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BODY AND NUTRIENT COMPOSITION OF *CLARIAS gariepinnus*, *HETEROBRANCHUS bidorsalis*, AND THEIR HYBRID (*HETEROCLARIAS sp*)

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Target Audience: Fish breeders, fish farmers, fish processors, nutritionists.

ABSRACT

***Clarias gariepinus*, *Heterobranchus bidorsalis* and their hybrid *Heteroclarias sp.* obtained from the Nigerian institute of Fresh Water Fisheries Research, New Bussa were studied for body and nutrient composition. This hybrid contained significant more ($p<0.05$) flesh, liver \and tail/fin than the parents. The hybrid flesh was higher in protein and lower in fat than either *Clarias gariepinus* or *Heterobranchus bidorsalis*. The combined head/skeletal bones of the hybrid contained more fat than either of the parents. Calcium and magnesium levels in the flesh of the hybrid were significantly higher ($p<0.05$) than corresponding levels in the parental species. The head/skeletal bones contained appreciable amounts of phosphorous, iron, manganese and zinc.**

Key words: Clarias, Heterobranchus, hybrid, body composition, nutrient content.

DESCRIPTION OF PROBLEM

Fish is a source of high quality protein, minerals and vitamins in human diet. Of significance is the fish lipids which are believed to have protective role against development of cardiovascular diseases and rheumatoid arthritis(1) because of the omega-3 fatty acid content (2). The presence of certain trace elements also have beneficial effects in the prevention of certain diseases(3). Fish is highly desired for consumption especially where animal proteins from other conventional sources are lacking. In particular, dark coloured fleshed fish like mackerel, salmon, herring, trout (4) and by extension, carp, clarias and heterobranchus which are also dark coloured could be more health promoting than the popular white fleshed fish.

Heterobranchus and Clarias are two genera from the family Clarridae which have been found to be culturable and have enhanced commercial and economic value in West Africa. Their air breathing and hardy nature, disease resistance, high reproductive ability, positive nutritional efficiency with ability to utilize both natural and formulated feed for rapid growth have made them prominent in Africa aquaculture(5). *Heterobranchus specie* (H. cal), the hybrid from *Heterobranchus bidorsalis* (H. bid) and *Clarias gariepinus* (C. gar) have been shown to exhibit hybrid vigour in respect of growth rate, survival and certain morphometric characteristics (6).

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While these species have been subjected to rich studies directed mainly at determining their biological and morphological indices, there is a lack of information on their carcass characteristics and nutrient profile. The present study was therefore aimed at characterising the three species with respect to their processing yields and nutrient composition of the flesh, and non flesh components of the carcass.

MATERIALS AND METHODS

Catch of fish were harvested from three separate ponds of fish shoal of *Clarias gariepinus* (C. gar), *Heterobranchus bidorsalis* (H. bid) and their hybrid *Heterclarias sp* (H. cla) maintained by the Hatchery section of the Nigerian Institute of Freshwater Fisheries Research, New Bussa (NIFFR). They were transported live in bowls in their native pond water to the fish processing laboratory of the Federal college of Freshwater Fisheries Technology, New Bussa. One piece was randomly selected from each catch, immobilized and neatly separated into head, flesh with skin on, tail/fin, skeletal bones, visceral organs and liver. Each portion was weighed to determine proportionality.

The flesh and the combined head with skeletal bones were separately chopped and pulverized to form homogenous masses and stored in sterilized specimen bottles at 2^{0}C pending analysis. Samples were equilibrated overnight at 2^{0}C, and sub samples from each taken for analysis for moisture, protein, fat and ash using standard methods of the A.O.AC.(7). Value for carbohydrate was determined by differences. Phosphorous was determined by the variadomolybdate calorimetric method while other minerals were determined by atomic absorption spectrophotometry(8). The experimental procedure was replicated four times by further selection of fish pieces from the three species.

Data obtained were subjected to analysis of variance (9) and treatment means were separated when necessary by Duncan's Multiple Range test (10).

RESULTS AND DISCUSSION

Data shown in Table 1 indicate that in all the three fish species, the flesh made up the preponderant part of the body ranging from 61.97% in C. gar. To 69.44% in H. cla. The head followed with range from 19.50% in H. cla to 22.49% in H. bib. The non edible part including the tail fins, visceral organs and skeletal bones constitute less than 12.5% of the body. Thus while the percentages of the individual components were similar in the two parental lines, their hybrid H. cla. had significantly improved ($P<0.05$) flesh component, liver, tail with fins and visceral organs. Greater tail and fin component suggests greater ability of H. cla to move through water in search of its prey while lower visceral organ and high liver percentage in relation to the flesh component would suggest greater efficiency in digestion, and utilization of available feed. The combined flesh and skeletal bone content varied from 67.92% in C. gar to 74.44% in H. cla thus showing a wider variation than 71.68 to 72.57% observed for composite flesh and skeletal bone of three species of cultured Acipencer (11). These authors also reported a range of 11.06 to 13.70% for the head portion of Acipenser compared with a range of 19.50

to 22.65% observed in the present study.

Table 1: Physical and chemical composition of the fish species

	Fish Species					
	C. gar		H. bid.		H. cla	
	Mean + SD		Mean + SD		Mean + SD	
Body Composition (%)						
Flesh	61.97^{a}	1.12	63.65^{a}	1.10	69.44^{b}	1.0
Head	22.65	0.30	22.49	1.10	19.50	0.10
Skeletal bones	5.95	0.30	5.48	0.05	5.0	0.10
Tail/fins	2.89^{a}	0.09	2.48^{a}	0.05	5.00^{b}	0.10
Visceral organs	3.64	1.00	3.53	1.30	2.25	1.00
Liver	0.89^{a}	0.10	0.87^{a}	0.10	1.50^{b}	0.30
Chemical Composition (g/100g) (raw flesh)						
Moisture	72.17^{a}	0.12	75.62^{b}	0.01	71.24^{a}	0.10
Protein	19.56^{a}	0.22	18.20^{a}	0.03	25.05^{b}	0.11
Fat	5.75^{b}	0.22	3.05^{b}	0.07	2.61^{a}	0.21
Carbohydrate	0.99	0.01	1.48	0.10	0.60	0.12
Ash	1.54	0.11	1.65	0.02	1.10	0.11
(Head and Skeleton)						
Moisture	60.24	0.01	60.17	0.10	5770	0.14
Protein	16.74	0.07	15.84	0.10	18.01	1.01
Fat	3.11^{b}	0.01	1.88^{b}	0.11	4.20^{a}	0.22
Carbohydrate	1.46^{a}	0.01	3.21^{b}	0.11	1.03	0.14
Ash	18.46	0.06	17.80	0.04	19.65	0.12

ab: Values bearing different superscripts in a row are significantly different ($p<0.05$).
C. gar: *Clarias gariepinus*
H. bid: *Heterobranchus bidorsalis*
H. Cla: *Heteroclarias sp.*

Chemical composition provides valuable information on the nutritional potential of a product. Chemical composition of the raw flesh indicates reduced moisture content of 71.24% in the flesh of the hybrid, H. cla which was comparable with 72.17% in C. gar but significantly less ($P<0.05$) than 75.62% observed in H. bid. The fat content of 5.75% observed for C. gar was significantly greater ($P<0.05$) than that observed for H. bid (3.05%) or for H. cla (2.16%); both of which were similar. This difference in fat content may have had a dilution effect on the flesh colour, thus, while the flesh of C.gar is pinkish brown in colour that of H. cla with the least fat component was reddish to dark brown in colour. The observed protein content of 25.05% was also significantly higher ($P<0.05$) than 19.56% and 18.20% observed in C. gar and H. bid. respectively. There was no significant difference observed either in the carbohydrate or ash contents among the three species.

Previous report by Puwastein *et al.* (1) on several Thailand fresh water fish had the following range for moisture (65-80%), protein (17-20%), fat (<2 to 14.7%) and ash (1-1.6%). Specifically, cat fish had an analysis of 65% moisture, 17.8% protein, 14.7% fat and 1.1% ash. Eckhoff and Maage (12) in their studies reported a dry matter content of 16.4 to 17.5% for the flesh and 23.8% in the skin of East African C. gar. Stansby (13) as well as Guner *et. al.,* (14) used Lipid content in classifying fish species into high, medium and low fat fish with the medium containing 5 to 10% fat. By this delineation, C. gar just fell within the lower range for medium fat fish. The three Nigerian varieties can therefore be safely classed as low fat fish as the fat contents are within the range of 2.6 to 5.75%. Ash as determined for the Nigerian varieties were all higher except in H. cla than ash observed in nine important Black sea fish specie (14). On the other hand carbohydrate values showed considerable variation from 0.6% in the hybrid H. cla. to 1.48% in H. bid but were much lower than values reported for the Black sea species.

The clarias group is often used in Nigeria in the preparation of fish pepper soup, a well sort after delicacy. Casual observation also shows that the fish head portion is often the favourite of consumers since if properly cooked, most of the bone is rendered softened and readily chewed prior to ingestion. Thus the head furnishes ample amount of protein, fat and minerals present in the bone. Chemical evaluation of the composite head and skeletal component indicates lower moisture but higher protein, fat and ash content in H. cla than in any of the other two. However, significant difference ($P<0.05$) was observed only in the fat component

As seen in Table 2, H. cla, the hybrid, contained higher values for most of the minerals evaluated both in the flesh portion and in the composite head and skeletal bones than the other species. Similarly, the composite head and skeletal bones for the three species were generally richer in the macro-nutrients Ca, P and Mg than the flesh portion but lower in the micro-nutrients Fe and Mn. Zinc on the other hand had equitable distribution in both the flesh and the composite head and skeletal portions.

As shown by Lazos *et al.* (15) nutritional information on the mineral composition of many fresh water fish species are lacking and where available, wide compositional variability occurs due to geographical location of catch, season of the year, sex, feeding habits and reproductive status among others. Eckhoff and Maage (12) also observed that nutrients derived from fish vary depending on whether the whole fish including the bones is consumed or only the fillet with or without the skin. Thus Ca content in the flesh varied from 143.41mg/100gm in C. gar to 191.25mg/100gm determined for the fresh water fish, silver cap (16).

Data for P were also lower than 208-263mg/100gm reported by these authors although they were within range of values reported by Chandrashekar and Deosthale (17) in Indian fresh water fish species. Mg observed in the flesh of the three Nigerian species was about twice as much as that obtained by Lazos (15). Fe content varied from 10.66mg/100gm in H. bid to 13.32mg/100gm in H. cla. Vlieg *et al* (16) obtained a range of values from 0.47mg/100gm in grass carp to 15mg/100gm in brown trout. However, Chandrashekar and Deosthale (17) obtained extremely low values of 0.6 to 0.9mg/100gm in some Indian Fresh water fish

Table 2. Mineral Composition of flesh and skeletal portions of the fish species (mg/100g)

	Fish Species					
	C. gar		H. bid.		H. cla	
	Mean	+ SD	Mean +	SD	Mean +	SD
Mineral Composition (Flesh)						
Ca	143.41[a]	0.11	1.66.43[b]	0.10	191.25[c]	0.01
P	190.36[b]	0.05	164.60[a]	0.05	180.86[b]	0.20
Mg	160.02[a]	0.11	155.76[a]	0.11	186.82[b]	0.08
Fe	11.37	0.16	10.66	0.13	13.32	0.11
Mn	160.02[b]	0.11	155.76[b]	0.11	110.05[a]	0.08
Zn	2.89[b]	0.24	1.67[a]	0.11	4.34[c]	0.10
(Head/Skeletal Bones)						
Ca	200.39	0.21	201.68	0.19	215.61	0.04
P	278.32[a]	0.06	256.61[a]	0.12	389.77[b]	0.14
Mg	190.02	0.11	194.91	0.03	200.14	0.16
Fe	4.12[a]	0.01	3.73	0.09	6.47[b]	0.11
Mn	5.09[a]	0.05	5.31[c]	0.21	7.25[b]	0.16
Zn	2.64[a]	0.13	2.66[a]	0.10	4.01[b]	0.16

abc: Values bearing different superscripts in a row are significantly different ($p \leq 0.05$).
C.gar: *Clarias gariepinus*
H.bid *Heterobranchus bidorsalis*
H.cla: *Heteroclarias sp.*

CONCLUSION AND APPLICATION

The findings of this study have shown that hybridization of *Clarias gariepinus* and *Heterobranchus bidorsalis* has resulted in *Heteroclarias sp.* which has greater nutritional potential especially in relation to flesh and liver percentages, protein and mineral elements such as iron, manganese and zinc in the head and skeletal bones. The fat content of the flesh of *Heteroclarias sp* was significantly lower ($P<0.05$) than that of *Clarias gariepinus* while fat in the head and skeleton was higher in H. cla than in C. gar. There is need to determine fatty acid composition of these fats for proper assessment of their nutritional and health significance.

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