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# Comparison of chemical composition and physicochemical properties of meat of males and females of African catfish (*Clarias gariepinus* Burchell, 1822)

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## Abstract

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The objective of this study was to analyze gender differences in the chemical composition and physicochemical properties of African catfish meat. The experimental material included fish with body weight of ca. 1 kg, aged < 1 year, cultured in the intensive system (pond culture). Fillets were analyzed for the proximate chemical composition, energy and TBARS value. Additional analyses were conducted for natural drip and thermal loss, for water-holding capacity and shear force. Acidity ($pH_u$) was determined 24 h *post mortem* in fillets and in an aqueous homogenate. The colour of the external and internal surface of fillets was characterized based on L*, a*, b* values. The statistical analysis showed no effect of gender on the chemical composition, energy and TBARS value of the muscle tissue of catfish. Meat of both sexes was characterized by high contents of total protein and fat and by low calorific value. In addition, fillets of both analyzed groups of African catfish had appropriate acidity and small natural drip loss. It was demonstrated that, compared the males, meat of females was characterized by higher water-holding capacity, tenderness and thermal loss. The internal and external surface of fillets of the male fish was darker and characterized by greater contribution of red and lesser of yellow colour.

*Keywords:* African catfish; fish gender; chemical composition; physicochemical properties

## Introduction

African catfish (*Clarias gariepinus)* occurs mainly in Africa and south-eastern Asia. Its habitats include steady lakes, rivers and swamps as well as seasonally-flooded areas. On the evolutionary road, this fish species has adapted to living in unfavourable environmental conditions. Owing to specific gill morphology, long body, spine-ended pectoral fins and high capability to produce mucus, it may function in aquifers with limited access of nitrogen which disappear in the dry season. In its natural habitat, the catfish is an omnivorous predator, feeding with zooplankton, arthropods, molluscs, other fish, reptiles and amphibian. It usually preys at night, hence its eyes were subject to significant regression. It localizes the prey mainly by touch, using 4 pairs of barbells located around the mouth (Yalçin et al., 2001b; Pruszyński, 2003; Turan et al., 2005; Vitule et al., 2006; Amisah et al., 2009). In culture conditions, this species is claimed to easily adapt and have no large requirements regarding water quality indicators. Nevertheless, the intensive culture of catfish tends to achieve possibly the highest body weight of fish in a short period of time, which is feasible only under optimal conditions. Commercial culture enables production of fish with unitary body weight of 800-1000 g within 6-8 months.

According to Adamek (2011), fish with an average unitary body weight above 1200 g are the most desired on the Polish market. Noteworthy is that the reproduction of catfish is seasonal and linked with maturation of gonads depending on water level, its temperature and access of light. In the pond culture, females of *C. gariepinus* reach sexual maturity after 6-7 months, whereas gonads of males become well-developed already after 1.5-2.0 years (Yalçin et al., 2001a; Adamek, 2011).

Meat of African catfish is a valuable source of cheap, high-quality and easily-digestible protein. An additional advantage of this fish species is pink, almost boneless and tasty meat, as well as high yield in the production of both carcass and fillet. The average slaughter yield of *Clarias gariepinus* is at 38.9%, and the content of total protein in meat reaches 18.6% (Adamek, 2011). The intensity of feeding, type and quality of administered feedstuff, as well as intake of natural feed by fish determine the chemical composition of fish body (mainly contents of protein and fat), energy value and sensory attributes, i.e. colour, texture, taste and aroma. The use of industrial feed mixtures may contribute to an increased content of fat not only in meat but also in the whole body, thereby reducing carcass yield (Jankowska et al., 2007b; Puchała & Pilarczyk, 2007). In trade, African catfish are sold in the form of live fish, carcasses, and hot-smoked or frozen fillets. However, without appropriate pre-treatment (earlier catch and fasting for ca. 3-4 days) which deprives them of unpleasant odour of environment and feed that penetrates into meat and skin (Sadowski & Trzebiatowski, 1993), they are unsuitable for sale.

The available literature works provide relatively scanty data on differences in the utility value between females and males of *C. gariepinus* originating from pond culture. For this reason and due to poor knowledge of dietary and technological values of meat of this species among Polish consumers, a study was undertaken with the aim to analyze results to evaluate the quality of meat of African catfish depending on gender.

## Material and Methods

### Experimental fish, diets and origin

The experimental material included 40 fish of African catfish (*Clarias gariepinus* Burchell, 1822) with body weight of ca. 1 kg and age of < 1 year, with a sex ratio of 1:1 (females ♂ : males ♀). Fish were caught in the autumn-winter season of 2016 at the Agricultural Farm specializing in the culture of fresh-water fish, located in the northern part of Poland. During rearing, the catfish were cultured in a concrete pond (in the intensive system) with the volume of 9000 L and a closed circuit of water having the temperature of 25 ± 1°C. The fish were fed manually (every 3 h) with pelleted feed prepared at the farm. The composition of feed was as follows (per 100 kg): 17.8 kg of fish meal, 44.6 kg of extracted soybean meal, 14.9 kg of wheat grain, 7.4 kg of corn grain, 11.9 kg of rapeseed cake, 2.4 L of fish oil, and 1 kg of a vitamin-mineral premix. Contents of basic nutrients in feed were determined at the Laboratory of the Department of Animal Nutrition and Fodder Science, University of Warmia and Mazury in Olsztyn (Poland), according to AOAC (2005). The pelleted feed mixture contained: 33.57% of total protein, 5.82% of crude fat, 6.45% of crude ash, and 3.80% of crude fibre, whereas its energy value reached 17.229 MJ/kg.

### Preparation of fillets and meat samples

The fish were caught 48 hours before slaughter and transferred to a separate pond at the farm and subjected to physiological cleansing, then stunned and slaughtered accordingly to standard procedures (EC Directive, 2009/1099). Catfish pre-treatment included: manual evisceration (opening of body cavity, removal of viscera and blood clots), decapitation (cut behind epicranium outgrowths), removal of fins (cutting off: caudal, dorsal, abdominal and pectoral fins ca. 0.5 cm from the base) and filleting. The analytical material included 40 fillets without skin (left ones) that were earlier cooled for 24 h to a temperature of 4 ± 1°C in a chilling chamber by Frost company (Hamilton, Ontario, Canada) with relative air humidity of 85% Meat samples of the catfish were then analyzed at the Laboratory of Meat Quality Assessment of the Department of Commodity Sciences and Animal Raw Material Processing, University of Warmia and Mazury in Olsztyn (Poland) for quality attributes.

### Chemical composition, energy and TBARS value of meat

The evaluation of the proximate chemical composition involved determinations of contents of: water (PN-ISO, 2000a), total protein with Kjeldahl method (PN-A, 2002) using the FOSS Tecator Kieltec 2200 System I (Höganäs, Sweden), crude fat acc. to Soxhlet (PN-ISO, 2000b) using the FOSS Tecator Soxtec$^{TM}$ Avanti 2050 extractor (Höganäs, Sweden), and crude ash (PN-ISO, 2000c). Meat was also analyzed for the content of hydroxyproline (PN-ISO, 2000d), that was next expressed per total collagen content using a conversion factor of 7.25 (Palka, 1999). In order to determine oxidative changes of intramuscular lipids of meat, the content of thiobarbituric acid- reacting substances (TBARS) was determined according to Rak and Morzyk (2002). Absorbance of the samples was measured (at $\lambda$ = 532 nm) with a Specord 40 spectrophotometer by Analityk Jena AG (Jena, Germany), and values achieved were expressed in mg of malondialdehyde per 1 kg of meat. The energy value of meat was calculated using conversion factors for protein and fat, i.e. 4.00 kcal (16.78 kJ/g) and 9.00 kcal (37.62 kJ/g), respectively (Jeszka, 2010).

**Physicochemical properties and shear force of samples**

Acidity of muscle tissue was measured 24 h *post mortem* immediately after catfish carcasses cooling in fillets (left ones) and in the aqueous homogenate of meat (ultimate acidity-$pH_u$), assuming the quantitative ratio of meat to redistilled water at 1:1. Measurements were taken with a 340i pH-meter with a TFK 150/E temperature sensor by WTW company (Weilheim, Germany) equipped in a combined electrode (Double Pore) by Hamilton (Bonaduz, Switzerland). Before measurements, the pH-meter was calibrated against buffers with known pH (PN-ISO, 2002).

To determine natural drip (Honikel, 1998), a weighed sample of meat (ca. 20 g) was placed in a string bag (PE) and suspended in an incubator at air temperature of 4 ± 1°C. After 24 h, the sample was carefully dried and weighed again with the accuracy of 0.001 g. The size of natural drip was calculated from the difference between sample weight before and after cold storage. In turn, thermal loss (Honikel, 1998) was determined by weighing the meat sample (ca. 50 g) and subjecting it to heat treatment in string bags (PE) in a water bath with a temperature of 75°C for 50 min. Afterwards, the samples were cooled (30 min) under the stream of cold water, dried and weighed with the accuracy of 0.001 g. The value of thermal loss was determined from the difference between meat sample weight before and after heat treatment.

Water-holding capacity was determined with Grau and Hamm method (Van Oeckel et al., 1999) by placing a ground sample (300 mg) on Whatman blotting-paper no. 1. The blotting-paper with the sample was fixed between two glass plates and exposed to pressing of 5 kg for 5 min. After the assumed pressing time, boundaries of surfaces occupied by the meat sample and drip of meat juice were drawn on the blotted-paper, and scanned. Afterwards both surfaces were planimetred with the use of digital image analysis using MultiScanBase ver.18.03 software by Computer Scanning System III, Ltd. company (Warsaw, Poland). The measure of the size of enforced drip of meat juice was the difference of both size areas that was converted per 0.3 g, which represented the result corresponding to water-holding capacity ($cm^2$) (higher value meaning lower water-holding capacity of meat).

Meat samples prepared like for thermal loss determination were wrapped in aluminium foil and stored for 24 h at a temperature of 4 ± 1°C. Cylinders (at least n = 3) with diameter of ca. 1.27 cm and height of 2 cm were cut out of samples, cut crosswise to muscle fibres in the INSTRON 5542 (Norwood, MA, USA) universal testing machine equipped with a Warner-Bratzler head (500 N, speed of 100 mm/min). The maximum force required to cut the specimens was registered.

**Colour parameters measurement**

The colour of fillets was characterized based on values of L*, a*, b* parameters in the CIELAB system (CIE, 1978) with the reflectance method, using a HunterLab MiniScan XE Plus spectrocolorimeter (Hunter Associates Laboratory Inc., Reston, VA, USA) by direct 3-fold measurement of their internal surface (from the abdominal side) and external surface after skinning, performed at the same points relative to surface area. In colour analysis, it was using illuminant D65, a 10° standard observer angle and aperture diameter of 2.54 cm. Measurements were carried out after 0.5-h storage of fillets at 4 ± 1°C. Before each measuring session, the apparatus was calibrated against white and black standards.

**Statistical analysis**

The results were processed statistically by one-way analysis of variance in the Statistica computer software version 13.1 program (2016). They were presented in tables as mean values, standard deviation and standard error of the mean (SEM). The significance of differences ($p \leq 0.05$ and $p \leq 0.01$) between the means values of chemical composition, TBARS values and physicochemical properties in male (n = 20) and female (n = 20) catfish was analyzed by the Student's t-test.

## Results and Discussion

Data on the chemical composition of meat of the evaluated fish species (Table 1) show that contents of total protein, crude fat and total collagen in females were at: 17.42%, 5.76% and 0.99 mg/g fresh tissue. These values were slightly higher than the respective values determined in males, however no statistically significant differences were reported. Another significant component of meat quality evaluation is the content of crude ash which represents the total content of mineral compounds left after samples incineration. The conducted statistical analysis confirmed a significant effect of gender on ash content in meat of African catfish. Females were characterized by a higher (by 0.07%) content of this component compared to males. The reported higher contents of total protein, fat and ash in muscle tissue of female fish corresponded also with a lower percentage content of water (i.e. ♀ 75.15 vs. ♂ 76.03%). The statistical analysis of results achieved in our study (Table 1) did not confirm differences in protein hydratation of meat of *C. gariepinus* males and females expressed by the W/P ratio (i.e. 4.40 and 4.31, respectively). In our study (Table 1), no statistical differences were determined depending on the gender of catfish, however a tendency was observed for a higher energy value (by 24.55 kJ) in meat of females compared to males (♂ 484.32 kJ/100 g). Our study demonstrated that the cooled muscle tissue of both males and females of African catfish was characterized by a low TBARS value (0.25 and 0.35 mg MDA/kg meat, respectively), which was indicative of high oxidative stability of lipids.

The pH value is one of the critical parameters which affect the growth of microorganisms and food spoilage. Data collated in Table 2 show that fillets of African catfish were characterized by a similar pH value measured 24 h *post mortem* in both analyzed groups (♂ 6.33, ♀ 6.28) and 48 h *post mortem* measured in aqueous homogenate from meat (♂ 6.55, ♀ 6.56). The conducted analysis of normal drip loss in fillets of African catfish showed no significant effect of gender upon mean values of this characteristics (Table 2). In contrast, it demonstrated that meat of catfish males was characterized by a higher ($p \leq 0.01$) value of thermal loss (27.14%) compared to females (24.69%). The extent of losses of meat weight during heat treatment has a significant effect on the scores of sensory attributes, flavour and juiciness in particular. Results achieved in the study demonstrate that the muscle tissue of fillets obtained from male fish was characterized by lower water-holding capacity of own and added water, which was indicated by a significantly higher value of this parameter – 8.11 $cm^2$. Meat of *C. gariepinus* females was characterized by higher water-holding capacity and, thereby, better usability for processing and culinary treatment. Results presented in Table 2 demonstrate also the effect ($p \leq 0.01$) of gender on the value of shear force in the analyzed experimental groups. Definitely higher tenderness was determined in muscle tissue of female fish, which was confirmed by the achieved lower value of the discussed parameter (4.04 N).

Data concerning the colour of the internal surface of fillets of African catfish (Table 3) showed a highly significant effect of gender on lightness (L*), contribution of red (a*) and yellow (b*) component. It was demonstrated that the muscle tissue of females was characterized by higher values of L* (49.25) and b* (16.50) parameters, compared to meat of males, which was confirmed statistically ($p \leq 0.01$). The statistical analysis of results achieved in our study demonstrated a significantly higher ($p \leq 0.01$) value of a* coordinate of the internal sur-

**Table 1. Chemical composition, calorific and TBARS value of *C. gariepinus* meat**

| Specification | African catfish | | SEM |
|---|---|---|---|
| | Male – ♂ (n = 20) | Female – ♀ (n = 20) | |
| Moisture (%) | 76.03 ± 0.77 | 75.15 ± 0.60 | 0.252 |
| Protein (%) | 17.32 ± 0.79 | 17.42 0.16 | 0.249 |
| Fat (%) | 5.15 ± 0.75 | 5.76 ± 0.66 | 0.296 |
| Ash (%) | $1.06^b$ ± 0.08 | $1.13^a$ ± 0.02 | 0.015 |
| Total collagen (mg/g wet tissue) | 0.90 ± 0.15 | 0.99 ± 0.04 | 0.026 |
| Water/protein ratio (W/P) | 4.40 ± 0.21 | 4.31 ± 0.04 | 0.035 |
| Energy value (kJ/100 g) | 484.32 ± 40.15 | 508.8 ± 22.65 | 10.285 |
| TBARS value (mg MDA/kg meat) | 0.25 ± 0.09 | 0.35 ± 0.13 | 0.027 |

The results obtained were expressed as mean ± SD; mean values denoted by different letters in the row are statistically significantly different at: $^{a, b}$ – $p \leq 0.05$; SEM – standard error of means

**Table 2. Physicochemical properties and shear force of *C. gariepinus* fillets**

| Specification | African catfish | | SEM |
|---|---|---|---|
| | Male – ♂ (n = 20) | Female – ♀ (n = 20) | |
| $pH_{24}$ | 6.33 ± 0.09 | 6.28 ± 0.09 | 0.020 |
| $pH_{u\ (ultimate)}$ | 6.55 ± 0.17 | 6.56 ± 0.09 | 0.030 |
| Drip loss (%) | 1.05 ± 0.38 | 0.97 ± 0.07 | 0.061 |
| Thermal loss (%) | $27.14^A$ ± 0.79 | $24.69^B$ ± 0.82 | 0.434 |
| Water-holding capacity ($cm^2$) | $8.11^A$ ± 0.53 | $7.18^B$ ± 0.70 | 0.173 |
| Shear force value (N) | $6.63^A$ ± 0.87 | $4.04^B$ ± 0.82 | 0.394 |

The results obtained were expressed as mean ± SD; mean values denoted by different letters in the row are statistically significantly different at: $^{A, B}$ – $p \leq 0.01$; SEM – standard error of means face of fillets produced from males (11.75) compared to fillets from female fish (8.65), which confirms findings reported by Wedekind (1995). The characteristics of colour profile of the external surface of fillets from the investigated species of fish was presented in Table 3. It shows no effect of sex on values of L* and a* parameters. However fillets of male fish were characterized by darker colour (L* = 41.96) and a higher value of the red component of colour (a* = 15.54) compared to fillets from female fish (43.14 and 14.53, respectively). The statistical analysis demonstrate that the contribution of yellow pigment, measured from the side of the removed skin, was significantly higher ($p \leq 0.05$) in females and reached 12.73.

The nutritive value of fish results from the content of easily digestible protein, high content of n-3 and n-6 fatty acids as well as minerals and vitamins. All these compounds are utilized by the body as a building material, as sources of energy and factors that regulate metabolic processes (Polak-Juszczak & Adamczyk, 2009). Protein content of fish reaches ca. 16-20% on average, while tuna is characterized by its higher content accounting for ca. 25%. Noteworthy is that fish protein is not only of high quality (is characterized by beneficial and rich amino acid composition) but is also easily digestible, i.e. more easily than the protein of meat of slaughter animals, protein of dairy products or even eggs (Skibniewska & Zakrzewski, 2008; Skibniewska et al., 2013). African catfish is also an interesting species in terms of technological value and chemical composition of meat. As reported by Klasa and Trzebiatowski (1992), muscle tissue of catfish is characterized by a low fat content (3.5%) and a high total protein content (17.9%). According to Kapelinski (2003), the content of fat in meat of these fish produced in farm conditions was at the level of ca. 3-4%, which classifies them as especially suitable for cold-smoking and with low calorific value. In turn, Łuczyńska et al. (2011) demonstrated that the muscle tissue of carps collected from the dorsal part of fish had the lowest fat content (2.81%), whereas samples of trout meat were characterized by a higher (4.93%) and these of salmon meat- by the highest content of fat (11.57%). The composition and quantities of mineral substances in meat of livestock animals, including fish, depends mainly on the availability of these elements in feed mixtures, on species, physiological condition and age of animals (Skibniewska et al., 2012). Data obtained by Polak-Juszczak (2007), i.e. 17.90, 5.30, 0.98 and 75.53% of total protein, free fat, crude ash and water, respectively, in meat of African catfish were similar to results reported in our study. In comparing data presented in Table 1 with findings from the study by Yanar (2007), it was concluded that fresh meat of *C. gariepinus* catfish evaluated by this author was characterized by significantly lower contents of fat (3.64%) and ash (0.68%) and by slightly higher contents of protein (17.85%) and water (77.89%). According to Goda et al. (2007), water content in muscle tissue of the analyzed species of fish fed a standard feed mixture accounted for 75.73%, whereas that of total protein- for 15.96%. These authors achieved also a significantly higher content of crude ash (3.71%) and, simultaneously, a lower content of fat (4.60%). When analyzing the chemical composition of meat of whole marine fish (2 species), Skałecki et al. (2008) demonstrated that muscle tissue of herrings, compared to that of cod, was characterized by a significantly lower water content (69.66% and 80.44%, respectively), but by a higher fat content (8.35% and 0.95%), with a similar content of protein (17.01% and 17.66% in herrings and cods, respectively). In turn, in the study conducted by Skałecki et al. (2013a) with fresh-water fish, protein content in meat of carp reached 17.21%, whereas according to Puchała and Pilarczyk (2007), the content of this component ranged from 11.85 to 17.74%. The above-mentioned authors emphasize that fat content was increasing along with size of fish, which was linked to a great extent with feeding. Data achieved by Skibniewska et al. (2013) regarding the effect of different rearing systems of carps (*Cyprinus carpio* L.) on the mean protein content in their meat indicated that the highest content of this component (18.07%) was found in fish from intensive production, and the lowest one- in fish from low-intensive culture. The optimal degree of protein hydratation in both experimental groups was comparable to the values re-

**Table 3. Colour parameters of the surface of *C. gariepinus* fillets**

| Specification | | African catfish | | SEM |
|---|---|---|---|---|
| | | Male – ♂ (n = 20) | Female – ♀ (n = 20) | |
| Internal surface | L* | $46.69^{B} \pm 0.78$ | $49.27^{A} \pm 0.80$ | 0.422 |
| | a* | $11.75^{A} \pm 0.96$ | $8.65^{B} \pm 0.98$ | 0.440 |
| | b* | $15.13^{B} \pm 0.91$ | $16.50^{A} \pm 0.93$ | 0.220 |
| External surface | L* | 41.96 ± 0.74 | 43.14 ± 0.67 | 0.376 |
| | a* | 15.54 ± 0.74 | 14.53 ± 0.77 | 0.400 |
| | b* | $11.25^{b} \pm 0.88$ | $12.73^{a} \pm 0.96$ | 0.365 |

The results obtained were expressed as mean ± SD; mean values denoted by different letters in the row are statistically significantly different at: $^{A,B}$ – $p \leq 0.01$; $^{a,b}$ – $p \leq 0.05$; SEM – standard error of means ported by Yanar (2007) – 4.74, Goda et al. (2007) – 4.36 and Polak-Juszczak (2007) – 4.21. In turn, Skałecki et al. (2013b) demonstrated a higher degree of muscle protein hydratation (3.92) in a group of rainbow trout from S weight category (to 350 g), which was attributable to higher water and lower total protein content.

Carbohydrates, proteins and fats are meat components which determine its energy value. The average serving of fish (100 g) is characterized by a calorific value ranging from less than 400 to ca. 1225 kJ. Despite higher gross energy value, the very fat fish are still less calorific than other products of animal origin (Jeszka, 2010). According to the Polish Standard (PN-A, 1999), fat content in muscles below 7% classifies the African catfish to a group of medium-fat fish. Values obtained in both groups regarding the aforementioned parameter in *C. gariepinus* meat fitted within the bottom range and reached 496.59 kJ/100 g on average, which confirmed low calorific value of catfish meat. According to Rosa et al. (2007), the energy value of 100 g of fresh muscle tissue of catfish reached 457.90 kJ and was lower than the values presented in Table 1 (♂ 484.32 and ♀ 508.87 kJ).

Direct, adverse symptoms of autooxidative processes which affects meat quality include products of secondary lipid oxidation expressed by the concentration of malondialdehyde (MDA) (Kamkar et al., 2014). In the experiment conducted by Yanar (2007), the average level of TBA lipids in fresh muscles of *C. gariepinus* reached 0.45 mg MDA/kg, and upon the smoking process increased to 0.84 mg MDA/kg. In turn, Kamkar et al. (2014) who analyzed fresh fillets of silver carp, demonstrated that the initial content of malondialdehyde was at 0.54 mg MDA/kg, whereas on completion of the 30th day of storage at -3ºC it increased to 3.75 mg MDA/kg.

Throughout fish lifespan, the pH value maintains in the range of 6.7 to 7.0 and is subjected to changes depending on the season, feeding, stress responses and activity of fish (Yanar, 2007; Merkin et al., 2010). The analysis of pH value of fillets from Atlantic salmon conducted by Erikson and Misimi (2008) confirmed the significant effect of fish catch method on pH value and time of *rigor mortis* development. In the case of muscle tissue sampled from anaesthetized fish, the pH value reached 7.5 and was higher than in meat of exhausted fish (pH = 6.7). The aforementioned authors stated that in both analyzed groups of fish *rigor mortis* occurred at similar pH, i.e. at 6.6 and 6.7. According to Marx et al. (1997), the limit value of $pH_{24}$ for fresh fish meat is at 6.5. In turn, Skałecki et al. (2013b) demonstrated that irrespective of fish culture system of rainbow trout, a descending tendency occurs in the pH value of muscle tissue evaluated in the 48-h period, from the average level of 7.25 to 6.68. At the same time, Skałecki et al. (2008) report that meat of cods was characterized by significantly higher pH values after 24 h (6.89) and 48 h (6.74) compared to meat of herrings (6.67 and 6.49, respectively). A research by Kamkar et al. (2014) addressing changes in acidity of fillets of silver carp during cold storage for up to 30 days demonstrated a significant increase in $pH_u$ from the initial value of 6.6 to the final value of ca. 8.20. Comparing own results in Table 2 obtained for the ultimate pH with pH of the aqueous homogenate from fresh meat of African catfish analyzed by Yanar (2007), it was concluded that the mean value of this parameter was lower by 0.23 units in males and by 0.22 units in females.

A very important indicator of quality and technological usability of meat is the content and ability to retain water (water-holding capacity), namely a trait that characterizes the physicochemical condition of muscle proteins hydratation. It depends on the pH value being a measure of *post mortem* changes (Jankowska et al., 2007b). Migration of fluids in inter- and intracellular compartments results from the weakening of structural membranes of muscle tissue after slaughter and from water retention by myofilaments (Skałecki et al., 2008). According to Kulikowski (2000), after the initial *rigor mortis* there occurs weakening of the myofibrillar structure and plasticity of muscle tissue that is caused by small changes in water-soluble proteins and activity of proteolytic enzymes. The hydratation properties of muscle tissue depend on the condition and content of protein and have a significant effect upon juiciness, texture and weight losses during heat treatment that determines values of the attributes of the sensory quality of meat. Fish with a low protein content tend to lose more water during heat treatment, which has a negative influence on meat texture (Økland et al., 2005; Jankowska et al., 2007b).

Meat of African catfish is free of the intensive "fish-like" after-taste being typical of marine fish and in taste and colour resembling veal and poultry meat. Klasa and Trzebiatowski (1992) as well as Kapelinski (2003) demonstrated that modification of the taste and colour of meat is feasible through the use of "finisher" type feed mixtures, enriched with carotenoids or a higher dose of fish oil, at the final stage of fattening. The colour of fish meat is a species-specific trait and depends on the number of red muscle fibres and contents of pigments, i.e. myoglobin, hemoglobin and carotenoids. Wedekind (1995) reports on significant sexual dimorphism in the quality of fillets from *Clarias gariepinus*. Meat of males is characterized by intensively red colouration, is leaner and more cohesive, compared to the muscle tissue of females. Fillets obtained from female fish are preferred mainly in fried and cooked form, whereas these of male fish are perfectly suitable for smoking. According to Skałecki et al. (2013a), meat of rainbow trout of the S weight category (up to 350 g) was characterized by highly significantly darker colour (L* = 46.06) compared to meat of fish from D weight category (over 350 g) (L* = 52.33). As reported by Jankowska et al. (2007a), the lightness of fillets produced from perches did not differ statistically, however these authors demonstrated the ascending tendency in the value of L* parameter in the group of wild fish (46.21) compared to the cultivated fish (44.12). In addition, Jankowska et al. (2007b) who evaluated the quality of meat of European catfish *(Silurus glanis)* administered natural and formulated feed, did not demonstrate any differences in the values of lightness and yellowness of their fillets. A comparison of results achieved in our study with those of the above-mentioned authors demonstrated that the value of L* parameter of muscle tissue of African catfish and European catfish was similar and reached 47.98 vs. 48.11. The contribution of yellow pigment in the colour of *C. gariepinus* fillets reached 15.82 on average in both sexes and was higher by 5.78 compared to *S. glanis* catfish.

## Conclusions

The conducted statistical analysis showed no significant effect of gender on contents of chemical compounds, energy and TBARS value in meat of African catfish. In addition, the analyzed fillets of males and females were characterized by a relatively high content of total protein, an optimal content of crude fat, and a low calorific value. Despite the lack of significant differences, it was noted that the muscle tissue of *C. gariepinus* catfish from both experimental groups was characterized by appropriate acidity measured 24 h *post mortem* and that measured in aqueous homogenate ($pH_u$), and by a small natural drip. Data achieved in the study demonstrate that fillets of female fish were characterized by lower value of water-holding capacity and better tenderness as well as smaller thermal loss, which was confirmed statistically. The analysis of colour parameters enabled concluding that the internal surface of fillets from male fish was darker compared to female fillets, which was indicated by a higher contribution of red pigments and a lower contribution of yellow component of the analyzed samples. A similar tendency was observed for values of L* and a* parameters measured from the side of the removed skin of fillets. In summary, it needs to be concluded that sexual dimorphism occurring in African catfish had a significant effect on values of hydratation, tenderness and colour profile of fillets. In contrast, the chemical composition, acidity, energy value and lipid stability of meat of *C. gariepinus* catfish were not affect by fish gender.

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