchus mykiss 3rd summer	L2	20	1.59±0.01	3.92	1.48	1.69
Oncorhynchus mykiss 4th summer	L3	20	1.40±0.03	8.00	1.24	1.65
Significance of differences between batches' means	L1 vs. L2 = n.s.; pt. 1:38 GL L1 vs. L3 = ***; pt. 1:38 GL L2 vs. L3 =***; pt. 1:38 GL					

In according with the data cited in literature the ash content in smoked rainbow trout varies between 1.3 and 2.4% [2].

The obtained values as result as determination of chemical composition of smoked rainbow trout meat for all the three experimental batches are in according with the value mentioned in literature for this fish breed [1, 2, 6, 10].

CONCLUSIONS

Smoking efficiency recorded ascendant values function of age, the lowest values being recorded at trout individuals from batch L1, and the highest ones at individuals from batch L3.

Water content, in the case of smoked trout, is influenced by the smoking method, breed and fish waist.

Quality of smoked rainbow trout meat is characterized by the content in dry matter, proteins and lipids, starting from these premise from quality angle is recommended, for smoking, 2nd summer rainbow trout which have a better quality, fact proved by the highest content in dry matter and proteins.

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