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ARTICLE

Fillet Quality and Gut Content Analysis of *Parachanna obscura* and *Clarias agboyiensis*

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ABSTRACT

Nigeria waters are rich with a variety of fish species but only very few are cultured and available for consumption. This study was conducted to know the fillet quality, gut content and condition of *Parachanna obscura* and *Clarias agboyiensis* in Nigeria using Igbokoda river as a reference because it is a the major fishing site in the nation. Studies were conducted on the viscera somatic index based on the organ weight and the body weight of the fish and the food item consumed by *Parachanna obscura* and *Clarias agboyiensis* between May to October, 2019 to infer on the fillet quality and gut content of *P. obscura* and *C. agboyiensis* in the water body respectively. A summary of food items that constituted the diet of *Clarias agboyiensis* are *Baccillariophyta,* fish, fat droplets, *dinoflagellate*, insect and *Chlorophyta* which constituted the most important food items both occurring in all stomachs containing food. The fishes has more muscle than the viscera organs which indicate that the weight of the fish before dressing out is higher than the weight of the fish after dressing out. This is suggestive of a good quality of food fish. There was a significant correlation between body weight and total length of specimens found in this study. Increases in total length resulted in corresponding increases in body weight. The result for the condition factor showed was below the expected or standard value (K = 1) which shows this species was not in favorable environmental condition. It is therefore necessary to allow phytoplanktons grow well in water body to increase availability of food items to *Parachanna obscura* and *Clarias agboyiensis*. *P. obscura* and *C. agboyiensis* are also good food fishes of a high fillet quality. They are omnivorous feeders therefore having potentials for aquaculture.

1. Introduction

Fish is a vital source of high-quality protein, providing approximately 16% of animal protein consumed by the world's population and human demand of fish consumption has increased all over the world [1]. Fish is a resource mostly exploited by man and is basically linked to the tropic chain in the entire environment where they are

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commonly found [2].

Nigeria is highly blessed and endowed with vast expense of inland freshwater and brackish ecosystems with abundant fish species and these water bodies play an important role in the provision of protein to Nigerians [3]. Nigeria fresh water bodies are the richest in West Africa in terms of fish abundance [4]. Many depend heavily on the resources of such water bodies for their main source of animal protein and family income [5]. *Parachanna obscura* is a widely distributed fresh water fish endemic to Africa. It is called snake head fish and it is a hardy species that can survive stressful condition with rapid growth performance and high nutritional value and economic potential. *Parachanna obscura* is commonly found in intertropical convergent zone where water temperature is 26-28 degree centigrade. They are both bottom dwellers and a fresh water migratory species.

The desirability and suitability of *Clarias agboyiensis*, a Clariid species as a pond-raised fish is one of the small clariid catfishes of southwestern Nigeria (West Africa). Large numbers of this species are caught with various fishing gear throughout the year in freshwater swamps and rivers of the region. Despite their small size, they are exploited as food fish and command fairly high market prices, especially when smoked. Because of its economic importance and easy maintenance in captivity an evaluation proved it desirable for cultivation in ponds [6]. Information on length-weight relationship is one of the crucial requirements for fisheries management purposes. It is also important to study how their food intake helps their increase in length and weight and also the relationship between them. The condition which leads to survival of this fish in that environment could also be examined

The nature of food depends to a great extent upon the nature of environment as well as ecological point of view [7]. Stomach content analysis provides important insight into fish feeding pattern and quantitative assessment of food habits as an important aspect of fisheries management. The food habit of *Parachanna obscura* and *Clarias agboyiensis* gives more insight on what they feed on and how it can be improvised for a successful culture to ensure survival and optimum growth. It also determines the rate of growth of fish species. Gut content analysis also gives information on seasonal and life history changes of fish because the types and magnitude of food available as well as the season it occurs play an important role in the history of fish [8]. Viscero somatic index is used to evaluate the dress out percentage of a fish after processing which is an indicator of fish quality. It helps to determine how much food fish is left for consumption after the visceral mass has been removed. Viscera mean the visceral organs in the fish like the intestine. Viscero somatic index is basically used to investigate how much materials is deposited in the visceral rather than in the muscle (the edible part of the fish) that is the ratio of the viscera mass to the body mass of the fish. The structure, length and conformation of the intestine are closely related to the diet of the fish [9]. Therefore, understanding this relationship is important to predict the diet of fishes, how fishes feed and the mechanism of feeding[10]. Therefore, this study is also aimed at examining the stomach contents of *Parachanna obscura* and *Clarias agboyiensis* in Igbokoda River highlighting the viscero somatic index, condition factor and gut content of the species in the natural habitat for optimal utilization by local fisheries and processing factories.

2. Materials and Methods

2.1 Description of Study Area

Igbokoda River in Ilaje local government area is a stream and is located in Ondo State, Nigeria. It is located at an elevation of 39 meters above sea level and its population amounts to 71,027. It coordinates are 6º19’0” N and 4º49’0” E in DMS (Degree Minutes Seconds) or 6.31667 and 4.81667 (in decimal degrees). The vast expanse of the water makes for an exciting fishing expedition. This site is located about 142 km from Akure. It is the longest territorial water in Nigeria and has fishing terminal [11]. It is reported that 80% of the population of the study area engages in fishing and that the area always records the bulk produced in Ondo State. The Ilajes who are the major fish producers in Ondo State, with over 80 fishing communities along the coastline [12].

2.2 Fish Sample Collection and Identification

Parachanna obscura and *Clarias agboyiensis* were captured with the assistance of fishermen fishing in Igbokoda River using cast net, long lines and traps. A total of eighty (80) specimens each of *P. obscura* and *C. agboyiensis* were obtained. The species was collected on a monthly basis from May to October and transported live in a plastic container with ice pack to the laboratory for fresh examination. The fish samples were identified using the appropriate field guide. Personal communication with experienced fisher folks on the local name of the fishes was done. The fishes used for the research were further processed after the gut contents were removed for the experiment. The fillet quality was investigated.

2.3 Fish Measurement

Specimen was examined fresh. Morphometric parameters were measured on each sample with the aid of measuring board, measuring rule, weighing balance (JA-5000), pair of scissor and forceps. Morphometric parameters measured were total length (TL), standard length (SL) and head length (HL) which was made to the nearest 0.1 cm using a fish measuring board. A longitudinal incision was made with the aid of stainless steel scissors and forceps along the mid-ventral line from the mouth to the anus to expose the visceral organs and the gut was carefully removed with a pair of throngs. The total weight of the fish was recorded before dissecting. The total weight of viscera was recorded and the total weight of the remaining flesh was recorded.

2.4 Length-Weight Relationship

Length-weight relationship was determined using the formula $\mathbf{W=aL^b}$ according to Nwani *et al*. (2006). The parameters a and b in the formula was estimated through logarithmic transformation form for the purpose of data analysis; thus:

$$\mathbf{Log\ W = Log\ a + b\ Log\ L}$$

where W = weight of the fish in gram, L = total length of fish in centimeter, a = proportionality constant,b = allometric growth coefficient. Equation expressing the length-weight relationship of *Parachanna obscura* and *Clarias agboyiensis* was calculated in relation to possible significance ($p<0.05$), hence the need to transform into logarithm.

2.5 Condition Factor (K)

The condition factor was calculated from length-weight relationship using the following equation.

$$K = \frac{100 \times W}{L^3}$$

where, K = condition factor, W = total weight (g), L = total length (cm) and b = the value obtained from length-weight equation formula.

2.6 Viscero Somatic Index

VSI is basically used to investigate the quality of the fillet and how much material is deposited in the viscera rather than in the flesh. It is calculated as:

$$VSI = \frac{Total\ weight\ of\ all\ visceral}{\text{Total body weight of the fish prior to removal of viscera}} \times 100$$

2.7 Stomach Fullness Classification

Stomach contents classification of the fish species based on degree of fullness was determined. The condition of the stomach was determined visually and categorized as follows: 0/4 = empty stomach, 1/4 = one quarter full stomach, 1/2 = half full stomach, 3/4 = three quarter full stomach, 4/4 = full stomach.

2.8 Gut Contents Analysis

Specimen was dissected from the lower jaw region to the anal region and gut was taken out. The stomach contents were dissected and weighed with and without food materials contained in them. Gut was opened surgically and emptied into petri dish to which 10% saline was added to disperse the contents. The food items were sorted into categories, viewed under photomicrograph at different magnification to aid visibility and identification of food item to species level where possible using key guides by Pennak [13]. Food items in those guts that could not be examined immediately were preserved in refrigerator. Large food items easily recognized with the naked eyes were counted, while microscopic ones were teased to disperse their aggregates in accounting chamber. Food item was counted under objective lens of x10 magnification power of an electrical binocular microscope.

Stomach contents were analyzed using two (2) methods, frequency of occurrence and numerical methods as describe by Hyslop [14]. To avoid post mortem digestion, the stomach content was kept in the refrigerator for further analysis.

2.9 Statistical Analysis

All data collected were subjected to statistical analysis using statistical package for social science (SPSS 2007) software. Analysis of variance (ANOVA) was used to test for significant differences at 5% from data of stomach contents, standard and total lengths, weight and condition factors, morphometric parameters and length class interval of the species measured. Length-weight and morphometric were subjected to least square regression and correlation analysis. Student t-test was used to test for significant difference in the fullness index and stomach contents between seasons. Least Significant Difference (LSD) was carried out to rank means where necessary.

3. Results

A total of 80 specimens of *Parachanna obscura* and *Clarias agboyiensis* were obtained. The total length of *Parachanna obscura* ranged from 22.4 cm to 31.1 cm and standard length ranged from 19.2 cm to 28.6 cm, the weight ranged from 77.3 g to 229 g in Table 1, while the total length of *Clarias agboyiensis* ranged from 20.0 cm to 27.7 cm and standard length ranged from 18.1 cm

to 24.8 cm, the weight ranged from 50.42 g to 185.07 g in Table 2. There was a significant correlation between body weight and total length of specimens found in this study. The reported "b" value of this study for *P. obscura* is "b" 1.556, 1.546, 1.599, 1.559, 1.567 and 1.579 (Table 1) for the month July, August, September and October respectively while the reported "b" value of this study for *C. agboyiensis* is "b" 1.423, 1.492, 1.477, 1.406, 1.431 and 1.499 (Table 2) for the month of July, August, September and October respectively.

The ratio of the visceral mass to the body mass of fish for *P. obscura* in the month of July to October were 5.00, 3.97, 4.15 and 4.51 (Table 3) which indicate that the weight of the fish before dressing out is higher than the weight of the fish after dressing out while for *Clarias agboyiensis* for the month of July to October were 3.75, 4.32, 3.27 and 3.00 (Table 3) which indicate that the weight of the fish before dressing out is higher than the weight of the fish after dressing out.

Out of the 80 specimens collected on *P. obscura*, 0% had empty stomachs, 5% had 1/4 full stomachs, 62.5% had 2/4 full stomachs, 17.5% had 3/4 full stomachs and 15% had full stomachs. During the course of this examination, it was observed that the fullness of the stomach was not in relation to length or weight. Table 7 shows the overall number of food items present in *Parachanna obscura* while out of the 40 specimens collected on *C. agboyiensis*, 0% had empty stomachs, 42.5% had 1/4 full stomachs, 25% had 2/4 full stomachs, 22.5% had 3/4 full stomachs and 10% had full stomachs. During the course of this examination, it was observed that the fullness of the stomach was not in relation to length or weight.

Table 5 shows the stomach fullness of *Parachanna obscura* analyzed. 62.5% of the sampled stomachs were 2/4 half full stomach. A summary of food items that constituted the diet of *Clarias agboyiensis* from Igbokoda river is given in Table 6. Baccillariophyta, fish, fat droplets, dinoflagellate, insect, others and chlorophyta constituted the most important food items both occurring in all stomachs containing food (100% in occurrence). The stomach fullness of *Clarias agboyiensis* analyzed. 42.5% of the sampled stomachs were 1/4 full stomach.

Table 1. Length Weight Relationship of *Parachanna obscura* in Igbokoda River

MONTHS	EQUATION	BETA VALUE
MAY	LogW=1.556× - 0.510	1.549
JUNE	LogW=1.546× - 0.632	1.544
JULY	LogW=1.599× - 0.726	1.599
AUGUST	LogW=1.559× - 0.510	1.559
SEPTEMBER	LogW=1.567×- 0.684	1.567
OCTOBER	LogW=1.579× - 0.699	1.579

Table 2. Length Weight Relationship of *Clarias agboyiensis* in Igbokoda River

MONTHS	EQUATION	BETA VALUE
MAY	LogW=1.423× - 0.477	1.448
JUNE	LogW=1.492× - 0.572	1.439
JULY	LogW=1.477× - 0.569	1.477
AUGUST	LogW=1.406× - 0.474	1.406
SEPTEMBER	LogW=1.431× - O.309	1.431
OCTOBER	LogW=1.499× - 0.592	1.499

4. Discussion

4.1 Length Weight Relationship

Parachanna obscura and *Clarias agboyiensis* growth was negative allometry (Tables 1 and 2). The regression coefficient (b) for isometric growth is '3' and a value lesser than '3' indicates negative allometry growth which shows that fish becomes smaller while a value greater than '3' indicates positive allometry growth which indicates that fish becomes heavier for a particular length as it increases in size [15]. Kunda et al. [16] proposed that fluctuations observed in certain length groups might be due to variation in sample size, sex, gonad condition and amount of gut content. Length weight relationship measurements are important for the estimation of weight where only length data are available, and the condition index of the specimens. The result gotten from this study for the condition factor showed above was below the expected or standard value (K = 1) which shows this species was not in favorable environmental condition. Hence, the analysis of length weight relationship condition and relative condition factors proved to be very helpful tool in the research of fisheries that later could be used in fisheries management and assessment of fish stock [17,18]. The relative condition factor (K) gives an idea about fish physiological status and is also useful to compare feeding, climate and other condition of a fish. The correlation coefficient "r" were negative for *Parachanna obscura* and *Clarias agboyiensis*. This means that there as a negative correlation between length and weight of *P. obscura* and *C. agboyiensis* in Igbokoda River. Undernourished/ thin fish has a condition factor of less than 1. Adequately fed or fat fish has a condition factor greater than 1. The condition factor usually increases when sexual maturation approaches, the fact that sexually immatured fishes were used in this study could have also contributed to the low values recorded in its condition factor. [19] reported that the larger the condition factors the better the well-being of the fish. In this study the result of the condition factor indicated that the environment of fish species was not conducive (K<1) for the whole month in both species.

Table 3. Viscero Somatic Index of *Parachanna obscura* and *Clarias agboyiensis* during the Period of Study

SPECIES	MONTHS						
	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	MEAN(VSI)
Parachanna obscura	4.86	4.27	5.00	3.97	4.15	4.51	4.46
Clarias agboyiensis	4.12	3.97	3.57	4.32	3.27	3.00	3.70

Table 4. Analysis of Stomach Fullness of *Parachanna Obscura* in Igbokoda River

STOMACH FULLNESS (%)	NUMBER OF SAMPLE	PERCENTAGE (%)
0 (empty)	-	0
25	4	5
50	50	62.5
75	14	17.5
100(full)	12	15
TOTAL	80	100

O-/4- Empty stomach, 25-1/4- 25% Full, 50-2/4- half full, 75-3/4- 75% full, 100-4/4- totally full

Table 5. Analysis of Stomach Fullness of *Clarias agboyiensis* in Igbokoda River

STOMACH FULLNESS %	NUMBER OF SAMPLE	PERCENTAGE %
0 (empty)	-	0
25	34	42.5
50	20	25
75	18	22.5
100(full)	8	10
TOTAL	**80**	**100**

O-/4- Empty stomach, 25-1/4- 25% Full, 50-2/4- half full, 75-3/4- 75% full, 100-4/4- totally full

Table 6. Summary of the Stomach Contents Analysis of *Parachanna obscura* in Igbokoda River

	Frequency of occurrence		Numerical method	
Food items	**No**	**%**	**No**	**%**
DINOFLAGELLATE				
Protopteridinium pentagonum	22	55	18	6.45
BACCILLARIOPHYTA				
Thalassiosira anguste-lineata	18	45	13	4.65
Nitzchia closterium	33	82.5	38	13.62
Licmophora sp.	13	32.5	12	4.30
CRUSTACEAN				
Copepods	13	32.5	15	5.38
INSECT				
Insect part	24	60	35	12.54
FISH				
Fish part	37	92.5	37	13.26
Fish egg	28	70	30	10.25
PLANT MATERIAL				
Plant part	4	10	2	0.72
OTHERS				
Sand particles	39	97.5	39	13.98
Unidentified digested food	40	100	40	14.34

Table 7. Summary of the Stomach Contents of *Clarias agboyiensis*

	Frequency of occurrence		Numerical method	
Food items	**No**	**%**	**No**	**%**
CHLOROPHYTA				
Closterium sp	15	37.5	18	5.20
Scenedesmus	21	52.5	28	8.09
BACCILLARIOPHYTA				
Navicula	29	72.5	15	4.34
Nitzchia	31	77.5	12	3.47
Licmophora ehrenbergii	16	40	16	4.62
Thalassionema nitzschiodes	20	50	6	1.73
Synedra	8	20	7	2.02
DINOFLAGELLATE				
Ceratium lineatum	26	65	30	8.67
CRUSTACEAN				
Copepods	6	15	1	0.29
Cladocera	12	30	11	3.18
INSECT				
Insect part	25	62.5	30	8.67
Tunicate larva	5	12.5	2	0.58
FISH				
Fish part	33	82.5	34	9.83
Fish eggs	16	40	17	4.91
Fat droplets	39	97.5	30	8.67
OTHERS				
Sand particles	40	100	40	11.56
Detritus	6	15	12	3.47
Unidentified digested food	40	100	37	10.69

4.2 Viscero Somatic Index (VSI)

The study of viscero somatic index of this study indicated that the fish has more muscle than the viscera organs indicating that it is a good food fish of a high value and has a high fillet quality. Viscero somatic index is the percentage dress out of the fish weight before and after. The ratio of the visceral mass to the body mass of fish for *P. obscura* in the month of July to October indicated that the weight of the fish before dressing out is higher than the weight of the fish after dressing out while for *Clarias agboyiensis* for the month of July to October also follows suit (Table 3). Viscero somatic index has been used to know the gravimetric (weight) and volumetric (volume) analysis. In addition, knowledge of some quantitative aspects in fishes is an important tool for the study of biological fundamentals of viscero somatic indices, because measurement and analysis of these indices are very important. With respect to this study, *C. agboyiensis* and *P. obscura* are good fishes for consumption because of its rich fillet quality.

4.3 Gut Content Analysis of *Parachanna Obscura* and *Clarias Agboyiensis*

The nature of food depends to a great extent upon the nature of environment as well as ecological point of view [20]. Accurate description of fish food and feeding habits provides the basis for undertaking tropic interactions in aquatic food webs. It determines the rate of growth of fish species, as well as revealing the status of the foraging fish species and provides important insight into fish feeding pattern as an important aspect of fisheries management. The objective of gut content analysis is to estimate the total amount of food consumed by a population. During the course of this examination, it was observed that the fullness of the stomach was not in relation to length or weight.

The stomach fullness of *Parachanna obscura* analyzed. 62.5% of the sampled stomachs were 2/4 half full stomach. This may suggest in abundance of food items during the period of July to October. It also reveals digestion of food during the period of transportation from river to laboratory. Fish tends to optimize the energy content of prey ingested by maximizing their size in relation to their mouth gape [21]. A summary of food items that constituted the diet of *Clarias agboyiensis* from Igbokoda river is given in Table 6. Baccillariophyta, fish, fat droplets, dinoflagellate, insect, others and chlorophyta constituted the most important food items both occurring in all stomachs containing food (100% in occurrence). Others were present in 100% of sample collected followed by fat droplets, fish, baccillariophyta, insect and chlorophyta were the most abundant food items by numerical and occurrence methods in the gut of fish

species. Dietary component of *Clarias agboyiensis* proved undoubtedly that the fish obtain its diet consisting mainly of others, fat droplets, fish, baccillariophyta, insect part and chlorophyta. So the fish was found to be omnivore. The stomach fullness of *Clarias agboyiensis* analyzed. 42.5% of the sampled stomachs were 1/4 full stomach. This may suggest in abundance of food items during the period of July to October. It also reveals digestion of food during the period of transportation from river to laboratory.

5. Conclusions

Fillet quality in this study indicated that the fish specie is a good food fish because it has more muscle than the viscera organs indicating that the weight of the fish before dressing out is higher than the weight of the fish after dressing out. *Parachanna obscura* and *Clarias agboyiensis* were found to be omnivorous fish feeding mainly on both plants and animals. The condition factor of the river is not suitable for the growth of the fishes, with a variety of feed items they fed on. There was no seasonality in the composition or abundance of food items consumed generally in both fishes, because the fish specimens grazed on the same food items throughout the sampling period although at varying quantities or degrees. In conclusion, based on the observations from this research, *Parachanna obscura* and *Clarias agboyiensis* in river Igbokoda may be described as an omnivore feeding on both plants and animal thus a good candidate for aquaculture. It is therefore necessary to allow phytoplanktons grow well in water body to increase availability of food items to *Parachanna obscura* and *Clarias agboyiensis.* It is also a highly marketable food fish because of its fillet quality.

Author Contributions

The corresponding author has a 100% contribution to the manuscript.

Conflict of Interest

There is no conflict of interest.

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List of Abbreviations

C. agboyiensis - *Clarias agboyiensis*
P. obscura - *Parachanna obscura*

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