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Biochemical composition of five fish species (*C. laticeps; D. rostratus*; *S. schall*; *S. mystus* and *H. bebe*) from river Niger in Edo State, Nigeria

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Abstract
Five West Africa freshwater fishes namely *Clarotes laticeps*; *Distichodus rostratus*; *Synodontis schall*; *Schilbe mystus* and *Hyperopisus* bebe from the River Niger, Illushi, in Esan South East Local Government Area of Edo State were analysed to determine their biochemical composition. The fish specimens were purchased at the bank of the river, between June 2006 and January 2007. They were put in an iced box and immediately transported to the laboratory where routine body measurement and biochemical analysis were carried out. The result of the proximate compositions showed protein had a value of 11.29%; 23.59%; 11.79%; 12.95% and 14.10%, while lipid had a value of 5.49; 6.81; 8.80; 5.06 and 6.27. Moisture had a value of 68.81; 64.83; 67.76; 69.00; and 70.5 while ash had a value of 4.99; 3.74; 5.10; 4.29; 5.4 for *C laticeps; D rostratus; S. schall; S. mystus* and *H. bebe* respectively. This result shows that taste, size, freshness and other related external appearances should not be the only factors to be considered in making choice for marketing and consumption of fishes. The result obtained in this study has provided scientific information and detailed knowledge of the proximate composition of these five important commercial fish species.

Keywords: *C. laticeps, D. rostratus*, *S. schall*, *S. mystus* and *H. bebe*

Introduction
Fish constitutes a major source of protein in our diet. Uboma *et al.* (1981) [37], have reported that Nigerians obtain 40% of their animal protein from fish. Fish apart from being important in human diet, its fatty acids are currently under intense scientific investigation because of numerous health benefits attributed to them (Rahman *et al*. 1995 and Clucas & Sutcliffe, 1981) [29, 6]. The principal constituents of fish may be divided into five categories, namely; Protein, Lipid, Carbohydrate, Ash and Water. The biochemical analysis of these constituents may vary greatly from species to species and one individual to another depending on age, sex, environment and season (Stansby, 1962, and Love, 1970) [35, 23]. According to Kor (1995) [22], the biochemical composition of fish is closely related to feed intake, migratory and sexual changes in connection with spawning. He stated that fish will have starvation periods for natural or physiological reasons such as during migration, spawning or because of external factors like as shortage of food. Higher levels of energy are usually used up by fishes which embark on long migration to spawning grounds. Therefore, fish having energy reserve in the form of lipids will rely on this. Species performing long migrations before they reach specific ground(s) or river (s) may utilize protein in addition to lipids for energy, thus depleting both the lipid and protein reserves, resulting in a general reduction of the biological condition of the fish (Kor, 1995) [22]. Most species in addition, do not usually ingest much food during spawning or migration and are therefore not able to supply energy through feeding. Fish growth is influenced by a number of factors such as food, space, temperature, salinity, season and physical activity. Since fishes are poikilothermic and live permanently immersed in water, they are directly affected by changes in their ambient medium (Weatherly and Gill, 1987) [38]. The term growth signifies change in magnitude. The variable undergoing change may be the length or other physical dimensions, including volume, weight or mass of either an organism's whole body or its various tissues or it may relate to lipids, protein content, or other chemical constituents of the body. Growth may also relate to the change in the number of animals in population (Weatherly and Gill, 1987) [38].

Body composition is a good indicator of the Physiological condition and nutritional status of a fish but it is relatively time consuming to measure. However, these values (size, sexual condition, feeding season and physical activity) vary considerably within and between species. The analysis of four main tissue constituents, that is protein, water, lipids and ash content is sometimes described as "approximate analysis" (Love, 1970) [23].

A wide range of proteins occur which are mainly composed of 20 amino acids combined in different arrangement. Ten of the amino acids are classified as essential as they cannot be synthesized by man and therefore fish is important in maintaining a correct dietary balance (Johnwest, 2002) [20].

Lipid is regarded as one of the most important food reserve contributing to the condition of the fish and this has led to the use of fat indices as a measure of relationship between percentage water and percentage fat (Sinclair and Duncan, 1972) [3]. Such estimates are used simply because the measurement of water is easy and rapid. These relationships have been shown to exist in various fish species and have been extensively used for predictive estimates (Iles and Wood 1965; Brett; Shelbounsne; and Shoop 1969 and Salam; Ali; Chatta and Zuman 1993) [5, 31]. Protein content, which is an important component, tends to vary little in healthy fish (Weatherly and Gills, 1987) [38].

There is a wealth of literature available on body composition of various fish species (Dawson and Grimm, 1980; Jobling, 1980; Shearer, 1984; Weatherly and Gill, 1987; Salamand Davies, 1994; Grayton and Beamish, 1997; Jonsson and Jonsson, 1998; Berg; Thronaes and Bremset 2000; Ekpo and Elakhame, 1998 and 2004; Dempson *et al*., 2004; Ali; Igbal; Salam, Iram and Athar 2005a; and Ali, *et al*., 2005b) [4, 12, 11, 28, 2].

Scope and Justification

Fish constitutes a major source of protein in our diet and its growth is influenced by a number of factors such as food, space, temperature, salinity, season and physical activity (Weatherly and Gill 1987) [38]. Studies on the body composition of the freshwater fishes have not really caught attention of researchers in fisheries; and the lack of adequate information on fishes especially from River Niger in Illushi area, Esan South East, Edo State, Nigeria, hence the consumer and fishery workers are left with limited or paucity of information's on the importance of some particular fish species in their daily diets (Adeqoye *et al*, 2003) [1]. And the present study is aimed to provide an important information on the biochemical composition of some species marketed in the area.

Aim of the Study

The aim of the study are to determine the biochemical Composition of the various fishes found in Illushi, Edo State, Nigeria

Materials and Methods

Sampling Site

Fresh fish samples of *C. laticeps; D. rostratus*; *S. schall*; *S. mystus* and *H. bebe* were purchased from commercial fish landing at the bank of the River Niger in Illushi on market days for an interval period of 7 months. Illushi is a town in Esan-South-East Local Government Area of Edo State. It lies between latitudes 6^{o} 33' 45N and longitude 6^{0} 33 30E (fig.1). The river Niger forms a boundary between Edo and Kogi states and the plains are always subjected to flooding annually whenever the river overflows its banks during the raining season.

The fish samples were transported in an insulated iced container to the Zoology Lab, AAU, Ekpoma.

Laboratory Study of Samples

1) **Identification:** In the laboratory, the fish samples were identified using the taxonomy keys by Reed *et al,* (1967) [30], Babatunde D.O. and Aminu R., (1998) [3]. And Elakhame, L.A. (2004) [14]. The identified samples were then labelled in triplicates.

2) **Measurement:** In the laboratory, measurement of the standard length, total length and weight were recorded.

1. **Standard length**: distance from the tip of the snout or the anterior-most part of the head to the hyporal bone.
2. **Total Length**: Distance from the anterior most part of the head to the posterior most part of the tail (usually tip of the caudal fin).
3. **Weight**: Fish samples were weighed on Triple beam balance 2610g and electronic digital balance LP 503.

Moisture Determination

Triplicates of the pre-weigh samples were placed into Petri dishes dried in an air drought oven (Oven SM-9023, Electric heated blast dry box, PEC Medical USA). The drying was done at 100 ^{0}c. Heating continued till successive weighing showed no further loss, it was then removed from the Oven, placed in a desiccators, allowed to cool and weighed.

Lipid Determination

14g of finely homogenized sample (i.e. flesh and bone) was weighed into a conical flask. To this was added chloroform and methanol in a ratio of 1:2. It was blended for 5 minutes and the mixture centrifuge for another five minutes. The supernatant was decanted using a filter paper. This process was repeated using the residue with 0.8ml water added. Chloroform was added to the supernatant to make a ratio of 1:1 with 0.8ml of water added. Using a separating funnel, the oil was separated from the solvent. Subsequently, at 40 ^{0}C using a water bath, the solvent was evaporated from the lipid and weigh.

Protein Determination

Micro-kjeldahl Nesslerization method was followed for protein determination. 2g of sample were weighed into three different Kjeldahl digestion flasks containing 20ml of Concentrated H_2SO_4 and a spatula of Kjeldahl catalyst. The sample was gently heated initially till frothing ceases, subsequently brisk boil and continuous digestion was carried out till mixture was colourless. The digests were cooled and water was added to a volume of 100ml water.

4ml of Nessler's reagent was added to 1ml of diluted digest obtained. The absorbance of this mixture was then read spectrophotometrically at 490nm against a blank. The solution, 0.01g/100ml H_2O similarly treated as the sample. The protein content was obtained from this by multiplying with 6.27

Ash Determination

1g of triplicate sample was weighed into different porcelain dishes. 5ml of solution of aluminum nitrate and calcium nitrate, (40g Al (NO_3) $9H_2O$ + 20g Ca (NO_3) $4H_2O$ in 100ml of water) was added. They were dried in a thermo stately controlled Oven at 100 ^{o}C. Subsequently, the sample was

charred by placing flame from a glass jet over the same. Then they were placed into a muffled furnace (carbolite LMF 12/2) at 450 ^{0}C overnight. They were cooled in a desiccators and reweighed to obtain the ash content.

Results

The results of proximate composition of fish samples are presented in table 1 below.

Table 1: Mean values of various body constituents in the fish sampled

Fish	Protein	Lipid	Moisture	Ash
C. laticeps	11.2817 ± 0.26	5.4860± 0.28	68.8180± 1.78	4.9860 ± 0.00
D. rostratus	23.5897 ± 2.00	6.8130 ± 1.10	64.8330 ± 1.60	3.7390 ± 0.21
S. schall	11.7947 ± 1.12	8.7980 ± 1.10	67.7590 ± 1.24	5.1020± 0.00
S. mystus	12.9487 ± 0.46	5.0610 ± 0.12	68.9980 ± 1.60	4.2880± 0.00
H. bebe	14.1027 ± 1.28	6.2700 ± 0.45	70.5520 ± 2.00	5.4210± 0.16

Result represents the mean± SEM of three replicates.

Protein Content

D. rostratus recorded the highest protein content of 23.5897±0.200, followed by *H. bebe* with value of 14.1027±1.28. Comparable amount were also recorded in *S. schall* and *C. laticeps* with values 11.2817±0.26 and 11.7947±1.12 respectively. *C. laticeps* recorded the least protein value of 11.2817±0.26 (Table 1). Comparism of the mean protein of *D. rostratus* with all other species (*C. laticeps. S. schall, S. mystus* and *H. bebe*) shows that *D. rostratus* was significantly different (P<0.05) (Table 2).

Lipid Content

S. schall recorded the highest lipid value of 8.7980±1.10, followed by 6.8130±1.10, 6.2700±0.45 and 5.4860±0.28 for *D. rostratus, H. bebe* and *C. laticeps* respectively. The least lipid content was observed in *S. mystus* with a value of 5.0610±0.12 (Table 1). Mean values between *S. schall* and *C. laticeps, H. bebe*, and *S. mystus* recorded significant difference (P<0.05) in lipid content (Table 3).

Moisture Content

The highest moisture content was observed in sample *H. bebe* with a value of 70.5520±2.00, while the least observed moisture content was recorded in *D. rostratus* with value of 64.8330±1.60. A value of 68.9980±1.60, 68.8180±1.78 and 67.7590 ± 1.24 was recorded for *S. mystus, C. laticeps* and *S. schall* respectively (Table 1). Only comparison of mean moisture content of *H. bebe* and *D. rostratus* recorded significant difference (P<0.05) (Table 4).

Ash Content

H. bebe recorded the highest ash values of 5.4210±0.16, followed by *S. schall* with ash value of 5.1020±0.00. Comparable amount were also recorded in *C. laticeps* and *S. mystus* with values 4.9860±0.00 and 4.2880±0.00 respectively. *D. rostratus* recorded the least ash values of 3.73900.21 (Table 1). Only mean comparison values for *S. schall* with *C. laticeps* and *H. bebe* recorded insignificant difference (P>0.05) (Table 5)

Carbohydrates Content

Carbohydrates and non-protein compounds are present in negligible amount and are usually ignored for routine analysis (Love, 1970; Love 1980; Weatherly and Gill, 1987; Cui and Wootton, 1988) [23, 24, 38, 8], hence no value is given in table.

Table 2: Interspecies Comparison of Protein Content in all the Fish Samples

(1) Species	(J) Species	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
					Lower Bound	Upper Bound
C. laticep	*D. rostratus*	-12.3080*	1.6951	.000	-16.0849	-8.5311
	S. schall	-.5130	1.6951	.768	-4.2899	3.2639
	S. mystus	-1.6670	1.6951	.349	-5.4439	2.1099
	H. bebe	-2.8210	1.6951	.127	-6.5979	.9559
D. rostratus	*C. laticeps*	12.3080*	1.6951	.000	8.5311	16.0849
	S. schall	11.7950*	1.6951	.000	8.0181	15.5719
	S. mystus	-10.6410*	1.6951	.000	6.8641	14.4179
	H. bebe	9.4870*	1.6951	.000	5.7101	13.2639
S. schall	*C. laticeps*	.5130	1.6951	.768	-3.2639	4.2899
	D. rostratus	-11.7950*	1.6951	.000	-15.5719	-8.0181
	S. schall	-1.1540	1.6951	.511	-4.9309	2.6229
	H. bebe	-2.3080	1.6951	.203	-6.0849	1.4689
S. mystus	*C. laticeps*	1.6670	1.6951	.349	-2.1099	5.4439
	D. rostratus	10.6410*	1.6951	.000	-14.4179	-6.8641
	S. schall	1.1540	1.6951	.511	2.6229	4.9309
	H. bebe	-1.1540	1.6951	.511	-4.9309	2.6229
H. bebe	*C. laticeps*	2.8210	1.6951	.127	-.9559	6.5979
	D. rostratus	-9.4870*	1.6951	.000	-13.2639	-5.7101
	S. schall	2.3080	1.6951	.203	-1.4689	6.0849
	S. mystus	1.1540	1.6951	.511	-2.6229	4.9309

*The mean difference is significant at the. 05 level

Table 3: Interspecies Comparison of Lipid Content in all the Fish Sample

(1) Species	(J) Species	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
					Lower Bound	Upper Bound
C. laticep	*D. rostratus*	-1.3270	±1.0206	.223	-3.6011	.9471
	S. schall	-3.3120*	±1.0206	.009	-5.5861	-1.0379
	S. mystus	.4250	1.0206	.686	-1.8491	2.6991
	H. bebe	-7840	1.0206	.460	-3.0581	1.4901
D. rostratus	*C. laticeps*	1.3270	1.0206	.223	-.9471	3.6011
	S. schall	-1.9850	1.0206	.080	-4.2591.	.2891
	S. mystus	1.7520	1.0206	.117	-.5221	4.0261
	H. bebe	.5430	1.0206	.606	-1.7311	2.8171
S. schall	*C. laticeps*	3.3120*	1.0206	.009	1.0379	5.5861
	D. rostratus	1.9850	1.0206	.080	-.2891	4.2591
	S. mystus	3.7370	1.0206	.004	1.4629	6.0111
	H. bebe	2.5280*	1.0206	.033	.2539	4.8021
S. mystus	*C. laticeps*	-4250	1.0206	.686	-2.6991	1.8491
	D. rostratus	-1.7520	1.0206	.117	-4.0261	.5221
	S. schall	-3.7370*	1.0206	.004	-6.0111	-1.4629
	H. bebe	-1.2090	1.0206	.264	-3.4831	1.0651
C. laticeps	*C. laticeps*	.7840	1.0206	.460	-1.4901	3.0581
	D. rostratus	-.5430	1.0206	.606	-2.8171	1.7311
	S. schall	-2.5280*	1.0206	.033	-4.8021	-0.2539
	S. mystus	1.2090	1.0206	.264	-1.0651	3.4831

*The mean difference is significant at the.05 levels.

Table 4: Interspecies Comparison of Moisture Content in all the Fish Sample

(1) Species	(J) Species	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
					Lower Bound	Upper Bound
C. laticep	*D. rostratus*	3.9850	2.3466	.120	-1.2435	9.2135
	S. schall	1.0590	2.3466	.661	-4.1695	6.2875
	S. mystus	-.1800	2.3466	.940	-5.4085	5.0485
	H. bebe	-1.7340	2.3466	.477	-6.9625	3.4945
D. rostratus	*C. laticeps*	-3.9850	2.3466	.120	-9.2135	1.2435
	S. schall	-2.9260	2.3466	.241	-8.1545	2.3025
	S. mystus	-4.1650	2.3466	.106	-9.3935	1.0635
	H. bebe	-5.7190*	2.3466	.035	-10.9475	-.4905
S. schall	*C. laticeps*	-1.0590	2.3466	.661	-6.2875	4.1695
	D. rostratus	2.9260	2.3466	241	-2.3025	8.1545
	S. mystus	*-1.2390*	2.3466	609	-6.6475	3.9895
	H. bebe	*-2.7930*	2.3466	261	-8.0215	2.4355
S. mystus	*C. laticeps*	*.1800*	2.3466	.940	-5.0485	5.4085
	D. rostratus	4.1650	2.3466	.106	-1.0635	9.3935
	S. schall	1.2390	2.3466	.609	-3.9895	6.4675
	H. bebe	-1.5540	2.3466	.523	-6.7825	3.6745
H. bebe	*C. laticeps*	1.7340	2.3466	.477	-3.4945	6.9625
	D. rostraus	5.7190*	2.3466	.035	.4905	10.9475
	S. schall	2.7930	2.3466	.261	-2.4355	8.0215
	S. mystus	1.5540	2.3466	.523	-3.6745	6.7825

*The mean difference is significant at the.05 levels.

Table 5: Interspecies Comparison of Ash Content in all the Fish Sample

(1) Species	(J) Species	Mean Difference (I-J)	Std Error	Sig	95% Confidence Interval	
					Lower Bound	Upper Bound
C. laticep	*D. rostratus*	1.2470*	1827	.000	-8399	1.6541
	S. schall	-.1160	1827	.540	-5231	.2911
	S. mystus	.6980*	1827	.003	.2909	1.1051
	H. bebe	-.4350*	1827	.039	-8421	-2.7898E-02
D. rostratus	*C. laticeps*	-1.2470*	1827	.000	-1.6541	-.8399
	S. schall	-1.3630*	1827	.000	-1.7701	-.9559
	S. mystus	-.5490*	1827	.013	0.9561	-.1419
	H. bebe	-1.6820*	1827	.000	-2.0891	-1.2749
S. schall	*C. laticeps*	.1160	1827	.540	-.2911	.5231
	D. rostratus	1.3630*	1827	.000	.9559	1.7701
	S. mystus	.8140*	1827	.001	.4069	1.2211
	H. bebe	-3190	1827	.111	-7261	8.810E-02
S. mystus	*C. laticeps*	-.6980*	1827	.003	-1.1051	-.2909
	D. rostratus	.5490*	1827	.013	.1419	.9561

	S. schall	-.8140*	1827	.001	-1.2211	-.4069
	H. bebe	-1.1330*	1827	.000	-1.5401	-.7259
H. bebe	*C. laticeps*	4350*	1827	.039	2.790E-02	.8421
	D. rostraus	1.6820*	1827	.000	1.2749	2.0891
	S. schall	.3190	1827	.111	-8.8102E-02	.7261
	S. mystus	1.1330*	1827	.000	.7259	1.5401

*The mean difference is significant at the.05 level.

Table 6: Fat Indices of Studied Fish Samples

Fishes	Fat Indices
C. laticeps	12.5443
D. rostratus	9.5161
S. schall	7.7016
S. mystus	5.0610
H. bebe	11.2523

Discussion and Conclusion

Result analysis on the estimation of proximate composition of fresh water fishes: *D. rostratus C. laticeps; S. Schall, S. mystus* and *H. bebe* on moisture content are quite similar with results obtain from other African fresh water fishes such as *Oreochromis niloticus, Clarias gariepinus, Sarotherodon* and *Heterotis niloticus* with values 75%, 66%, and 79% respectively (Fawole; Ogundiran; Ayandiran; and Olagunju 2007) [16]. The results also agreed with the values obtained for freshwater species on the comparative study of body composition of different fish species from brackish water pond and fillets of various fish species (Kor, 1995 and Ali *et at.,* 2005) [22, 2]. The values when compared with fishes such as *Micromesistius poutassou, Scophthalmus rhombus; Grand aeglefinus; Scomber scombrus* and *Perca fluviatilis* obtained from temperature waters (73-84%) are low (Murray and Burt, 1969) [25]. Water serves as a medium of transportation for food substances like fat, protein, etc. to the cells, organs, and various parts of the fish for proper co-ordination (Connor *et al.,* 1991) [7]. According to Murray and Burt, (1969) [25]. And Turan *et al*. (2007) [26], the values obtained for fat in this present study are higher than figures obtained for marine fishes such as *Cyprinus carpio*, *Trigia sp*, *Clupea herengus* etc., with a range of 0.5-2.2%. As the fat content rises, the water content falls and vice versa. As shown in the results, the sum of fat and moisture for any of the studied fishes approximates 80% (Murray and Burt, 1969; Gunstone, 1969; and Poulter and Nicoiaides, 1985) [25, 17, 28]. This explains the difference between the result of this study (freshwater fishes) and that obtained from marine fishes. The value for fat in this study agrees with results obtained from the study of fish composition in South African Freshwater fishes (Eramus; Ewa; Mary-Jane; Luke; Hermogene and Hlanganani 2008) [15]. Fish are usually categorize as lean, moderately fat, and fat according to its fat content, which is, less than 5 percent, from 5 to 10 percent and greater than 10 percent respectively (Dean, 1990) [10]. Thus the five fish species: *D. rostratus; C. laticeps; S schall; S. mystus* and *H. bebe* can be classified as moderately fat with its fat content ranging between 5 to 10%. Lipids in fishes are important for energy reserve and is useful in consideration of fish wholesomeness. It serves as predictive estimates of fish condition (Iles and Wood, 1965; Brett *et al.,* 1969; Sinclair and Duncan, 1972 and Salam *et al.,* 1993) [18, 5, 33, 31]. These values can be accepted as the condition of wholesome fish sourced in these localities. The values can serve as a quality index for trade purpose though more extensive investigation is still needed to confirm these indices.

Protein content in *D. rostratus, S. mystus* and *H. bebe* agrees with the report from some fish species obtained from brackish, fresh and marine water (Murray and Burt, 1969; Poulter and Nicolaides, 1985; Ali *et al.,* 2005; and Turan *et al.,* 2007) [25, 28, 2, 36,]. Seasonal changes could be responsible for low values in *C laticeps* and *S. schall* as the amount of protein in fish muscle is usually between 13 and 23% but values lower than 15% or as high as 25% are occasionally met with some species. Protein is useful for maintenance of good health (Murray and Burt, 1969) [25].

Ash content is a reflection of the mineral content in the sample. The values observed in the samples studied are lower than that reported for four Commercial West African Freshwater food fishes, 5.96 ± 0.42 – 6.74 ± 0.95 (Oyedapo; Mosunnola; Oluwayemis; and Ameenal 2005) [17]. But the same with reports from Comparative Study of Body Composition of different fish species from brackish water pond and Comparative study of body composition of four fish species in relation to pond depth from the works of Ali *et al.* (2005a and 2005b) [2]. Fawole *et al*. (2007) [16] in the study of proximate and mineral composition in some selected fresh water fishes *(Oreochromis niloticus; Clarias gariepinus* and *Sarotherodon galilaeus)* in Nigeria, reported comparable values of 4.55%; 4% and 4.76% respectively. The result obtained in this present study is higher than that reported for marine *Raja clavata*, (1.38±0.0%) (Turan *et al.,* 2007) [26]. generally, according to Murray and Burt (1969) [25], the basic causes of change in the composition of ash are usually variations in the amount and quality of food that the fish eats and the amount of movement it makes.

Conclusively**,** it can be suggested that taste, size, freshness and other related external appearances should not be the only factors to be considered in making choice for marketing and consumption of fishes. The result obtained in this study has provided scientific information and detailed knowledge of the proximate composition of these five important commercial fish species.

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