

Study on the Influence of the Coriander (*Coriandrum sativum*) on the Chemical Composition of the Muscle in European Catfish (*Silurus glanis*)

Petruța Gherescu¹, Gabi Dumitrescu¹, Silvia Pătruică¹, Lavinia Ștef¹,
Sandra Mihailov¹, Miruna Copil¹, Adrian Grozea^{1*}

¹University of Life Sciences „King Mihai I” from Timișoara, 300645-Timișoara, Calea Aradului, 119, Romania

Abstract

European catfish (*Silurus glanis*) plays an important role in aquaculture due to its fast growth rate, its resistance to different environmental conditions, its adaptability to different rearing systems and the high nutritional and qualitative properties of the meat. Studies by many researchers have proven that coriander (*Coriandrum sativum*) has beneficial biological effects in fish, but studies regarding its or other phyto-additives influence on the meat quality of European catfish are sparse. The current study aimed to evaluate the influence of coriander seeds powder as phyto-additive (2 and 4%) in dry food pellets given to the European catfish, on chemical composition of its muscle. The coriander seed powder was administered 14 weeks in fish feed in two trials in duplicate: 2% and 4% to one-year-old European catfish. Three hundred fish were randomly selected and stocked into 6 tanks, 50 fish per tank. At the end of the experiment, 5 fish were collected from each tank, euthanized and used for the evaluation of the muscle quality. A piece of epaxial muscle from the highest part of the body was sampled, and subjected to the assessment of the crude protein and fat content, ash and moisture. The results revealed that coriander do not have a significant influence on muscle quality in general, but led to a significant ($p \leq 0.01$) decrease of crude fat content.

Keywords: coriander, European catfish, muscle quality, phyto-additives, *Silurus glanis*

1. Introduction

Nowadays, aquaculture is one of the swiftest-growing sectors for food production due to the possibility of obtaining high-quality and rich protein sources with efficient digestibility, prosperous amino acid profile, and high content of vitamins and minerals [1]. European catfish (*Silurus glanis*), also known as sheatfish or wels, is a native predator megafish for Eastern and Central Europe as well as Western Asia which plays an important economic value in aquaculture due to increased and fast growth rate, resistance to different environmental conditions and resilience against diseases [2, 3]. Among megafishes

species, European catfish have extreme body sizes with a heightened commercial value due to high nutritive and qualitative meat, well appreciated by consumers and anglers [3]. On the global scale, it is considered among the twenty largest freshwater fish reaching approximately 2.7 m total lengths with an estimated 130 kg of body weight [4]. The wels is known in Romania as the largest fresh water species [5], this fish being reared especially in ponds in polyculture with carps [6]. Previous studies specified that *S. glanis* has a more pronounced nocturnal feeding and can be adapted to feed itself during the daytime but with a reduced voluntary feed intake [7]. This predator has a wide trophic niche, and its diet could be unpredictable because the species fastidiously adapts to novel and available diet sources. For instance, during the invasion of a new habitat, they are characterised by a new adaptable type of

* Corresponding author: Adrian Grozea
Email: adriangrozea@usvt.ro

feeding behaviour (e.g. beaching behaviour) described in terms of praying of semi-aquatic or terrestrial organisms and exotic species such as shrimps and crayfishes [3].

Unfortunately, the aquaculture sector is prone to different infectious diseases, which cause a continuous significant economic impact worldwide [1, 8]. Another meaningful problem is the overuse of antibiotic substances in fisheries and livestock sectors due to the continuous appearance of antibiotic resistance and other side effects [9, 10]. Consequently, antibiotic applications in aquaculture should be reduced. Fish industry sectors are interested in applying alternative antibiotic strategies, such as employing medical plants, probiotics, bacteriophages and natural antimicrobials to combat and control aquatic diseases [11, 12]. Medicinal plants have been used throughout history in medicine, cuisine, and different industries, including aquaculture and livestock sectors, to mitigate the negative outcomes of diseases, suppress food contamination or improve animal and fish productivity traits [12-18]. Plant-based or phyto-additives [19] exhibit different biological and molecular effects for the host due to the presence of different bioactive compounds (i. e., phenolics, tannins, alkaloids, steroids, flavonoids, terpenoids, etc.), which previously provided scientific evidence on the improvement fish growth, appetite, immune system and stress alleviation [14, 18, 20, 21]. Plant-based feed additives could be administered in the diets of fisheries in different forms, for example, in crude or encapsulated form, extracts, mixtures, essential oils, separated active compounds, powders or even mixed with probiotics. The general role of plant-based feed additives is to control pathogenic microorganisms, enhance the growth of aquatic animals, stimulate immunity, and assure water quality.

Literature sources indicated that coriander (*Coriandrum sativum*) supplements are suggested for aquatic animals to stimulate growth performance, antioxidant status and immunity [21-23]. Also, displays strong antimicrobial, antifungal and anthelmintic properties [1, 22]. Coriander seeds contains a rich abundance of A/ β -carotene, linalool, petroselinic acid, linoleic acid, oleic acid, and palmitic acid. Other studies have registered a rich profile of vitamin C and minerals

(i.e., Ca, Zn, Mg, K, and Fe) [1, 21]. The efficient antioxidative and immunostimulant activity of coriander was associated with the increased β -carotene composition and was recently demonstrated in Nile tilapia, which resulted in the mitigation of negative outcomes induced by peroxide radicals [24]. Other researchers have recently stated that the administration of coriander positively influenced the growth performance and the antioxidative and immune responses in various fish species (e., g. European sea bass, Rainbow trout, Nile tilapia, beluga and catla) respectively [1, 21, 23, 24]. Dietary intervention with coriander could enhance the physicochemical properties of meat and act as a detoxification agent against heavy metals [25]. Likewise, dietary intervention with coriander at 10–20 g/kg resulted in a gradual increase in the lipid fraction of European sea bass and beluga meat carcasses compared with the control specimens [21, 26]. Furthermore, beluga fed with coriander showed increased carcass moisture and ash levels [27]. However, no previous reports aimed at exploring the effects of coriander dietary supplementation in European catfish.

Therefore, the novel approach of the current study consisted of assessing the potential of coriander powder feed additive as an additional valuable source in the diets of European catfish, a carnivorous mega fish of high economic importance for Romania. The study aimed to investigate the possible improvements of juvenile European catfish meat carcasses in terms of improving the physico-chemical parameters of meat.

2. Materials and methods

Study design

The study was composed of 300 specimens of juvenile European catfish grown in the recirculated water system randomly selected and distributed in 6 water tanks of 50 specimens/tank. The experiment was carried out at the Pădurea Verde fish farm within the University of Life Sciences "King Mihai I" From Timișoara, Romania. At the beginning of the experimentation, the fish weighed \approx 130 g, and at the finish of the experimental trial the fish subjects reached \approx 644 g.

The daily feed was composed of a high-quality low-fat dietary pellets with the following nutritional composition (Table 1). At the end of the experiment, 5 fish samples were

collected from each tank, euthanized, and utilized to evaluate the physico-chemical properties of meat carcasses. Samples were immediately frozen and stored at -20°C until analysis was performed.

Table 1. Nutritional composition of dietary pellets

Parameter	Value
Protein (%)	49
Fat (%)	10
Crude fibre	1.6
Ash (%)	7.0
Total Phosphorus (%)	1.22
Calcium (%)	1.5
Sodium (%)	0.4
Antioxidants (mg/kg)	
Propyl galate (mg/kg)	70
Butylated hydroxianisole (mg/kg)	70
Vitamins	
Vitamin A (U/kg)	19998
Vitamin D3 (U/kg)	1264
Gross Energy (MJ/kg)	20.5
Digestible energy (MJ/kg)	17.5
Pellet size (mm)	3.0
Trace elements	
Iron (mg/kg)	40
Iodine mg/kg)	
Copper mg/kg)	3.3
Manganese mg/kg)	13.3
Zinc mg/kg)	40

Protein determination

First, the Kjeldahl method was chosen to determine the brute protein content of the *S. glanis* meat based on the determination of total nitrogen levels. A segment of epaxial musculature was collected from the highest part of the fish anatomical segment and was subjected to homogenisation. A proportion of 0.5 g from the homogenised sample was weighted and introduced in the Kjeldahl flask, where an additional 15 g of potassium sulphate, 0.5 g of copper sulphate and 20 ml of concentrated sulfuric acid was added. Next, the tube with the sampled and mixed content was introduced into the automatic analytical digestion block and connected to the system with the suction module. After the samples reached a temperature of 420±10°C, the mineralisation was prolonged for approximately 80 minutes and was left to cool down. The total time of digestion took at least 2 hours. The mineralisation of the sample

was analysed according to the SR ISO 937/2007, which stands for meat and meat products standard. Determination of nitrogen content (Reference method) [28].

The calculation method and formula applied for the nitrogen content evaluation were expressed in percentages (% of nitrogen) equal to:

$$0.0014 \times (V_1 - V_0) \times \frac{100}{m}$$

V₁- is the volume expressed in millilitres of hydrochloric acid (0.1 N) solution used for the control sample;

V₀- is the volume, in millilitres, of the hydrochloric acid solution (0.1 N) required for analysis;

m - is the mass, expressed in grams, of the sample to be tested.

Total fat content

Secondly, the free fat content from the fish meat was determined by extraction with organic solvents (by petroleum ether) by utilizing the Soxhlet method according to the standard SR ISO 1444/2008 for meat and meat-based products [29]. A cut of epaxial muscle was well homogenised, and then 5 g of the sample was weighed at the analytical balance with a precision of 0.001 g. The sample was dried in an oven-drying procedure at a temperature of $103 \pm 2^\circ\text{C}$ according to the SR ISO 1422-2010 standard to determine the moisture content. The dried sample was inserted inside a filter cartridge with filter paper. Next, the sample was introduced into an extraction filter cartridge (the cartridge can also be manufactured from low-porosity dried and degreased filter paper). The weighing vial utilised for sample drying was wiped with cotton swabs soaked in solvent and inserted into the filter cartridge, plugged with a cotton swab and fixed in the extractor through a metal ring. A few pieces of pumice stone were inserted into the extraction glass and dried for 1 hour at a temperature of $103 \pm 2^\circ\text{C}$. The cooling of the flask was done in a desiccator for 30 minutes and weighted with a precision of 0.001 g, respectively.

Subsequently, the extraction solvent (75 ml of petroleum ether) was poured into the glass of the extraction apparatus. The glass was fixed to the extraction device, after which the extractor program was started according to the work instructions IL-LC-37. After the machine program was completed, the glass was kept in the water bath until the solvent reached complete evaporation and further was inserted into the oven. After preliminary drying in the oven at a temperature of $103 \pm 2^\circ\text{C}$, the glass was removed and left for 30 minutes in the desiccator. After cooling, the glass is weighed on an analytical balance with a precision of 0.001g. The heating in the oven and the cooling in the desiccator are repeated until the difference between the two weightings does not exceed 0.1% of the weight from the sample taken for analysis. Calculation and expression of the results were represented according to the following formula:

$$w_f = \frac{m_2 - m_1}{m_0} \times 100\%$$

m_1 = mass of the extraction cup with the porcelain pieces installed for boiling;

m_2 = mass of the glass and porcelain pieces with fat after the drying process;

m_0 = mass of the sample taken for drying;

The results are reported and rounded to two decimal places and expressed in g.

Moisture evaluation

Next, the evaluation of mineral substances (crude ash) was accomplished by calcinating the fish meat samples at $525 \pm 25^\circ\text{C}$ until reaching the constant weight, whilst the residue represented the total mineral substance (ash) level. The followed procedure was respected according to the previously described method [30] and was in accordance with the standard

SR ISO 936/2009 designed for meat and meat-derived products determination of the total ash.

Finally, the meat moisture was determined by oven drying method at a temperature of $103 \pm 2^\circ\text{C}$ until a constant mass was observed. The mass fraction of the ash from the hypaxial muscle pieces was calculated according to the following equation:

$$W_a = \frac{(m_2 - m_0)}{(m_1 - m_0)} \times 100 \%$$

W_a - mass fraction of ash, as a percentage, of the test sample;

m_0 - mass (g), from the empty vial;

m_1 - mass, (g), of the vial with the testing sample;

m_2 - the mass (g), of the dish with the ash.

Statistical analysis

The data was analyzed using the STATISTICA 10 software. The significance of differences was assessed using the Kruskal-Wallis test. The statistically processed data are presented in the paper as Mean \pm SD. P -values < 0.05 and $P \leq 0.01$ were considered statistically significant.

3. Results and discussion

Coriander is one of the herbal supplements suggested for different aquatic animals. However, no previous studies investigated the outcomes of coriander seed in the diets of European catfish. The results from table 2 depicted that coriander diet supplementation did not induce any significant changes in the moisture, protein content of *S. glanis* epaxial muscle. The values showed insignificant variations in moisture between all groups ($P > 0.05$), ranging from $78.53 \pm 0.32\%$ (control), $78.46 \pm 0.42\%$ (trial 2) and

78.62±0.19% (trial 1). Similar insignificant differences ($P>0.05$) were registered between groups for crude protein and ash fractions. The exception was only observed for the crude fat content, which displayed significant ($P\leq 0.01$) decreasing trends in both trials (0.68±0.03% and 0.60±0.05%) compared with the control group (0.80±0.03) after coriander was introduced into the fish diet as the phyto-additive. An equivalent decreasing tendency of crude fat after coriander powder supplementation was also observed in edible portions of common carp (*Cyprinus carpio*) [31]. Despite the coriander treatment, our results are in line with the earlier studies, which reported a similar proximate composition of European catfish meat by reporting approximation values of moisture 79.5%, crude protein 17.45%, crude fat 1.12%, including the ash 1.9% content [32]. Another example of megafish, namely the Mekong giant catfish (*Pangasianodon gigas*),

previously mentioned in a study, displayed analogously chemical and physical properties of dorsal cut by showing approximate content of moisture 78.88±0.17 mg/g, protein 19.00±0.03 mg/kg, fat 0.54±0.14 g/100 g and ash 1.47±0.12 g/100 g, respectively [33]. The latest studies including different species of fish, such as European sea bass (*Dicentrarchus labrax*), coriander seed supplementation at the concentration of 5, 10, and 20 g/kg resulted in a significant increase in the fish weight gain and final weight [21]. The authors also reported that coriander did not influence the carcasses' initial and final body chemical composition after 150 days of experimentation. Their study concluded that coriander advanced the growth performance and the levels of growth hormones, improved feed utilisation and regulated the blood biochemical as well as haematological parameters, which facilitated an activated immune response.

Table 2. Proximate composition of *Silurus glanis* epaxial muscle from 3 experimental groups

Composition (g/100g sample)	Group		
	Control (0%)	Trial 1 (2%)	Trial 2 (4%)
Moisture	78.53 ± 0.32 ^a	78.62 ± 0.19 ^a	78.46 ± 0.42 ^a
Crude protein	18.39 ± 0.37 ^a	18.08 ± 0.26 ^a	18.30 ± 0.44 ^a
Crude fat	0.80 ± 0.03 ^a	0.68 ± 0.03 ^b	0.60 ± 0.05 ^b
Ash	1.33 ± 0.06 ^a	1.39 ± 0.07 ^a	1.35 ± 0.08 ^a

Values are given as mean±SD. Different lowercase superscripts in the same row indicate significant differences ($P\leq 0.05$) between groups

4. Conclusions

Our results revealed that coriander does not significantly influence the general muscle quality of European catfish. Anyway, the introduction of coriander powder to the dry feed could lead to a significant decrease in crude fat content in epaxial muscle.

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