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QUALITATIVE ANALYSIS OF SILVER CARP AND AFRICAN CATFISH FILLET AND PRODUCTS

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1. OBJECTIVES

Nowadays, extraordinary emphatic role is given to healthy and conscious nutrition as this way we can sustain our body's health. Nevertheless, it is important to know more about the composition of our food. The author studied the raw fillet of silver carp as well as the chemical and fatty acid content of products made of silver carp originated from pond and natural water samples in three different seasons (spring, summer, autumn). The author studied the chemical content of raw fillet of African catfish fed for six weeks with three different oil supplements (fish oil, linseed oil, soy oil) in feed.

Goals of analyses demonstrated here were to answer the following questions:

- What is the chemical composition of silver carp's fillet and how does that vary annually(after overwintering, in the summer and before fish harvesting).
- In which period of year does silver carp contain the most n-3 fatty acid, how does fatty acid content vary after the period of overwintering?
- Which products made of silver carp has the highest n-3 fatty acid content and how does chemical and fatty acid content alter in processed products?
- What preservability do products of silver carp have?.
- In what extent can n-3 fatty acid content of African catfish be increased by oil added feeding.

2. MATERIALS AND METHODS

2.1. Experiments with silver carp

Silver carp experimental stock was obtained from two different sources. One group was obtained from the Mike fish farm (Tógazda Zrt.), from pond conditions. Rearing was carried out in a 60 ha pond where in the previous year 1000 common carps (450 g) and 150 silver carps (700 g) were stocked per hectare. The average body weight of silver carps was 4.5 kg. The other group was obtained from the Öreg-Duna river and its forks between Ásványráró and Kisbodak. The average body weight was 4.5 kg in this group as well.

One sampling was made by season, fish were collected in March, July and October.

Besides of the raw silver carp fillet, 5 products were produced in the fish processing plant in Kisbajcs (Győri „Előre" Htsz.): smoked fillet, smoked pasty, plain pasty, fish sausage and breaded meatball.

10-10 samples were selected randomly from the raw fillets and fish products. Samples were analyzed for chemical composition in the Laboratory of the University of West Hungary. Microbiological analyses were performed on 6-6 samples from each product in the Microbiological Laboratory of the University of West Hungary, to define the shelf life of the products.

2.2. Experiments with african catfish

African catfish stock was obtained from the Tuka fish farm (Szarvas Fish Ltd., Szarvas, Hungary), where rearing was carried out in an intensive system using mixed geothermic water supply. At the average size of 1 kg, juveniles were transported to the Fish Laboratory of the Kaposvár University. Fish was accommodated in 1000 l tanks. Experimental tanks were covered with black plastic, dark environment and frequent feeding helped to avoid stress and aggression among fish.

Stocking density (60-65 kg 1000 l^{-1}) was similar to normal farming conditions. The water flow rate was adjusted to 2.5 l/min and the temperature was 28 ± 0.5 °C. The daily water replacement rate was about 20-25% of the useful volume. The experimental unit had a total useful volume of 10000 l attached to a simple bio-filter unit and a 1600 l settling tank from where the water was pumped back to the fish keeping units.

Feeding experiment was preceded by a 14 day conditioning period. During conditioning, fish were kept in the same system as during the trial. In this period fish were fed a commercial catfish diet (basal diet) containing 6% crude fat.

At the beginning of the experiment, the initial body weight was 1026 ± 121 g (n=374). Ten fish were killed at the beginning of the experiment after anaesthesia. After dissection, fillet samples were analyzed for chemical composition in the Laboratory of the University of West Hungary.

At the beginning of the experiment, three groups were formed. Each group was fed a different diet. The experimental feeds contained, besides

the basic 6% crude fat content 6% added oil from different sources: fish oil, and two vegetable oils, soybean and linseed oil.
Diets were fed six times daily, from 8 to 18 hours, according to appetite. The feeding lasted for 42 days.
Experimental fish were killed (after anaesthesia) after 3 and 6 weeks in the study, each time 5-5 fish from each dietary treatment. After dissection, fillet samples were analyzed for chemical composition in the Laboratory of the University of West Hungary.

2.3. Chemical analysis

The chemical analysis (dry matter, crude protein, crude fat, crude ash) of the fillets and fish products was carried out according to the Hungarian Feed Codex Vol.2. (1990). Fatty acid content was extracted and measured by methil esters with a gas chromathograf (HP Agilent Technologies 6890N Network CC System).

2.4. Microbiological analysis

Products were stored refrigerated at 4 °C for up to 4 weeks, depending on their projected shelf life. Microbiological analyses were performed at weekly intervals. Two replicates of each sample were tested at each sampling time, and the entire experimental program was repeated twice. Our results were primarily compared with the criteria contained in Decree No. 4/1998 (XI. 11.) EüM on the acceptable levels of microbiological contamination in foods (Ministry of Health 1998).

Salmonella spp. were detected and organisms indicating poor hygiene (*Staphylococcus aureus*, *Escherichia coli*) and indicator organisms (total plate count, coliforms, mesophilic sulfite-reducing clostridia, yeasts and molds) were enumerated according to LMBG §35, the German collection of official methods for the investigation of foods (Bundesgesundheitsamt 1991-2004). Detection of *Listeria monocytogenes* was performed following the DIN EN ISO 11290-1 protocol (Deutsches Institut für Normung 2005).

Lactobacilli counts were determined in *Lactobacillus* Agar (MRS; Merck KGaA, Darmstadt, Germany) according to the method of De Man et al. (1960). Samples (10 g) were measured into sterile bags, and 0.1% peptone water was poured into each bag. The mixtures were blended in a laboratory blender (Stomacher 400; Seward Medical, London, UK) at normal speed for 1 min. One milliliter of undiluted stomached solution was pour-plated with MRS Agar, and further serial dilutions were treated similarly. Incubation of plates took 5 days at 30°C under anaerobic conditions, which were generated using anaerobic culture jars (2.5 L) and AnaeroGen AN 25 sachets (Oxoid Ltd., Basingstoke, UK).

2.5. Statistical analysis

Fatty acid and chemical composition data were evaluated and differences between groups means were compared by multiway analysis of variance by using GenStat.11.1.® software (Payne, 2008). Statistical significance was considered at $P<0.05$.

3. RESULTS

3.1. Results of examinations of silver carp's raw filet

Chemical content of raw fillets has been analysed. In 1000 g original substance 316.32 ± 36.15 g dry matter, 184.18 ± 17.36 g crude protein, 121.49 ± 31.78 g crude fat and 13.26 ± 3.02 g crude ash content has been determined.

During the analysis of raw silver carp's chemical content it became apparent that seasons (spring, summer, autumn) do not significantly influence its crude protein content whereas fish fillets originating from summer harvest significantly contained more crude fat ($P<0.05$) than spring and summer samples.

Impact of different seasons (spring, summer, autumn) on fatty acid content has been studied as well. Studying PUFA, significantly less value has been found in summer samples compared to the other two seasons. n-6/n-3 ratio showed no considerable difference in the three seasons' samples. Both EPA and DHA reached significantly lower value ($P<0.05$) in summer samples compared to the other tow seasons' samples.

Pond and natural water originated silver carps' samples did not show considerable deviation in the chemical and fatty acid content, however a significantly greater value of EPA ($P<0.05$) has been measured in the case of natural water samples and that of DHA in the case of pond samples.

3.2. Analysis results of silver carps's products

Five different processed products have been made of silver carp (smoked fillet, plain pasty, smoked pasty, fish sausage, breaded meatball) and were studied their chemical contents besides fatty acid content. Crude protein content of fish has been significantly decreased by each ways of processing ($P<0.05$). SFA, MUFA, PUFA content has been studied besides n-6, n-3 fatty acid quantity and the ration of n-6 and n-3. Considering PUFA significant difference ($P<0.05$) has been experienced in each processing ways. Smoked pasty is equipped with the highest PUFA content among the products, then comes plain pasty, after it carps sausage and then carps meatball. The lowest PUFA content appeared in smoked carp fillet. Considerably the widest n-6/n-3 ratio showed up in smoked pasty ($P<0.05$), significantly ($P<0.05$) narrower than this was the n-6/n-3 ratio of plain pasty. The narrowest n-6/n-3 ratio appeared in the cases of carp meatball, carps sausage and smoked fillet. Highest EPA and DHA quantity ($P<0.05$) could have been presented in the case of carp sausage. Among our products by consuming no more than 43.79 g of carp sausage, 44.92 g of carps fillet and 47.39 g of carps meatball we can reach the suggested daily input value (0.22 g) both from EPA and DHA.

3.3. Results of microbiological analysis

As a result of microbiological analysis smoked carps filet and carps sausage had the longest preservability time: ten days. Preservability time of plain and smoked pasty has been seven days and carps meatball proved to be the weakest with three days of preservability time.

3.3. Results of African catfish experiment

In the case of African catfish's raw fillet on the impact of three kinds of oil added feed we could not present significant difference (P>0,05) in differently handled groups (control, fish oil, linseed oil, soy oil) considering the main fatty acids after the third week. Similarly, considering cumulative SFA, MUFA, PUFA besides n-3, n-6 fatty acids and the relation of n-6 and n-3, no considerable difference could be experienced between control and the three experimental results groups. After the sixth week notable differences could be observed in the case of some important fatty acids. Fish oil treatment showed significantly higher EPA and DHA content compared to the control group. Fish oil group showed the notably narrowest n-6/n-3 ratio (P<0,05), linseed oil group had broader relation (P<0,05), the widest relation has been represented by control and soy oil group. Among the three different feed, supplementation fish oil and linseed oil feed could significantly increase n-3 fatty acid content of samples from the third week on until the end of sixth week which appears in the relation of n-6 and n-3, both oil supplementations notably narrowed (P<0,05) the n-6/n-3 ratio in the raw fillet of African catfish.

Considering DHA, significant deviation was not experienced in any of the groups whereas EPA quantity showed considerable growth in the case of fish oil treatment from third week on until the sixth week. It can be stated that 6% fish oil supplemental feed is able to increase EPA and DHA quantity of African catfish significantly and to narrow n-6/n-3 ratio of fish.

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4. NEW SCIENTIFIC RESULTS

1. Seasons do not significantly influence crude protein content of silver carp's raw fillet while fillet of fish originating from summer harvesting have greater crude fat content (441.6 g/1000 g dry matter) than that of the ones originating from autumn harvesting (364.3 g/1000 g dry matter) or from summer harvesting (384.1 g/1000 g dry matter).

2. The different pond and natural water habitat does not significantly influence the chemical and fatty acid content of silver carp's raw fillet.

3. Processing of silver carps causes significant decrease in crude protein content. Products made with the fewest additives showed the narrowest n-6/n-3 ratio: smoked fillet (0.43), carp sausage (0.51), carp meatball (0.57) and they have the most advantageous EPA and DHA content.

4. Smoking takes the most favourable effect for preserving silver carp fillets as the result of microbiological analysis smoked products have the longest preservability time (from seven to ten days).

5. Feed supplemented with 6% fish oil is able to significantly increase n-3 fatty acid quantity, EPA and DHA content of African

catfish besides to narrow n-6/n-3 ratio of fish during a six weeks' period (from 1.86 to 1.12).

6. On the basis of studies the 6% linseed supplemented feed narrowed the n-6/n-3 ratio of African catfish (1.86 to 1.4) and significantly increased n-3 fatty acids quantity during six weeks. The 6% soy oil supplemented feed was not appropriate for this intention, it did not increase neither n-3 fatty acids, nor n-6/n-3 ratio.

7. LIST OF PUBLICATIONS IN THE THEME OF THE DISSERTATION

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