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PHYSICO-CHEMICAL COMPOSITION AND INFLUENCE OF SOME HEAT TREATMENTS ON FISH

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Abstract. ***Fish is a food that has a complex chemical composition with high nutritional value and that is given by the content of protein, lipids, mineral salts and vitamins. It is a very perishable product and failure to comply with food safety conditions can lead to risks to the health of the consumer. The use of heat treatments leads to the formation of compounds that can become toxic to the body. The heat treatments used were boiling, roasting and baking in the oven. These processes bring improvements to the sensory characteristics of the fish. Following the interpretation of the data we can state that roasting is the preferred method of most participants in the tasting of products. The physico-chemical composition and the influence of some heat treatments on the sensory characteristics of the fish were determined.***

Keywords: treatments, rainbow trout, carp, fat, protein, mineral salts.

1. INTRODUCTION

The thermal processes determine an extension of the validity period and the marketing of safe products for the consumer. The processes used in the fish and fishery products industry are designed to achieve microbial control that is safe for the consumer.

Fish-based products that are little processed require short-term storage at refrigerator temperature and consumption as quickly as possible in order to eliminate risks for the consumer [1].

The quality of the final products is significantly influenced by the quality and especially the freshness of the raw material. The freezing and thawing process as well as the storage time have a major influence on the quality of the final product [2].

Reference [3] studies the influence of cooking methods (frying, steaming, oven cooking and microwave cooking) on protein, fat, minerals and fatty acids in red mullet (*Mullus barbatus*) fillets.

Reference [4], evaluates the influence of frying, baking, grilling and smoking on the chemical composition and lipid quality of rainbow trout (*Onchorhynchus mykiss*). They observed significant changes in all the thermal processes used.

Grilling and smoking decreased protein content, and oven-roasted samples showed no changes [4]. Food processing processes improve the taste, aroma and can prolong the shelf life of the fish but can cause the formation of toxic compounds and degrade the physico-chemical composition [5]

Such as it is presented in literature, temperature and time can affect the physical and nutritional quality of fish and fish dishes [6].

The purpose of this study is to evaluate the influence of the thermal process (baking, boiling and roasting) on the physico-chemical parameters in carp (*Cyprinus caprio*), rainbow trout and brook trout (*Salvelinus fontinalis*).

2. MATERIALS AND METHODS

MATERIAL AND WORKING METHOD

A number of 10 samples/carp/rainbow trout/fountain trout were collected and the physico-chemical composition was analyzed after applying the following thermal processes:

- baking
- boiling
- roasting in
    - palm oil
    - sunflower oil

The analyzed physico-chemical parameters are:

- fat
- protein
- water content
- mineral substances

The protein is analyzed by the Kjeldahl method, Büchi model. The stage of mineralization of the organic substance. The amount of sample to be analyzed is 2 g.

The sample to be analyzed is introduced into the test tube of the mineralization block and then the catalyst (0.5 g of copper sulfate + 15 g of anhydrous potassium sulfate) and 25 ml of sulfuric acid.

The addition of sulfuric acid is done in small quantities, to remove possible traces of the sample or catalyst. The test tubes are inserted into the mineralization block.

Mineralization is conducted at high temperature (step 10 of the energy regulator until the water evaporates and then switches to step 8).

After the mineralization is finished, stop the mineralization block and remove the test tubes and wait until they cool down.

The next step is distillation. Mounted in the distillation unit, the device automatically receives the quantities of water and sodium hydroxide required for distillation. The volume of 60 ml of boric acid is sucked into the collection vessel in which the electrode of the pH-meter is also inserted.

The distillation takes 3 minutes, the nitrogen being captured in the boric acid solution. The titration is carried out with the automatic indication of the end point with the help of the pH-meter.

Ammonia is titrated with 0.1 n sulfuric acid solution until the final point indicated by the pH-meter (pH=4.65). In parallel, a control sample containing around 1 g of sucrose is performed instead of the sample to be analyzed.

Two determinations are made on the same sample for analysis. A control analysis is performed by determining the total nitrogen content of acetanilide or tryptophan and adding 1g of sucrose.

The maximum difference between the determinations performed simultaneously must not exceed 3 g/kg of dry substance.

The result is the arithmetic mean of two determinations if the repeatability conditions are met. The result is expressed with a precision of 0.01 g/100g product.

The crude protein content of the product is calculated by multiplying the total nitrogen content by the characteristic factor.

The fat was analyzed with a Soxhlet apparatus. Extraction of fat from fish samples is done with organic solvent (petroleum ether).

Weigh the extraction glass; add 40-50 ml of petroleum ether to the extraction beaker.

The sample is inserted into the extraction cartridge; a 30-minute immersion and washing at 130℃ in the Soxhlet apparatus is carried out.

The drying of the extract is done in an oven at 100° C for 60-90 minutes.

In the next step, it is inserted into the desiccator for 30 minutes to cool the sample and the extraction glass is weighed.

Calcination was used for the analysis of mineral substances. Calcination takes about six hours.

After calcination, the crucible is placed in a desiccator with anhydrous calcium chloride and weighed, after which it is cooled to room temperature.

Cooling takes about two hours. Moisture is determined by drying at 105° C and for a duration of six hours.

3. RESULTS AND DISCUSSION

Figure 1-3 shows the physico-chemical composition for carp and trout after the application of thermal treatments (baking, boiling and frying).

The fat according to the applied thermal process undergoes the following changes: baked carp in the oven has the lowest value of 6.12%, followed by boiled carp 6.58%.

The highest fat content is in carp fried in sunflower oil 6.92%, followed by carp fried in palm oil (Figure 1). Protein ranges in the range of 15.81% for carp fried in palm oil and 16.52% for baked carp.

The water content showed the lowest values of 49.5% for baked carp in the oven and the highest for the boiled carp 55.4% (Figure 1).

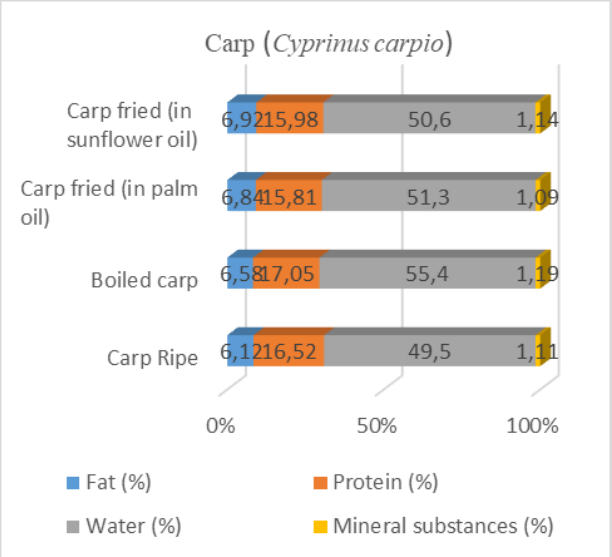


Figure 1. Physico-chemical composition of carp (Cyprinus carpio) under the influence of thermal treatments (baking, boiling and frying).

These treatments influence the physico-chemical parameters in the fish but improve the sensory characteristics (taste, smell, consistency), appreciated by consumers.

Reference [3] evaluates the influence of the frying process on the fat content of red mullet (*Mullus barbatus*)

fillets. Steamed, oven- and microwave-cooked fillets showed the least changes for fat.

The boiling process caused a decrease in Na, Mg and Zn levels. In comparison to the present study, reference [7] evaluates steaming and moderate pan-frying of salmon and notes that this method has no significant impact on lipid oxidation.

Depending on the oil used and the applied process, the fatty acid profile was also modified [7].

Minerals underwent significant changes in cooked trout compared to other thermal processes applied.

In the case of grilled rainbow trout, it was found to be the best method for health with the least physico-chemical changes [8].

The protein in rainbow trout has average values that are superior to well trout, but also superior to carp. The fat content of rainbow trout for all the thermal processes applied shows values lower than fountain trout and carp (fig. 2).

Rainbow trout behaves similarly to the analyzed carp, showing the highest values when roasting with palm oil and sunflower oil.

The average values fall within the range of 3.27% for fat in rainbow trout, cooked in the oven and 3.58% for rainbow trout, fried in sunflower oil.

The mineral substances in rainbow trout range from 1.15% in trout fried in palm oil to 1.20% in boiled trout (fig. 2).

Reference [9], observes a reduction in moisture but an increase in fat, protein and ash content. Microwave cooking is considered the healthiest procedure for preparing rainbow trout.

Reference [10] evaluates the influence of some thermal processes on rainbow trout (*Oncorhynchus mykiss*) and the impact on nutritional value.

Comparing the samples after the application of thermal processes with raw fish, he finds a reduction in quality and a reduction in nutritional value.

Baking and boiling were the best cooking methods among other methods used [10].

These treatments influence the physico-chemical parameters in the fish but improve the sensory characteristics (taste, smell, consistency), appreciated by consumers.

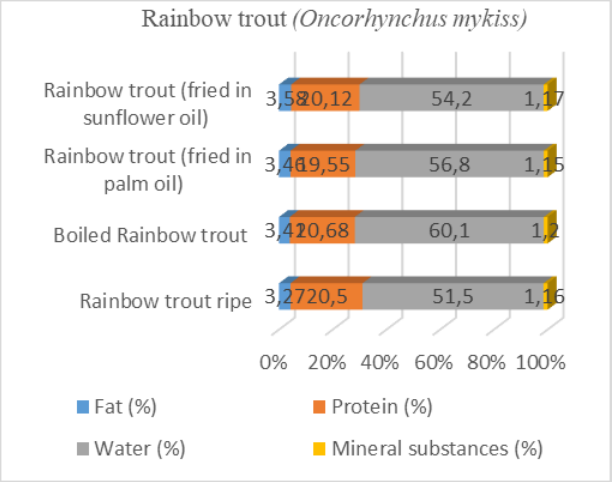


Figure 2. The physico-chemical composition of rainbow trout (Oncorhynchus mykiss) under the influence of heat treatments (baking, boiling and roasting).

Reference [3] evaluates the influence of the frying process on the fat content of red mullet *(Mullus barbatus*) fillets. The cooking process and the temperature used change the organoleptic and chemical properties of the fish [11].

Reference [12], uses different thermal processes (boiling, steaming, microwave oven, frying and baking) and sunflower oil for cooking. Analyzes how vitamin D2 and D3 was retained in rainbow trout.

Following the procedures, there were no significant differences in the retention of vitamin D2 and D3 that were added to sunflower oil.

The influence of the cooking process and the type of oil used for the salmon fillet was highlighted in the study carried out by reference [7].

The physico-chemical composition of rainbow trout (*Oncorhynchus mykiss*) raw and after the application of some thermal processes were evaluated and in other studies such as those reproduced by reference [8].

The influence of frying, boiling and microwaving is also investigated in the study by reference [9], in which he evaluates the physicochemical and mineral composition of rainbow trout (*Oncorhynchus mykiss*).

The fat content in the well trout varied in the range of 3.44% in the ripe one and 4.33% in the range of the one fried in sunflower oil.

The highest values for protein (18.45%) were in well trout, followed by the one fried in sunflower oil (figure 3). The lowest content for mineral salts was in baked well trout in the oven 1.18% and the lowest water content was also in baked in the oven.

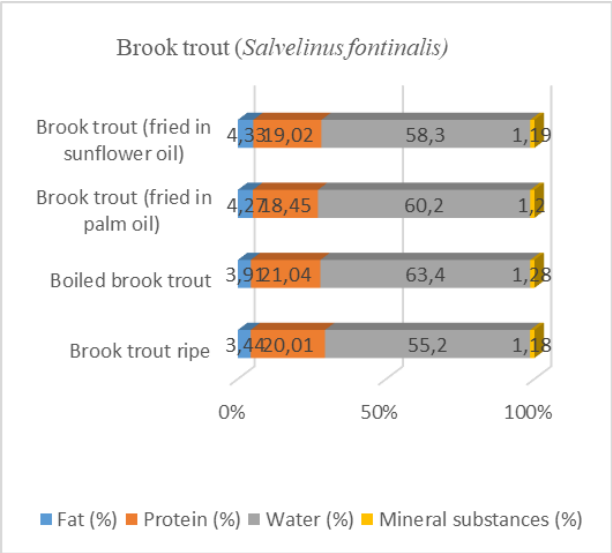


Figure 3. The physico-chemical composition of brook trout (Salvelinus fontinalis) under the influence of heat treatments (baking, boiling and roasting)

Studies on the physical-chemical composition of brook trout are also presented in the study by reference [13]. Another study that determines the influence of temperature and cooking time on fish roe is by reference [14].

He studies the impact of these factors on the meat and the shelf life according to different values for temperature and different action times.

There were changes for the lipids, with the increase of the action time and the increase of the temperature, on the other hand, the proteins did not undergo changes. Heat treatment at 80 °C for 1 hour, brings reduced changes for color, fat oxidation and a safe product for the consumer [14].

The heat treatment (cooking and frying) did not significantly change the composition of the fish compared to raw fish, but the frying procedure brought little changes for the Norwegian trout.

Boiled trout is a product that preserves its content of essential fatty acids and can be recommended due to the daily intake [1].

4. CONCLUSIONS

Frying in sunflower oil and palm oil most influences the fat content of carp (*Cyprinus carpio*), rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) presenting the highest values for the samples in which it was used oil compared to baked and boiled ones.

The protein from carp (*Cyprinus carpio*), rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) was positively influenced by baking and boiling showing the highest values and when frying in palm oil and sunflower oil, the values were more reduced.

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