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Original Research Article

Gut Content and Viscerosomatic Index Analysis of Family *Clariidae* in the Riverine Area of South Western Nigeria

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Abstract: Fish gut content analyses refer to methods of analyzing fish diet through assessment of materials found in dissected fish stomach. This work was conducted to determine the gut content, most frequently consumed prey and viscerosomatic index of the *Clariidae* species found in riverine area in south western Nigeria. The study spanned for six months (December, 2020 to May, 2021). Fish samples were examined fresh using frequency of occurrence, number and degree of fullness to examine the guts. Out of the 99 specimens collected in total, 45.83% and 54.17% of *Clarias gariepinus,* had ¼ full stomachs and half full stomachs respectively; 60%, 36.67%, 3.33% of *Clarias jaensis* had ¼ full, half full and ¾ full stomachs stomachs respectively, 63.33% and 36.67% of *Clarias anguillaris* had ¼ full and half full stomachs respectively while *Clarias agboyiensis* and *Clarias pachynema* species had similar stomach fullness of 33.33% for ¼ fullness and 66.67% for half fullness with none of the species having empty nor 100% full stomachs. Result also showed that the examined species are indiscriminate feeders; feeding on both plants and animals. The viscerosomatic index showed that the species had more flesh than carcass, giving an inference that the species have reasonable nutritional value and FCR. In conclusion, the *Clariidae* species were found to be omnivores and as such are to be provided with more natural materials in their environment for proper growth.

Keywords: Omnivorous, Gut content, *Clariidae*, Viscerosomatic index, Carcass and Fish food.

INTRODUCTION

Fish and seafood products, have a high nutritional value with beneficial amounts of protein, lipids as well as essential micronutrients. Aquatic animal foods are a rich source of protein and caloric density, and have a high content of omega-3 long chain polyunsaturated fatty acids compared to land living animals (Tacon and Metian, 2013). The species in the family *Clariidae* are freshwater species. The diversity of Clariids is largest in Africa although they occur in Syria and southern and western Asia (Nelson *et al*., 2016).

Nature offers a great diversity of organism that is used as food by individuals who differ in size and taxonomy. The study of food and feeding habits of fish has been used by researchers to know the food requirements of potential aquaculture candidate and the productivity of the water body because fishes only eat best next important food in the absence of their preferred diets (Omondi, 2013; Lawson and Aguda, 2010; Abd El-Rahman, 2005). 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 (Akinwumi, 2003). Fish gut content analysis helps provide an important insight into feeding patterns & assessment of feeding habits which is also an important aspect of fisheries management. A valid description of fish diets provides the basis for understanding trophic interactions in aquatic food webs. A food habit study might also be conducted to determine the most frequently consumed prey or to determine the relative importance of different food types of and to qualify the consumption rate of individual prey types (Zacharia, 2011). Conceptually, trophic relations of fishes begin with the food & feeding habits. Gut content analysis can be used to evaluate the habitat preferences, prey selection, effects of ontogeny & developing conservation strategies (Chipps & Garvey 2007). The nature of food depends to a great extent upon the nature of environment as well as ecological point of view (Fagbenro *et al*., 2000).

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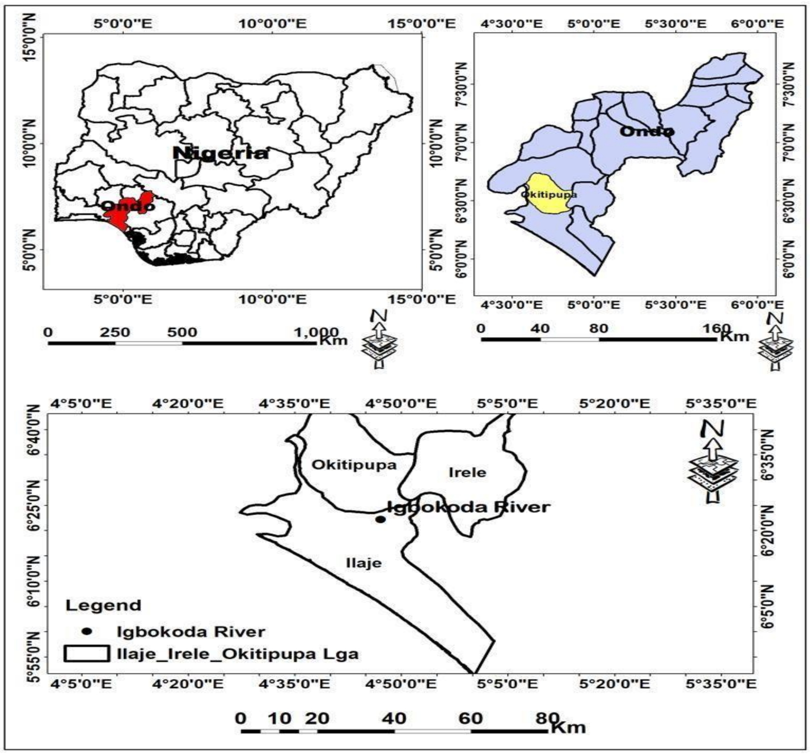
Viscera refers to the organs such as the intestine. Viscerosomatic Index (VSI) is related to the viscera and the body of an organism. It closely monitors the net amount of fillet produced by a fish. A substantial gross weight gain can result from an increase in the mass of viscera, yet, these parts of the fish are not valued as fillets. The (VSI) increases with increasing dietary lipid therefore, viscera resulting from digestible feed calories are usually discarded (Rasmussen *et al*., 2000; Chaiyapechara *et al*., 2003). Viscerosomatic Index (VSI) is an important biological index because its measurement is necessary in assessing food value. It is the ratio of the visceral mass to the carcass mass and is expressed in percentage. Just as in other vertebrates, there is an existing relationship between fish diets length of the gut or intestine (Miller and Harley, 2002). The understanding of this relationship therefore helps to predict the diet and the mechanism of feeding of fishes (Malami *et al*., 2004). The study of Viscerosomatic Index (VSI) plays an important role in the metabolism of fish, related to digestion, absorption, synthesis and secretion of digestive enzymes and carbohydrate. Therefore, the aim of this study is to determine the diet composition, gut content, most frequently consumed prey and viscerosomatic index of the *Clariidae* species found in River Igbokoda.

Experimental Section



River Igbokoda is located at an elevation of 39meters 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 river is one of the longest water bodies in the country.

Sample Collection and Identification.

Clariidae species were captured with the assistance of fishermen fishing in Igbokoda River. Gears employed by fishermen include gill nets, cast net of multiple mesh size, basket, drag net long lines and traps. The species were collected on a monthly basis from December to May and were transported live in a plastic container via public transport to the laboratory for fresh examination. The fish samples were sorted into species based on the taxonomy keys prepared by Field Guide to the commercial marine resources of the Gulf of Guinea (FAO, 2009), Fish base website, Olaosebikan and Raji (2013) and Adesulu and Sydenham (2007).Personal communication with experienced fisher folks on the local name of the fishes was done. Specimen was examined fresh. 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 pair of throngs. The total weight of the fish was recorded before dissecting, the total weight of visceral was recorded and the total weight of the remaining flesh was recorded.

Frequency of Occurrence

The number of times a particular food item occurred in the stomach was counted and was expressed as the percentage of the total number of stomachs with food

Percentage occurrence of a food item =
$\frac{Total\ no\ of\ food\ with\ a\ particular\ food\ item}{Total\ no\ of\ stomach\ with\ food}$ X 100

Numerical Method: the number of individual food item present in the stomach of the fish was counted and summed up to obtain the grand total number of all food items found in the stomach.

Percentage number of a food item =
$\frac{Total\ no\ of\ a\ particular\ food\ item}{Total\ no\ of\ all\ feed\ item}$ X 100

Viscerosomatic Index Analysis: - VSI =
$\frac{weight\ of\ fish\ visreal}{weight\ of\ fish}\ X\ 100$

Index of fullness- This is measured as the ratio of food weight to body weight as an index of fullness,

Which is very widely employed.
Fullness index = $\frac{weight\ of\ the\ stomach\ contents\ x\ 10000}{weight\ of\ fish}$

Index of Relative Importance (IRI): IRI = (% Ni +% Vi) % Oi.

Where, Ni, Vi and Oi represent numerical, volumetric and frequency of occurrence of prey respectively.

RESULTS

A total of ninety-nine (99) specimens were examined comprising of twenty-four (24) species of *Clarias gariepinus,* twenty-six (30) species of *Clarias jaensis*, thirty (30) species of *Clarias anguillaris*, nine (9) species of *Clarias pachynema* and six (6) species of *Clarias agboyiensis*. Total body weights of *Clarias gariepinus*, *Clarias jaensis*, *Clarias anguillaris*, *Clarias agboyiensis* and *Clarias pachynema* ranged from 8.70g to 444.90g, 15.60g to 642.90g, 14.00g to 234.50g, 46.60g to 409.30g and 30.00 to 63.80g respectively. On examination of the individual gut of the fish species using a microscope, below are the organisms and items found in individual fish guts.

Table-1: Stomach Contents Analysis of *Clarias gariepinus* From Igbokoda River

ORGANISM	N Occ	(%Oi)	(%Ni)	(%Vi)	IRI	%Ranks
BACCILLARIOPHYTA						
Navicula spp.	17	70.83	16.35	17.17	2272.33	27.87(1)
Licmophora spp.	1	4.17	0.96	0.47	5.63	0.07
Nitzchia spp.	3	12.50	2.90	2.92	69.38	0.85(9)
Guirnadia spp	2	8.33	1.92	1.76	29.24	0.36 (11)
Pleurosigma spp.	7	29.17	6.73	4.84	320.29	3.93(8)
Pinnularia spp	11	45.83	10.58	9.34	870.31	10.67 (5)
Thalassionema spp.	1	4.17	0.96	1.17	8.55	0.10
DINOPHTA						
Cysts	12	50.00	11.54	12.51	1152	14.13(3)
MALACOSTRACA						
Zoea	1	4.17	0.96	1.06	8.09	0.10
MAXILLOPODA						
Cyclops	1	4.17	0.96	0.47	5.63	0.07
COSCINODISCOPHYCEA E						
Coscinodiscus spp.	1	4.17	0.96	2.15	12.64	0.16
CRUSTACEAN						
Copepod	1	4.17	0.96	0.73	6.71	0.08
OSTRACODA						
Ostracod	1	4.17	0.96	0.49	5.71	0.08
INSECTS						
Insects parts	1	4.17	0.96	0.59	6.13	0.08
FISH						
Fish eggs	1	4.17	0.96	0.40	5.34	0.07
Fish parts	2	8.33	1.92	2.03	31.49	0.39 (10)
OTHERS						
Oil droplets	8	33.33	7.70	8.24	508.62	6.24 (6)
Undigested/ Unidentified food materials	13	54.17	12.50	12.43	1290.87	15.83(3)
Sand Particles	12	50.00	11.54	10.58	1055.50	12.94(4)
Detritus	7	29.17	6.73	10.65	489.76	6.01(7)
TOTAL	**17**	**429.19**	**99.05**	**100.00**	**8154.12**	**100.00**

Table-2: Stomach Contents Analysis of *Clarias anguillaris* from Igbokoda River

ORGANISM	No of Occ	(%Oi)	(%Ni)	(%Vi)	IRI	%Ranks
BACCILLARIOPHYTA						
Navicula spp.	10	33.33	9.26	5.34	486.62	7.66 (6)
Licmophora spp.	5	16.67	4.63	8.04	211.21	3.33 (10)
Nitzchia spp.	1	3.33	0.93	0.26	3.96	0.06 (12)
Guirnadia spp	8	26.67	7.41	7.80	405.65	6.39 (7)
Pleurosigma spp.	7	23.33	6.48	8.35	345.98	5.45 (8)
Pinnularia spp	10	33.33	9.26	5.87	504.28	7.94 (5)
DINOPHTA						
Cysts	10	33.33	9.26	8.74	599.94	9.45 (2)
MALACOSTRACA						
Zoea	4	13.33	3.70	3.75	99.31	1.56 (11)
COSCINODISCOPHYCEA E						
Coscinodiscus spp.	1	3.33	0.93	0.19	3.73	0.06 (15)
CRUSTACEAN						
Copepod	1	3.33	0.93	0.19	3.73	0.06 (15)
INSECTS						
Insects parts	1	3.33	0.93	2.30	10.76	0.17 (14)
FISH						
Fish eggs	2	6.67	1.85	1.25	20.68	0.33 (13)
Fish parts	3	10.00	2.77	1.10	38.70	0.61 (12)
OTHERS						
Oil droplets	10	33.33	9.26	9.78	634.40	10.00 (3)
Undigested/ Unidentified food materials	15	50.00	13.88	23.34	1861.00	29.31 (1)
Sand Particles	12	40	11.11	8.32	777.20	12.24 (2)
Detritus	8	26.67	7.41	5.39	341.38	5.38 (9)
Total	**108**	**359.98**	**100.00**	**100.00**	**6348.73**	**100.00**

Table-3: Stomach Contents Analysis of *Clarias jaensis* from Igbokoda River

ORGANISM	No of Occ	(%Oi)	(%Ni)	(%Vi)	IRI	%Ranks
BACCILLARIOPHYTA						
Navicula spp.	18	60.00	17.67	15.42	1974.00	28.92 (1)
Licmophora spp.	5	16.67	4.90	4.40	154.20	2.26 (2)
Guirnadia spp	2	6.67	1.96	3.14	33.88	0.50 (12)
Pleurosigma spp.	3	10.00	2.94	2.30	52.10	0.76 (11)
Pinnularia spp	14	46.67	13.73	13.10	1246.10	18.26 (2)
Thalassionema spp	2	6.67	1.96	1.57	23.41	0.34 (14)
DINOPHTA						
Prorocentrum spp	1	3.33	0.98	0.57	5.13	0.08 (15)
Cysts	6	20.00	5.88	4.62	209.00	3.06 (8)
CRUSTACEAN						
Copepod	2	6.67	1.96	1.71	24.35	0.36 (13)
INSECTS						
Insects parts	3	10.0	2.94	3.57	64.80	0.95 (10)
FISH						
Fish parts	6	20.00	5.88	8.23	281.20	4.12 (7)
OTHERS						
Oil droplets	7	23.33	6.89	7.90	342.95	5.03 (6)
Undigested/ Unidentified food materials	11	36.67	10.78	14.70	930.68	13.64 (3)
Sand Particles	10	33.33	9.80	8.76	615.61	9.02 (5)
Detritus	12	40.00	11.76	10.03	867.20	12.71 (4)
Total	**102**	**340.01**	**100.00**	**100.00**	**6824.61**	**100.00**

Table-4: Stomach Contents Analysis of *Clarias agboyiensis* from Igbokoda River

ORGANISM	No of Occ	(%Oi)	(%Ni)	(%Vi)	IRI	%Ranks
BACCILLARIOPHYTA						
Navicula spp.	1	16.67	5.56	9.52	251.38	2.53 (5)
Licmophora spp.	3	50.00	16.67	21.26	1896.50	19.08 (3)
Pinnularia spp	1	16.67	5.56	6.12	197.71	1.96 (7)
DINOPHTA						
Cysts	3	50.00	16.67	10.03	1335.00	13.43 (4)
COSCINODISCOPHYCEA E						
Coscinodiscus spp.	1	16.67	5.57	1.36	115.36	1.16 (8)
OTHERS						
Oil droplets	4	66.67	22.22	19.22	2762.80	27.80 (2)
Undigested/ Unidentified food materials	4	66.67	22.22	25.34	3170.83	31.91 (1)
Sand Particles	1	16.67	5.56	7.14	211.71	2.13 (6)
Total	**18**	**300.02**	**100.00**	**100.00**	**9938.29**	**100.00**

Table-5: Stomach Contents Analysis of *Clarias pachynema* from Igbokoda River

ORGANISM	No of Occ	(%Oi)	(%Ni)	(%Vi)	IRI	%Ranks
BACCILLARIOPHYTA						
Navicula spp.	3	33.33	8.82	8.60	580.61	5.03 (6)
Licmophora spp.	3	33.33	8.82	8.98	593.67	5.13 (5)
Guirnadia spp	5	55.55	14.71	10.08	1377.08	11.92 (3)
Pinnularia spp	2	22.22	5.88	11.0	375.07	3.25 (7)
DINOPHTA						
Cysts	4	44.44	11.76	9.06	925.24	8.01 (4)
COSCINODISCOPHYCEA E						
Coscinodiscus spp.	2	22.22	5.88	4.49	230.42	1.99 (8)
OTHERS						
Oil droplets	5	55.55	14.71	12.69	1522.07	13.17 (2)s
Undigested/ Unidentified food materials	9	100.00	26.47	32.41	5888.00	50.96 (1)
Sand Particles	1	11.11	2.94	2.69	62.55	0.54 (9)
Total						

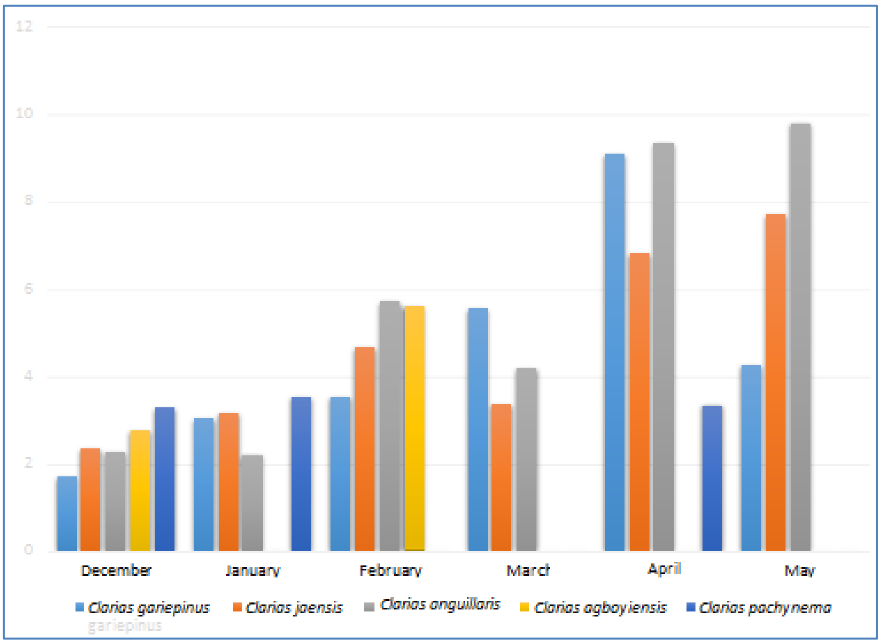


Fig-2.0: Showing a chart of the VSI (%) of *Clariidae* species in the study area

DISCUSSION

Gut Content Analysis of *Clariidae* Species

Many authors have studied the feeding habits of *C. gariepinus* species in different parts of Africa giving varying interpretations about the diversity of diet (Abayomi *et al*., 2005). Ecological studies in some reservoirs and ponds have shown that juveniles of *C. gariepinus* fed in decreasing order of preference on insects and crustaceans, mollusks, detritus and plankton which supports the result of this study to a large extent. According to table 1, Navicula spp. (baccillariophyta) and Undigested/ unidentified food materials constitute 1st and 2nd ranks in *Clarias gariepinus*; while the third, fourth and fifth places are held by cysts (dinophyta), sand particles and Pinnularia spp. (baccillariophyta) respectively. In table 2, Undigested/ unidentified food materials and sand particles constitute 1st and 2 ranks in *Clarias anguillaris*; while the third, fourth and fifth places are held by oil droplets, cysts and *Pinnularia spp*. respectively. The reasonable percentage of occurrence of sand particles could be associated with the fact that Catfishes are mud-dwelling species as was also observed by Abayomi *et al*. (2005). In Table 3, *Navicula spp. (baccillariophyta) and Pinnularia spp. (baccillariophyta)* materials constitute 1st and 2nd ranks in *Clarias jaensis*; while the third, fourth and fifth places are held by undigested/unidentified food substances, detritus and sand particles respectively. During the present study, the preference for fish prey and insects was observed to be low which negates the claim by Robbins (2004) in South Florida except that the author observed increased preference for zooplankton with increasing size. Consumption of phytoplankton *(Baccillariophyceae, Coscinodiscophyceae*, etc) by the species was considerably high in Igbokoda river throughout the period of the study. This result agrees with the observation of Yalcin *et al*. (2001) and Adeyemi *et al*. (2009) for *C. gariepinus* diets in Asi River and Gbedikere Lake. Numerous studies have been carried out on the food composition of *Clarias gariepinus* and other members of the *Clariid* family, however, a consistent pattern has not emerged and they are generally classified as omnivorous or predators. The presence of oil droplets in such a significant percentage in the gut of the species could be attributed to mass oil and agricultural pollution in the environment. The species are left with little or no option than to take in polluted water as that is their natural environment. The occurrence of *Clarias agboyiensis* and *Clarias pachynema* was scarce but were found to have a reasonable preference for diatoms (*baccillariophyta) and dinophyta* with a reasonable percentage being undigested food materials as shown in Tables 4 and 5.

The only occurring *Ostracod* in the gut of all the studied species occurred in a *Clarias gariepinus* and supports Yalçin *et al*. (2001) claims to a reasonable extent that microscopic food organisms including ostracods, zooplanktons and phytoplankton were more abundant in the diet of *C. gariepinus* in the summer than in other seasons. The study of food and feeding habits of species can be used as a tool in understanding the various factors controlling the distribution and abundance of organisms in an ecosystem. Food and feeding habits of fishes help in selection of such species of fishes which will utilize all the available food resources of the water bodies, with less competition with one another (Begum *et al*., 2008). This study shows that *Clariidae* species utilized a variety of food items, other than fish, including zooplankton, insects, crustaceans among others which supports the past reviews of many authors including that of Elias Dadebo, (2000). Dietary component of the *Clariidae* species proved without any shadow of doubt that the species could be referred to as omnivores.

VISCERO SOMATIC INDEX (VSI%)

The mean VSI% in all the species under study showed that the weight of the fish before dressing is more that its weight after dressing. *Clarias anguillaris* has the highest mean VSI% of 5.57, followed by *C. gariepinus, C. jaensis, C. agboyiensis* and then *C. pachynema* with mean VSI% of 4.52, 4.48, 4.19 and 3.38 respectively. The analysis of the viscerosomatic index of this study indicated that the fish has more flesh than the visceral organs. *Clarias anguillaris* has the highest mean VSI% of 5.57, followed by *C. gariepinus, C. jaensis, C. agboyiensis* and then *C. pachynema* with mean VSI% of 4.52, 4.48, 4.19 and 3.38 respectively which indicate that the weight of the fish before dressing out is higher than the weight of the fish after dressing out. For example, *Clarias gariepinus* weighed 354.80g before dressing gave a VSI% of 4.00, thus supporting the claim above. The viscerosomatic index showed that the species had more flesh than carcass, giving an inference that the species have reasonable nutritional value and food conversion.

CONCLUSION

The varieties of food a fish feeds on in the wild gives information on its dietary habit as an aquaculture species. *Clariidae* species were found to be omnivorous fishes feeding on both plants and animals. In conclusion, based on the observations from this research *Clariidae* species in river Igbokoda may be described as omnivores as they feed on both plants and animals. It is therefore necessary to allow phytoplanktons grow well in the water to make food items available to the species.

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