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Morphometric Characterization and Fillet Yield of Two Commercial Fish Species from Panyam Fish Farm Plateau State

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A total of 50 individual samples of *Parachanna obscura* and *Clarias gariepinus* were collected fresh from Panyam fish farm with the aid of crush ice for preservation until assessment was carried out to determine the fillet yield of *Parachanna obscura* in comparism with *Clarias gariepinus.*
The whole fresh fish samples were taken to the department of Fisheries and Aquaculture laboratory of the Federal University, of Agriculture, Makurdi for assessment. Their Total and Standard Lengths were recorded (in cm) using a Measuring Rule, while Total Body Weights were recorded (in grams) using an electronic weighing balance. Data were collected on: the Total Weight (g), Total Length

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(cm), Standard Length (cm), Visceral Weight (g), Head Length (cm), Weight of Bones (g), Weight of Fins (g) and Weight of Fillet (g) in comparism between the two fish species. Descriptive statistics for morphometric data were determined using Minitab 18® (Minitab 2017). Regression and correlation of variables was carried out in R (R Core Team 2020). Results of the mean measured parameters of *Parachana obscura* and *Clarias gariepinus* from Panyam Fish Farm Jos, showed that Total Length (42.66 ± 0.58cm), Standard Length (38.56 ± 0.29cm), Fin Weight (15.51 ± 0.37g), Visceral Weight (11.04 ± 0.17g), Head Weight (1.49 ± 4.01g), Bone weight (39.84 ± 0.80g) and Weight of fillet (89.02 ± 2.38g) of *Parachana obscura* were higher than the mean measured parameters of *Clarias gariepinus*. There was a significant difference (p= .05) among the measured parameters between *P. obscura* and *C. gariepinus*. The higher fillet percentage per body weight of *P. obscura* in comparism to *C. gariepinus* is a pointer to a relatively higher economic value for commercial purposes of this species. This assessment also provides information for further studies on this species to be built on, as there is obvious need for Nigeria's aquaculture system to diversify from the prevalent catfish culture.

Keywords: Filleting assessment; morphometric; descriptive; nutrition; research.

1. INTRODUCTION

1.1 Background of Study

"As the human population inevitably increases, the demand for fish as source of protein also grows " (Ikongbeh et al. 2013). "Fish is important to human population in trade and economy and also in the diet of different countries especially in the tropics and subtropics where malnutrition is a major problem" (Fawole et al. 2007). Studying the characteristics of fish quality requirement and assessment indices are basic trade processes in deciding prosperity of commercial fisheries products. To facilitate the availability of fish for consumption as a source of animal protein, the availability of data and relevant information on the edibility of various fish species should be encouraged, especially for consumer preferences through informed choice and this can effectively be possible by research and documentation. According to Okafor et al. 2012, most commercially important edible fish species have not been successfully cultivated on a commercial scale due to lack of deep knowledge of their biology. For a successful culture of any fish species, a good knowledge of its biology (particularly its growth characteristics) is important as it helps in planning and imposing proper management practice to ensure large scale commercial production Meye et al. 2012. The length-weight relationship of fish is generally an index used in fisheries studies to estimate the mean weight of a fish species sample based on a known length.

The flesh of the fish is basically the edible portion with the most economic value in the fish body. "Flesh yield or fillet yield refers to the edible portion that can be derived from a particular fish species. Fins, viscera, scales, and the vertebra column are not usually regarded as edible parts" (Solomon et al. 2005). "Also, filleting reduce the bulky transportation of fresh fish products from point of production to the retail shop, this saves consumers the drudgery of cleaning and processing of raw fish before cooking" (Solomon et al. 2005).

"The increasing cost of producing fish means that it is important to recover as much valuable flesh as possible, and this has encouraged greater attention to improving the yield of edible portions. Many species are filleted to satisfy consumer and market demands. Filleting is also important for logistics, economics, the edition of value along the marketing chain, and for the separation for edible parts from inedible ones. Filleting can be performed either by machine or by hand" (Rora et al. 2001).

Parachanna obscura, an edible fish species is the most prevalent African Channidae. It lives in fresh water in quiet and muddy areas. It is a medium sized carnivorous fish that has an elongated shape tapered on both ends and is covered in medium circular scales (cycloid). The head, resembling a snake, is long and depressed anteriorly, and covered with cycloid scales slightly larger than those scales on the body. It is a hardy species that supports stressful conditions. This fish species is one of the edible fish species obtained in Nigeria's fresh waters though not much research work has been done on it, to avail researchers, nutritionists, farmers, and the public with necessary data as a pointer to the significance of this species. Processors,

nutritionists and consumers have direct interest in the physical and chemical composition of fish, and the general condition of fishes such as body weight, body length and filleting yield indices are important in assessing the actual amount of fish tissue consumed, while the inedible parts are discarded.

Clarias gariepinus which is an indigenous species to inland waters of Africa has an average adult length of 1 – 1.5 m (3 ft 3 in – 4 ft 11 in) (Olorunfemi et al. 2014). It reaches a maximum length of 1.7 m (5 ft 7 in) Total Length and can weigh up to 60 kg (130 lb). These fish have slender bodies, flat bony heads, notably flatter than in the genus *Silurus*, and broad, terminal mouths with four pairs of barbels. They also have large accessory breathing organs composed of modified gill arches.

Morphometric characterisation and filleting of *Clarias gariepinus* and *Paranchana obscura* as a study provides information on dress percentage of these species, and it would provide information on the relevance of this fish to purchase in order to get maximum benefit from the purchase of fish.

The aim of this study is to determine the fillet yield and the morphometric characteristics of the selected fish species from Panyam fish farm plateau state, Nigeria.

2. MATERIALS AND METHODS

2.1 Sampling Site

The fish samples were collected from Panyam fish farm Mangu Local Government Area Plateau State, Nigeria.

2.2 Experimental Fish Species

A total of 50 individuals, belonging to two families, were sampled for this study. Fresh fish were collected and crush ice added for preservation during assessment. The whole fresh fish samples were taken to the Department of Fisheries and Aquaculture Laboratory, University of Agriculture Makurdi (Joseph Sarwuan Tarka University, Makurdi) where their total and standard length were recorded (in cm) using measuring rule (ruler) and total body weights were recorded in grams using an electronic weighing balance. The fishes were then filleted, eviscerated, beheaded using a sharp knife. The weight of viscera, fillets, heads, and skeletons (bones) were weighed separately using weighing balance.

Plate 1. Map of Panyam Mangu Local Government Area, Plateau State Nigeria

Plate 2. Sample of *Parachanna obscura* from panyam fish farm

Plate 3. Sample of *Clarias gariepinus* from panyam fish farm

2.3 Filleting Procedure

The fins of the fish were removed and weighted. The fish were then degutted (Removal of internal organs). Thereafter, the fish were beheaded, and the bones removed.

2.4 Data Collection

Data on the Total Weight (g), Total Length (cm), Standard Length (cm), Visceral Weight (g), Head Length (cm), Weight of Bones (g), Weight of Fins (g) and Weight of Fillet (g) from the two fish species were collected.

2.5 Statistical Analysis

Descriptive statistics for morphometric data were determined using Minitab 18® (Minitab 2017). In order to avoid autocorrelation, total weight (TW) and fillet weight (FW) were removed from the data before analysis since they are used to calculate fillet yield.

Condition factor which is an index used for monitoring feeding intensity, age and growth rate in fish was determined.

Correlation between morphometric characteristics and fillet weight was determined using the corrplot package Wei and Simko 2017, in R (R Core Team 2020).

Fillet yield (FY) was determined using fillet weight (FW) and Total weight (TW) in the formula as introduced by Yenmak et al. 2018.

$$FY = \left({}^{FW}/_{TW}\right) \times 100$$

3. RESULTS

Results of the mean measured parameters of *Parachana obscura* and *Clarias gariepinus* from Panyam Fish Farms, Jos are presented in Table 1. Mean total weight (543.61 ± 10.59g), Total length (42.66 ± 0.58cm), Standard Length (38.56 ± 0.29cm), Fin Weight (15.51 ± 0.37g), Visceral Weight (11.04 ± 0.17g), Head Weight (1.49 ± 4.01g), Bone weight (39.84 ± 0.80g) and Weight of fillet (89.02 ± 2.38g) of *Parachana obscura* were higher than the mean measured parameters of *Clarias gariepinus* with Mean total weight (g), Total length (cm), Standard Length (cm), Fin Weight (g), Visceral Weight (g), Head Weight (g), Bone weight (g) and Weight of fillet(g) of 180.25 ± 4.64, 27.19 ± 0.22, 23.78 ± 0.19, 5.56 ± 0.39, 6.10 ± 0.19, 1.28 ± 1.25, 9.11 ± 0.33 and 83.84 ± 6.05, respectively. There was significant difference ($p<0.05$) among the measured parameters between *P. obscura* and *C. gariepinus.*

Table 1. Mean measurement of parameters of *Parachanna obscura and Clarias gariepinus* fish species

Parameter	Total Count	*Parachanna obscura* Mean ± S*D*	*Clarias gariepinus* Mean ± SD	P- Value
Total Weight(g)	50	180.25 ± 4.64	543.61 ± 10.59	000
Total length (cm)	50	27.19 ± 0.22	42.66 ± 0.58	0.00
Standard Length (cm)	50	23.78 ± 0.19	38.56 ± 0.29	0.00
Fin Weight (g)	50	5.56 ± 0.39	15.51 ± 0.37	0.00
Visceral Weight (g)	50	6.10 ± 0.19	51.04 ± 0.17	0.00
Head Weight (g)	50	1.28 ± 1.25	1.49 ± 4.01	0.00
Bone weight(g)	50	9.11 ± 0.33	39.84 ± 0.80	0.00
Weight of fillet(g)	50	89.02 ± 2.3[a]	83.84 ± 6.05[b]	0.00

Means on the same row with different superscript are statistically significant (p = .05)

Table 2. Length-weight relationship, condition factor and slope "b" values of *Parachana obscura* and *Clarias gariepinu*s from Panyam Fish Farms, Jos

Fish species	Mean K±SD	Intercept (a)	Slope (b)	Regression coefficient (R^2)
P.obscura	0.85 ± 0.26	-2.10	3.18	0.92
C. gariepinus	0.94 ± 0.38	-1.44	2.72	0.76
Pvalue	0.17			

Results of the length-weight relation, condition factor and slope "b" values of *Parachana obscura* and *Clarias gariepinus* from Panyam Fish Farms, Jos are presented in Table 2. A higher mean condition factor (K) of 0.94 ± 0.38 was recorded for *C. gariepinus* compared to the lower (0.85 ± 0.26) recorded for *P. obscura.* On the other hand, higher slope (b value) of 3.18 was recorded for *P. obscura* than the lower slope of 2.72 recorded for *C. gariepinus.*

4. DISCUSSION

During this study, variations in the sizes of the sampled fishes were observed. The observed variations in these sizes with respect to the length and weight could be due to the interplay of certain factors such as nutritional, physiological, biotic and climatic factors affecting the growth of the fish. A similar observation was made by Adeyemo 2013, who reported different variations in length and weight of moonfish from the Makoko fish market in Lagos and attributed these variations to the interplay of factors (nutritional, physiological, biotic and climatic factors) affecting growth.

Variations in the fillet yield indices of the studied fishes in this study are in line with the previous works of Sulieman et al. 2011. The frames, fins and viscera of fish are usually inedible parts. *Parachana obscura* (84%) and *Clarias gariepinus* (89%) of fillet yield was generally high in edibility content though with significant difference *(p = .05*). Fish flesh is the edible portion thus, flesh yield (filleting yield), as implied in this study, shows the edible portion that can be obtained from these particular fish species Solomon et al. 2005 to be of high economic value. Variations in the fillet yields of the studied fishes in this present study could be attributed to the anatomical features of the fish species. This agrees with the reported work of Solomon et al. 2005, "who reported higher flesh yields in flat fishes than the deep bodied fish and attributed it to their anatomical features, characterized by smaller head and smaller fin bones. When fish are manually filleted, flesh attached to the bones is usually discarded as waste which accounts for between 40-60% of the total weight of fish depending on the fish species" (Eyo 2001). In this study however, percentage valuation of the discarded portion of the fish species were not up to 40% fillet yield from *Parachana obscura* (84%) and *Clarias gariepinus* (89%) invariably had a discarded body portion of 17% and 11% respectively.

"In general, variations in the filleting yield of the studied fish species in the present work is a reflection of their peculiar anatomy. The present study results revealed that *P. obscura* had a positive allometric growth pattern with regression analysis exponent 'b' greater than 3, and *C. gariepinus* exhibited a negative allometric growth pattern with regression analysis exponent 'b' values less than 3. The 'b' values in length-weight relationships determine the growth pattern

of the fish species. The 'b' values for both fish species were not significantly different *(P= .17*), and it conforms to the observations of" (Osho et al. 2014). "This result also corroborated the findings of (Obasohan et al. 2012) who reported a positive allometric growth pattern in five different fish species including *P. obscura* from Ibiekuma stream, Ekpoma, Edo state, Nigeria". Imam et al. 2010 also reported a similar positive pattern of allometric growth in the research conducted on four fish species including *Tilapia zilli*, *Oreochromis nilotcus* and others from Wassai Reservoir in Kano. However, Garba 2006 reported "isometric growth pattern for *Malapterurus electricus* from the Lower Benue River and similar findings on *Ethmalosa fimbriata* and *Ilisha africana* from the Nkoro River" Abowei and Hart 2009.

"The study showed that the condition factor (which is strongly influenced by both abiotic and biotic environmental conditions and can be used to assess the status of the aquatic ecosystem in which fish live" Anene 2005) of *P. obscura* and *C. gariepinus* from the Panyam Fish Farm ranged between 0.94 and 0.85, respectively. It agrees with what was reported by Odo et al. 2007 that "the results of the condition factor were less than 1 and are in tandem with the findings of" Obasohan et al. 2012, "who recorded values less than 0.5 and 0.9 for *Papyrocranus afer* and *P. obscura*, respectively. These results may be attributed to different factors such as sex, age, state of maturity, size, state of stomach fullness and environmental factors affecting fish in water bodies" Adeyemi et al. 2009. Kareem 2016 reported that "fish living in favourable environment in terms of food availability and suitable environmental conditions grow faster with K ≥ 1. However, most of the documented condition factor results of *P. obscura* from Nigeria's freshwater environment have reported values less than 1". Obasohan et al. 2012 recorded "values less than 0.5 and 0.9 for *Papyrocranus afer* and *P. obscura*, respectvely, from the Ibiekuma stream, Ekpoma, Edo state, Nigeria". Bassey et al. 2010 "also documented condition factors ranging between 0.63 and 0.79 for pond cultured *P. obscura* given different feed types in Calabar, Nigeria, while recorded a value of 0.80 for *P. obscura* from Ibadan, Southwest Nigeria" Oyelese et al. 2006. "Therefore, results from the present work are within the ranges that have been documented for captured and cultured *P. obscura* in Nigeria. These patterns of obtained results might be owed to the fact that the species is highly streamlined and not a robust fish or round". Froese 2006 and Treer et al. 2009 concluded that "different body forms of fish such as elongated, fusiform and short or deep body significantly have effect on condition factors" Leveque and Deget 1984.

5. CONCLUSION

The edible content from body characteristics and yield indices of *Parachana obscura* is more than that of *Clarias gariepinu*s. The fillet percentage (84%) from the total body weight of *Parachana obscura* from Panyam Fish Farms, Jos is of high economic and nutritional value, just as it is with *C. gariepinus*.

6. RECOMMENDATION

Since fish fillet yield helps track the skill level of filleters and also indicates how different sized fish have different yields and how that impacts the food cost, it is recommended that culturing and filleting of *Parachana obscura* be encouraged as well as it is done on *Clarias gariepinus*. Thus the culturing of *Parachana obscura* is as a result of this encouraged.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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