

FILLET AND CARCASS YIELD AND FILLET CHEMICAL COMPOSITION OF PIAVA FROM FISH FARMING AND FROM THE WILD*

Andressa Mariza Ribeiro GERALDO¹; Larissa da CUNHA¹; Márcio Aquio HOSHIBA¹; Matheus dos Santos CARDOSO¹; Vagner Callai da SILVA¹; Alessandra Sayuri Kikuchi TAMAJUSUKU¹

ABSTRACT

Piava (*Leporinus obtusidens*) is one of the main cultivated native fish and one of the most caught in Rio Grande do Sul, South Brazil. The objective of this work was to compare the carcass and fillet yields of piava, females and males, collected from the wild (Treatment 1 - T1) and from fish culture (Treatment 2 - T2) and to analyze the chemical composition of fillets. For this purpose, four females and four males of each treatment were used. T1 females had significant higher values ($P<0.05$) in the carcass yield. Chemical analyses of the fillet indicated that fish originating from fish farming, independent of sex, showed higher values ($P<0.05$) for protein and ash contents. Thus, the management and the suitable food in fish farming could contribute to the production of a better quality fish.

Keywords: *Leporinus obtusidens*; native fish; production data

RENDIMENTO DE FILÉ E DE CARÇAÇA E COMPOSIÇÃO QUÍMICA DO FILÉ DE PIAVA DE PISCICULTURA E DO AMBIENTE NATURAL

RESUMO

A piava (*Leporinus obtusidens*) é um dos principais peixes nativos cultivados e um dos mais capturados no Rio Grande do Sul. Objetivou-se, com esse trabalho, comparar o rendimento de carcaça e filé de piavas, fêmeas e machos, capturados em ambiente natural (Tratamento 1 - T1) e cultivadas em piscicultura (Tratamento 2 - T2), assim como analisar comparativamente a composição bromatológica dos filés. Para isso, quatro fêmeas e quatro machos de cada tratamento foram utilizados. Fêmeas do T1 apresentaram valores significativamente superiores ($P<0.05$) no rendimento de carcaça. As análises bromatológicas do filé indicaram que os peixes originários da piscicultura, independente do sexo, apresentaram maiores ($P<0.05$) conteúdos de proteína e cinzas. O manejo e a alimentação adequados na piscicultura podem contribuir com a produção de um peixe de melhor qualidade.

Palavras chave: dados zootécnicos; *Leporinus obtusidens*; peixe nativo

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¹ Universidade Federal do Pampa (UNIPAMPA), Campus Uruguaiiana. BR 472 – km 592 – Caixa Postal 118 – CEP: 97508-000 – Uruguaiiana – RS – Brazil. e-mail: andressamrgeraldo@gmail.com; laridacunha@gmail.com; tokudazoo@gmail.com; mscardoso27@gmail.com; vagnercallaidasilva@gmail.com; alessandratamajusuku@unipampa.edu.br (corresponding author)

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INTRODUCTION

Piava (*Leporinus obtusidens*) is a freshwater fish, native from Uruguay basin and Guaíba Lake, in Brazil's South region (HARTZ *et al.*, 2000). It has a good commercial acceptance because of its size and tasty flesh (CARVALHO, 2004). Indeed, GARCEZ and SÁNCHEZ-BOTERO (2005) consider piava as one of the most important exploited species by artisanal fishing. Moreover, COPATTI *et al.* (2008) declared that piava is a potential species for culture. According to BALDISSEROTTO (2009), piava is a native fish cultivated in Rio Grande do Sul farms with a production of 4,309.3 ton, mainly in northwestern which is the fastest growing region of the state in this sector. Among the factors that define a species as promising, carcass yield plays a key role.

Fillet and carcass yields are very important parameters for both fish processing industry and fish farmers, because they can assess the economic value of a fish species (MACEDO-VIEGAS and SOUZA, 2004) as well as to add value to the final product. The fish processing is one of the main barriers for small fishermen, because they sell the products mainly *in natura*, that is, fish that do not go through any kind of processing (COSTA *et al.*, 2014).

Among the studies related to yield and chemical composition of native freshwater fish in Brazil, we highlight those performed on matrinxã (*Brycon cephalus*) (GOMIERO *et al.*, 2003), piavuçu (*Leporinus macrocephalus*) (MARENGONI and SANTOS, 2006), surubim catfish (*Pseudoplatystoma* sp.) (BURKERT *et al.*, 2008), pintado (*Pseudoplatystoma corruscans*) (FRASCÁ-SCORVO *et al.*, 2008), jundia catfish (*Rhamdia quelen*) and dourado (*Salminus brasiliensis*) (VEIVERBERG *et al.*, 2008), ten Amazonian fish (SOUZA and INHAMUNS, 2011) and pacu-caranha (*Piractus mesopotamicus*) (LIMA *et al.*, 2012). About the exotic fish group, Nile tilapia (*Oreochromis niloticus*) is the most studied fish in this area (SOUZA, 2002; LEONHARDT *et al.*, 2006; MARENGONI and SANTOS, 2006; VEIVERBERG *et al.*, 2008; PIRES *et al.*, 2011).

According to MARENGONI and SANTOS (2006), the nutritional value and prices of fish depend on meat texture, chemical composition, fillet and carcass yields and factors related to capture and processing methods. In the common

sense of the study area, some people still have the idea that fish from fish culture and from the wild have different organoleptic characteristics, which could be caused by their different chemical composition. In this sense, the objective of the present study was to compare the fillet and carcass yields, byproduct incidence and the chemical composition of piava cultivated in fish farming with those captured from the wild. Moreover, as there are studies showing yield differences between males and females of commercial fish, such as curimatá (*Prochilodus lineatus*) (REIDEL *et al.*, 2004), all variables were compared also between sexes.

MATERIAL AND METHODS

Animals

Fish from the wild were acquired in September 2013 from fishermen on the Uruguay River in the city of Uruguaiana-RS, located in the west of the state. The specimens from fish farm were obtained in Ajuricaba-RS, located in the northwest, in January 2014. Both fish groups were acquired already slaughtered, packed in polystyrene boxes with ice into alternating layers and brought to laboratory of Universidade Federal do Pampa, Campus Uruguaiana, where they were processed.

Fish from the fish farming were fed with diets containing from 24 to 26% crude protein and the feeding was done once a day in a weir of 1.2 acres and the water quality was monitored daily. Sixteen adult piava were separated in two groups, each one containing eight animals: four females and four males in each group. Fish from the wild were denominated treatment 1 (T1) and those from fish farm were denominated treatment 2 (T2). Each fish was considered an experimental repetition. For this study the fish used were previously classified by size and body weight range, ensuring the homogeneity of the experiment.

Fish processing and yield calculation

As they arrived in the laboratory, fish were identified and measured (total length and standard length) as described by PIRES *et al.* (2011). Fish processing was made manually by the same operator in order to reduce the variability of

the operator (COSTA *et al.*, 2014). During fish processing the following weights were recorded with a digital scale: total; scaled fish; scaled and eviscerated fish; viscera; carcass; head; fillet with skin and fillet without skin. Carcass was considered the clean body trunk of the fish without head, viscera, fins and scales, but with skin (SOUZA and INHAMUNS, 2011). After fish processing, the fillets without skin were identified and stored in plastic bags at -20 °C. The condition factor was calculated according to CORRÊIA *et al.* (2009): Condition Factor = weight (g) / total length (cm)³ x 100. The formula used to calculate the yield was described by COSTA *et al.* (2014): Fillet yield (%) = (fillets weight / total weight) x 100. Therefore, the same formula was appropriately adapted for calculations of the other yields and performed in relation to total weight.

Chemical analysis

The samples of left fillet without skin were thawed at room temperature for 4 hours and

analyzed in Laboratório de Nutrição Animal e Forragicultura at the Universidade Federal do Pampa – UNIPAMPA – campus Uruguiana. Weende analysis method was performed to quantify the moisture, dry matter and ashes (SILVA and QUEIROZ, 2002). Protein was analyzed by micro Kjeldahl method and crude lipids by Soxhlet (SILVA and QUEIROZ, 2002), with each analysis carried in triplicate.

Statistical analysis

The experimental design was completely randomized with factorial arrangement 2 x 2 (origin x sex). The means of the analyzed characteristics were compared with the Tukey test at 95% probability using the SAS 9.0 software.

RESULTS

There were no significant differences ($P>0.05$) on biometric data between the treatments and sex of the fish (Table 1).

Table 1. Biometric data of female and male of piava (*Leporinus obtusidens*) from the wild (T1) and fish farm (T2).

Sex	Treatment	Total weight (g)	Total length (cm)	Standard length (cm)
Females	T1	1405.87 ± 180.06	46.72 ± 1.51	40.52 ± 1.74
	T2	1557.54 ± 119.88	48.85 ± 1.11	42.15 ± 0.93
Males	T1	1428.95 ± 157.58	46.60 ± 2.17	37.73 ± 5.09
	T2	1436.10 ± 92.67	47.58 ± 0.59	40.28 ± 0.68

The values are averages ± standard error.

The condition factor values were 1.37 ± 0.06 and 1.33 ± 0.03 for the females of T1 and T2, respectively, and 1.41 ± 0.06 and 1.33 ± 0.05 for T1 and T2 males, respectively. These values showed no statistical differences ($P>0.05$), demonstrating the homogeneity of the animals. Females of T1

presented approximately 10% more carcass yield than females of T2 (Table 2). Just head incidence from the males was significantly different ($P<0.05$) between treatments. Other parameters were not affected by the treatment or sex ($P>0.05$) (Table 3).

Table 2. Carcass and fillet yield (%) of male and male of piava (*Leporinus obtusidens*) from the wild (T1) and fish farm (T2).

Sex	Treatment	Carcass (%)	Fillet with skin (%)	Fillet without skin (%)
Females	T1	70.27 ± 1.28	54.38 ± 0.86	41.99 ± 1.45
	T2	62.31 ± 2.27*	55.72 ± 2.57	45.85 ± 2.86
Males	T1	72.90 ± 0.97	55.58 ± 1.77	44.32 ± 0.10
	T2	71.08 ± 0.63	55.08 ± 0.82	45.85 ± 1.42

*The values are averages ± standard error. * significantly different from T1 females ($P<0.05$).*

Table 3. Byproducts incidence data (%) of female and male of piava (*Leporinus obtusidens*) from the wild (T1) and fish farm (T2).

Sex	Treatment	Scaled fish (%)	Scaled and eviscerated fish (%)	Viscera (%)	Head (%)
Females	T1	96.47 ± 0.29	89.28 ± 0.19	6.91 ± 0.33	11.74 ± 1.08
	T2	96.24 ± 2.00	89.48 ± 2.00	7.65 ± 0.01	12.53 ± 0.26
Males	T1	97.06 ± 0.12	89.39 ± 0.73	7.28 ± 0.67	9.67 ± 0.12
	T2	96.62 ± 0.16	90.16 ± 0.15	6.08 ± 0.23	11.52 ± 0.46*

The values are averages ± standard error. * significantly different from T1 males ($P < 0.05$).

For moisture and crude lipids there was no statistically significant difference ($P > 0.05$) due to the treatment or sex. However, both males and

females from the fish farm (T2) presented significantly ($P < 0.05$) higher ash content and crude protein content (Table 4).

Table 4. Fillet chemical composition (% on dry matter) of female and male of piava (*Leporinus obtusidens*) from the wild (T1) and fish farm (T2).

Sex	Treatment	Moisture (%)	Ash (%)	Crude lipids (%)	Crude protein (%)
Females	T1	74.70 ± 0.64	1.33 ± 0.01	1.59 ± 0.37	18.72 ± 0.51
	T2	74.66 ± 0.65	1.53 ± 0.05*	2.01 ± 0.61	21.62 ± 0.71*
Males	T1	72.82 ± 0.21	1.43 ± 0.02	1.69 ± 0.27	19.16 ± 0.30
	T2	71.83 ± 1.33	1.57 ± 0.04*	3.86 ± 1.18	22.72 ± 0.16*

The values are averages ± standard error. * significantly different from T1 ($p < 0.05$).

DISCUSSION

In the present study, we compared the fillet and carcass yields, the incidence of other carcass components and the chemical composition of one of the most important species of Rio Grande do Sul piava (*L. obtusidens*), from two different origins, i.e., wild and farm.

Although it is not certain that the animals were in the same development period, according to LIZAMA and AMBRÓSIO (2002) the condition factor can be used to compare two populations living in different conditions, as feeding, climate and density. Also according GOMIERO *et al.* (2010), the condition factor is a parameter used in the study of biomass for estimates of populations in the wild or in captivity, using the relationship between weight-length to demonstrate that the fish growth was similar. The results suggest that both females as males of each treatment showed similar physiological state in relation to its welfare.

In relation to yield data, just two parameters were significantly different. The analysis of the results indicates significant difference for head

incidence (11.52 and 9.67%, respectively) between T2 males of and T1 males. REIDEL *et al.* (2010), in a study of jundiá catfish, observed that the higher the individual, smaller is its head. Although in this study the head length was not measured, T2 males showed longer bodies and may have smaller heads, which could explain the differences in head incidence.

The males showed no significant differences between treatments in relation to carcass yield. However, for females, there was a significant difference for carcass yield between the treatments, being T2 lower than T1. This may be related to the accumulation of visceral fat in the T2 coelomic cavity, which could lead to a lower carcass yield. According to GONÇALVES (2011), the carcass yield values are influenced by the percentage of residues, being residue the coelomic cavity content plus fins, scales and head.

The majority of the studies about yield did not analyze the data separating sex and they were performed with tilapia of different weight classes: between 250 and 450 g, the carcass yield

was 54.36-57.98% (MACEDO-VIEGAS *et al.*, 1997) and 53.27-56.49% (SOUZA *et al.*, 1999); between 160.66 and 234.75 g, it was found 49.46-51.39% (BOSCOLO *et al.*, 2001); and between 250 and 600 g, 58.20-60.56% (SILVA *et al.*, 2009).

Compared with tilapia, the fish of this study have a higher carcass yield, which could become a positive factor in the rearing of this species. Among Brazilian native fish, the cascudo viola (*Loricariichthys anus*) had yields of 70.43 to 74.78% (BRITTO *et al.*, 2014) and curimbatá (*Prochilodus lineatus*), with average weight of 1101.08 g, the carcass yields was 61.94% (REIDEL *et al.*, 2004), similar results compared to fish of this study.

Regarding the fillet with skin yield, there were no significant differences between the treatments; however, the values obtained are higher to those of other species of commercial value. SOUZA and INHAMUNS (2011) obtained a fillet yield around 38.4% for pintado and surubim. LIMA *et al.* (2012) obtained 30.17% for pacu and SIMÕES *et al.* (2007) obtained 21.63% for fillets with skin of Thai strain tilapia weighing 989.6 grams.

Analyzing the chemical composition of fillets of piava males and females it is possible to see that moisture showed no difference between treatments, however, the values obtained are similar to those found in other species.

The values found for the piava are similar to those found in fillets of other species already studied; it was found 1.41% of ash for tilapia (*O. niloticus*) (LEONHARDT *et al.*, 2006), 1.56% for pintado (*P. corruscans*) (FRASCÁ-SCORVO *et al.*, 2008) and 1.05 to 1.11% for cascudo (BRITTO *et al.*, 2014).

Males and females showed no significant difference in the crude lipid content due to treatment, although the farmed fish presented numerically higher values than those from wild. It could be explained, probably, due to heterogeneity of crude lipids values observed for T2 males, evident by higher error standard range. The results for crude protein are close to those found by FRASCÁ-SCORVO *et al.* (2008) for pintado (*P. corruscans*) (19.21%), by LEONHARDT *et al.* (2006) and SIMÕES *et al.* (2007) for Nile tilapia (19.33 and 19.36%, respectively), but

higher than the values observed by BRITTO *et al.* (2014) (between 16.58 and 16.87%).

The fish of the T2 group had a higher percentage of crude protein in fillets, which can be explained by the better management and a good quality and quantity of the diet given to the animals, in comparison to T1 animals, that had a natural feed based on planktonic and benthic community, that undergo a great variance in quantity depending on year's season and/or their habitats. According to KUBITZA (2000), protein-energy levels in feed, ingredients quality and feed management may influence the chemical composition of fish flesh. Therefore, it is possible that the specimens from T2 treatment were fed with a balanced commercial feed.

According to BALDISSEROTTO (2009), fish farming stands out for help to reduce the capture pressure on fish stocks taking into account the native species, i.e., it is an important alternative for the production of fish without harming the environment in relation to exploitation of native species. However, there are some doubts regarding the fish produced in aquaculture compared with those derived from the wild. In this sense, the present study demonstrated the superiority of animals kept in captivity in relation to levels of protein and ash, which corroborates the findings of LOGATO (2000), who states that the quality of feed offered to the fish influences the fish flesh quality. Thus, this could be configured as an advantage of fish farming in relation to fish obtained from the wild.

CONCLUSION

The animals from fish farming, despite having a lower carcass yield in females, showed higher protein and ash contents compared to animals from the wild. Thus, we can conclude that the origin of the animals, or the environment in which the animals developed, influenced the chemical composition of piava flesh and that a suitable management in captivity can bring positive results in the performance of this species.

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