

Original Research Article

**COMPARATIVE STUDY ON THE CONDITION FACTOR,
HEMATOLOGICAL AND SERUM BIOCHEMICAL
PARAMETERS OF WILD AND HATCHERY COLLECTED
BROODFISH OF THE AFRICAN CATFISH
Heterobranchus longifilis (Valenciennes 1840)**

ABSTRACT

This study was conducted to investigate the condition factor, hematological and serum biochemical parameters of wild and hatchery collected broodfish of the African Catfish (*Heterobranchus longifilis*) and used as an indicator of their health condition. A total of 30 wild broodfish of the African Catfish, *Heterobranchus longifilis* (15 males and 15 females) of mean length (62.13 ± 0.80 cm) and mean body weight (1506.50 ± 44.82 g) were collected from Ayadehe, Itu Head Bridge and 30 broodfish (15 males and 15 females) of mean length (61.93 ± 0.69 cm) and mean body weight (1499.84 ± 46.28 g) were collected from a private hatchery located in Calabar, Cross River State, Nigeria and used for the study. Results showed that there was no significant difference ($P > 0.05$) in the hematological parameters including PCV, WBC, Hemoglobin, RBC, MCV, MCH and MCHC of both male and female wild and hatchery bred broodfish of *H. longifilis*. Similarly, there was also no significant difference ($P > 0.05$) in the serum biochemical parameters including cholesterol, triglyceride, total protein, albumin, globulin, glucose and urea in both male and female wild and hatchery bred broodfish of *H. longifilis*. Condition factor of male, female and pooled sex of both the wild and hatchery broodfish of *H. longifilis* showed that the fishes were in healthy condition. Hematological and serum biochemical parameters are very useful tools in analyzing the health status of broodfish as they provide reliable information the stress status which could influence broodfish reproductive performance. Result of this study, along with other findings will provide a reference for catfish breeders and aquaculturists evaluating the health status of hatchery and wild *H. longifilis*.

Keywords: Condition factor, hematological parameters, serum biochemical parameters, wild broodfish, hatchery broodfish, African catfish *Heterobranchus longifilis*

32 INTRODUCTION

33 With the annual increase in global population projected at over nine billion people by 2050,
34 sustainable food production to meet the demand has become serious challenge of global concern.
35 Issues of undernutrition such as micronutrient deficiencies continue to remain problematic especially
36 in developing countries. In Nigeria, fish protein is a major part of diet because it is one of the cheapest
37 sources of protein that is nutritionally rich and could be used to drastically reduce the issue of
38 undernutrition. According to [1] and [2], the African Catfish is rich in nutrients such as omega-3- fatty
39 acid, riboflavin, iron, thiamine, vitamins A, vitamin D, phosphorus, and calcium which is necessary
40 for tissue development and good health. Declination in fish production through capture fisheries
41 resulting from poor management of wild fisheries has indicated the need for a more resilient and
42 responsible fish production system. According to World Bank [3], the future of fish supply-demand
43 scenarios indicates that to meet growing global demand, there is need to double the production of fish
44 and other aquatic animals by 2030. Aquaculture now becomes the most resilient, reliable and
45 responsible means of producing fish at sustainable levels without any footprint on the environment.
46 However, for aquaculture to meet the present and future demand of fish protein, there is need for
47 aquaculture expansion and intensification [4]. In Nigeria, expansion and intensification of aquaculture
48 is hindered by several challenges. Scarcity and high cost of high quality feed is a major problem for
49 farmers and intending farmers. Lack of high quality fingerlings produced from healthy broodfish is
50 another significant problem that has discouraged farmers due to poor growth resulting in loss of
51 money or very low profit margin. *Heterobranchus longifilis* is a species of the African Catfish
52 belonging to the family Clariidae. According to [5], this species can grow up to the size of 14
53 kilogram. Documentation of [6] shows that *H. longifilis* is an important aquaculture species in Nigeria
54 due to several biological attributes such as hardy nature, fast growth rate, disease resistance,
55 appreciable size, high fecundity, ease of induced breeding, tolerance of poor of environmental
56 conditions, tolerance of high stocking densities, acceptability of artificial feed, nice taste, high market
57 value and meat quality. Hematological and biochemical parameters of fish are biological tools used as
58 indicators in evaluating fish health conditions [7] and [8]. Hematological and biochemical parameters
59 can also be used to assess the health condition of the environment [9]. According to [8],
60 hematological and biochemical parameters can easily give information about the existence, status and
61 intensity of possible sickness in fishes. Therefore, understanding these parameters is important since it
62 can also be used to monitor the pathological and physiological changes in fishes. One of the
63 challenges in evaluating the health status via blood parameters in natural fish population has been the
64 lack of reliable information on the normal fish condition [10], [11]. In literature, normal ranges for
65 various hematological and biochemical parameters of the African Catfish have been established by
66 different authors [5], [12], [13], [14], [15] and [16]. In Nigeria, cost of hatchery raised broodfish of
67 the African Catfish is on the increase with price ranging from ₦4000.00/kg or even more depending

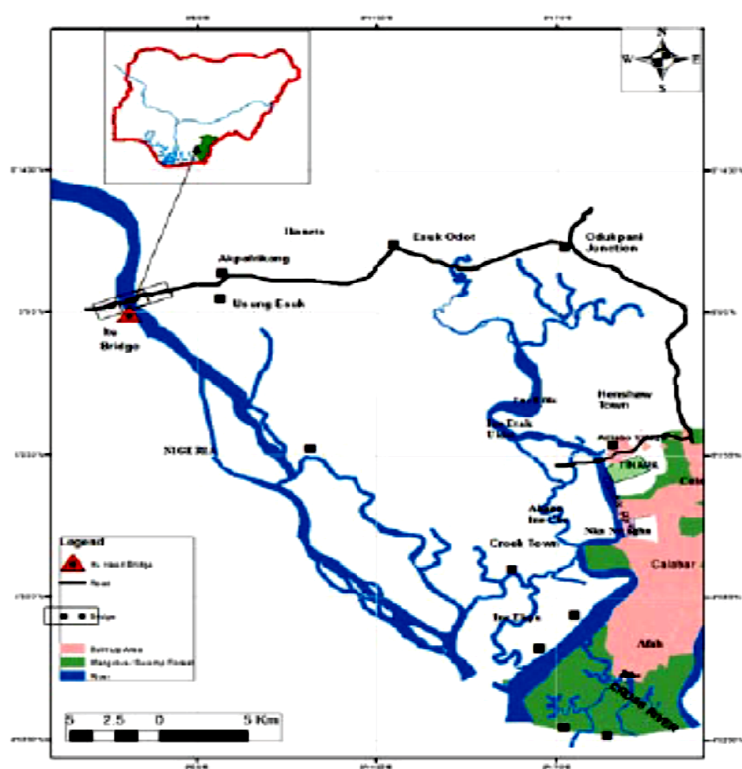
on the locality. Based on this challenge, fish breeders are searching for alternative sources of broodfish that will be cheaper resulting in collecting broodfish from the wild. Therefore, the objective of this study was to investigate the condition factor, hematological and serum biochemical parameters of wild and hatchery collected broodfish of the African Catfish (*Heterobranchus longifilis*) and used as an indicator of their health condition.

Materials and Methods

Study Area Description

This study area (Fig. 1) for this research was Ayadehe, Itu Head Bridge located between Akwa Ibom State and Cross River State, Nigeria. Geographically, it is located at latitude 5°14'30''N and longitude 8°06'0''E. Its distance is about 57km from Calabar, Cross River State. The study area has a rain forest vegetation with amphibious mangrove system such as *Rhizophora racemose*. The mangrove system is a spawning and feeding ground for shrimps and fish species such as *Chrysichthys nigrodigitatus* and *Macrobrachium sp.* The study area has a climate characterized by two seasons (dry season and wet season). The wet season begins from April and ends in October while the dry season begins from November and ends in March. Economic activities in the study area include farming, fishing, sand mining, fish processing and petty trading.

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87 Fig. 1: Map of the study area showing Ayadehe, Itu Head Bridge where wild broodfish were collected

88 **Collection and transportation of fish samples**

89 A total of 30 healthy wild broodfish (15 males and 15 females) were collected from Ayadehe, Itu
90 Head Bridge between April and June 2017. The samples were bought from landings of artisanal
91 fishermen from the study area. For hatchery broodfish, a total of 30 healthy samples (15 males and
92 15 females) were collected from a private hatchery located in Calabar, Cross River State, Nigeria. The
93 collected samples were transported immediately to the Fisheries and Aquaculture laboratory, Institute
94 of Oceanography, University of Calabar, Nigeria for blood collection.

95 **Collection of Blood samples for Hematological and Biochemical parameters**

96 Before collection of the blood samples from the experimental fishes, the morphometric measurements
97 including standard length (SL – cm) and total weight (TW – g) were measured and recorded for each
98 sample. Blood samples from both the wild and hatchery broodfish were collected following the
99 method described by [8] by direct heart and caudal vein puncture with the aid of a 2.5 mL sterile
100 plastic syringe and hypodermic needles. About 4 ml of blood were collected from each sample and
101 transferred into two different blood sample bottle (2 ml per sample bottle). One of the sample bottle
102 contained EDTA as an anticoagulant agent whereas the other did not contain any anticoagulant. The
103 blood samples transferred to EDTA sample bottle were used for the determination of hematological
104 parameters and blood samples transferred to sample bottle without EDTA were used for the
105 determination of biochemical parameters. The blood samples collected from wild and hatchery
106 collected broodfish were subjected immediately to hematological and biochemical analysis in the
107 Hematology Laboratory, University of Calabar Teaching Hospital, Calabar. Hematological
108 parameters were analyzed using an Automated Mindray Hematological Machine (Model BC-2800).
109 Measured serum biochemical parameters including glucose, triglycerides, globulin, cholesterol, total
110 protein and serum albumin were determined using bioanalytic test kits and a Shimadzu
111 spectrophotometer.

112 **Condition Factor**

113 Condition factor was calculated using Fulton's equation as given below:

$$114 \quad 100W/L^3$$

115 **Statistical Analysis**

116 Data obtained from the experiment was subjected to T-test Analysis to test for significant difference in
117 hematological and biochemical parameters of wild and hatchery bred broodfish of *H. longifilis* using
118 Predictive Analytical Software (PASW) windows software program for statistical analysis (version
119 18.0). Effects with a probability of ($P < 0.05$) was considered significant.

120

Results

Condition factor of Wild collected and Hatchery bred broodfish of the African Catfish *H. longifilis*

Condition factor (Table 1) of wild collected broodfish of male *H. longifilis* ranged from 0.57 – 0.63 with a mean of 0.61 ± 0.03 while hatchery bred male broodfish had condition factor ranging from 0.56 – 0.62 with a mean of 0.60 ± 0.01 . Female broodfish collected from the wild had condition factor ranging from 0.63 – 0.66 with a mean of 0.65 ± 0.04 while female broodfish collected from the hatchery had condition factor ranging from 0.64 – 0.67 with a mean of 0.66 ± 0.03 . For, pooled sex, wild collected broodfish had condition factor ranging from 0.57 – 0.66 with a mean of 0.63 ± 0.01 while hatchery collected broodfish had condition factor ranging from 0.56 – 0.67 with a mean of 0.63 ± 0.02 .

Hematological parameters of Wild collected and Hatchery bred broodfish of the African Catfish *H. longifilis*

Results of hematological parameters obtained in this study (Table 2) showed that in male broodfish of *H. longifilis* collected from the wild, PCV was 41.48 ± 1.03 %, WBC ($5.46 \pm 0.06 \text{ L}^{-1}$), Hemoglobin ($13.54 \pm 0.21 \text{ g/dl}$), RBC ($5.93 \pm 0.09 \text{ L}^{-1}$), MCV ($70.06 \pm 1.10 \text{ fem.}$), MCH ($22.96 \pm 0.24 \text{ Pg}$) and MCHC ($33.52 \pm 0.23 \text{ g/dl}$). For female broodfish of *H. longifilis* collected from the wild, PCV was 41.53 ± 0.89 %, WBC ($5.37 \pm 0.28 \text{ L}^{-1}$), Hemoglobin ($13.59 \pm 0.13 \text{ g/dl}$), RBC ($5.90 \pm 0.11 \text{ L}^{-1}$), MCV ($70.16 \pm 1.05 \text{ fem.}$), MCH ($22.99 \pm 0.16 \text{ Pg}$) and MCHC ($33.58 \pm 0.13 \text{ g/dl}$). For hatchery bred male broodfish of *H. longifilis*, PCV was 41.76 ± 0.96 %, WBC ($5.52 \pm 0.08 \text{ L}^{-1}$), Hemoglobin ($13.52 \pm 0.16 \text{ g/dl}$), RBC ($5.97 \pm 0.05 \text{ L}^{-1}$), MCV ($70.42 \pm 1.16 \text{ fem.}$), MCH ($23.13 \pm 0.43 \text{ Pg}$) and MCHC ($33.71 \pm 0.18 \text{ g/dl}$). For hatchery bred female broodfish of *H. longifilis*, PCV was 41.60 ± 0.75 %, WBC ($5.49 \pm 0.11 \text{ L}^{-1}$), Hemoglobin ($13.56 \pm 0.08 \text{ g/dl}$), RBC ($5.95 \pm 0.09 \text{ L}^{-1}$), MCV ($70.33 \pm 1.02 \text{ fem.}$), MCH ($23.21 \pm 0.26 \text{ Pg}$) and MCHC ($33.65 \pm 0.20 \text{ g/dl}$).

Table 1:

Condition factor of Wild collected and Hatchery bred broodfish of the African Catfish *H. longifilis*

Parameters	Male (♂) <i>H. longifilis</i>		Female (♀) <i>H. longifilis</i>		Pooled Sex <i>H. longifilis</i>	
	WBF	HBF	WBF	HBF	WBF	HBF
Number of broodfish	15	15	15	15	30	30
Mean Length (cm)	62.13 ± 0.77	62.36 ± 0.49	62.13 ± 0.87	61.50 ± 0.88	62.13 ± 0.52	61.93 ± 0.49
Mean weight (g)	1438.00 ± 22.90	1454.67 ± 27.17	1575.00 ± 66.67	1545.00 ± 65.39	1506.50 ± 43.96	1499.83 ± 37.56
Range of Condition factor	0.57 – 0.63	0.56 – 0.62	0.63 – 0.66	0.64 – 0.67	0.57 – 0.66	0.56 – 0.67
Mean Condition factor ± SE	0.61 ± 0.03	0.60 ± 0.01	0.65 ± 0.04	0.66 ± 0.03	0.63 ± 0.01	0.63 ± 0.02

*Mean values having the same superscript are not significant (P > 0.05), WBF = Wild broodfish, HBF = Hatchery broodfish

Table 2:

Hematological parameters of Wild collected and Hatchery bred broodfish of the African Catfish *H. longifilis*

Hematological Parameters	Wild Broodfish (WBF)		Hatchery Broodfish (HBF)	
	Male (♂)	Female (♀)	Male (♂)	Female (♀)
Pack Cell Volume (%)	41.48 ± 1.03 ^a	41.53 ± 0.89 ^a	41.76 ± 0.96 ^a	41.60 ± 0.75 ^a
White Blood Cell Count (L ⁻¹)	5.46 ± 0.06 ^a	5.37 ± 0.28 ^a	5.52 ± 0.08 ^a	5.49 ± 0.11 ^a
Hemoglobin (g/dl)	13.54 ± 0.21 ^a	13.59 ± 0.13 ^a	13.52 ± 0.16 ^a	13.56 ± 0.08 ^a
Red Blood Cell Count (L ⁻¹)	5.93 ± 0.09 ^a	5.90 ± 0.11 ^a	5.97 ± 0.05 ^a	5.95 ± 0.09 ^a
MCV (fem)	70.06 ± 1.10 ^a	70.16 ± 1.05 ^a	70.42 ± 1.16 ^a	70.33 ± 1.02 ^a
MCH (Pg)	22.96 ± 0.24 ^a	22.99 ± 0.16 ^a	23.13 ± 0.43 ^a	23.21 ± 0.26 ^a
MCHC (g/dl)	33.52 ± 0.23 ^a	33.58 ± 0.13 ^a	33.71 ± 0.18 ^a	33.65 ± 0.20 ^a

*Mean values having the same superscript are not significant (P > 0.05)

biochemical parameters of Wild collected and Hatchery bred broodfish of the African Catfish *H. longifilis*

Results of biochemical parameters obtained in this study (Table 3) showed that in male broodfish of *H. longifilis* collected from the wild, cholesterol was 2.42 ± 0.25 mmol/L, triglyceride (1.19 ± 0.06 mmol/L), total protein (59.10 ± 0.38 g/L), albumin (29.50 ± 0.38 g/L), globulin (29.39 ± 0.41 g/L), glucose (5.02 ± 0.05 mmol/L) and urea (1.82 ± 0.18 mmol/L). For female broodfish of *H. longifilis* collected from the wild, cholesterol was 2.45 ± 0.12 mmol/L, triglyceride (1.17 ± 0.05 mmol/L), total

173 protein (59.21 ± 0.24 g/L), albumin (29.37 ± 0.54 g/L), globulin (30.30 ± 0.32 g/L), glucose ($5.08 \pm$
174 0.10 mmol/L) and urea (1.83 ± 0.07 mmol/L). For hatchery bred male broodfish of *H. longifilis*,
175 cholesterol was 2.44 ± 0.32 mmol/L, triglyceride (1.18 ± 0.04 mmol/L), total protein (59.27 ± 0.13
176 g/L), albumin (30.16 ± 0.29 g/L), globulin (29.89 ± 0.26 g/L), glucose (5.06 ± 0.15 mmol/L) and urea
177 (1.84 ± 0.15 mmol/L). For hatchery bred female broodfish of *H. longifilis*, cholesterol was $2.41 \pm$
178 0.41 mmol/L, triglyceride (1.21 ± 0.15 mmol/L), total protein (59.24 ± 0.11 g/L), albumin ($30.09 \pm$
179 0.47 g/L), globulin (29.93 ± 0.43 g/L), glucose (5.04 ± 0.25 mmol/L) and urea (1.84 ± 0.20 mmol/L).

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Table 3:

181 **Serum biochemical parameters of Wild collected and Hatchery bred broodfish of the African**
182 **Catfish *H. longifilis***

Serum biochemical Parameters	Wild Broodfish (WBF)		Hatchery Broodfish (HBF)	
	Male (♂)	Female (♀)	Male (♂)	Female (♀)
Cholesterol (mmol/L)	2.42 ± 0.25^a	2.45 ± 0.12^a	2.44 ± 0.32^a	2.41 ± 0.41^a
Triglyceride (mmol/L)	1.19 ± 0.06^a	1.17 ± 0.05^a	1.18 ± 0.04^a	1.21 ± 0.15^a
Total protein (g/L)	59.10 ± 0.38^a	59.21 ± 0.24^a	59.27 ± 0.13^a	59.24 ± 0.11^a
Albumin (g/L)	29.50 ± 0.38^a	29.37 ± 0.54^a	30.16 ± 0.29^a	30.09 ± 0.47^a
Globulin (g/L)	29.39 ± 0.41^a	30.30 ± 0.32^a	29.89 ± 0.26^a	29.93 ± 0.43^a
Glucose (mmol/L)	5.02 ± 0.05^a	5.08 ± 0.10^a	5.06 ± 0.15^a	5.04 ± 0.25^a
Urea (mmol/L)	1.82 ± 0.18^a	1.83 ± 0.07^a	1.84 ± 0.15^a	1.84 ± 0.20^a

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*Mean values having the same superscript are not significant ($P > 0.05$).

184

185 **Discussions**

186 Generally, the physiological condition in matured fishes which could be used as a tool for their
187 selection as broodfish can be reliably determined by hematological parameters [8]. In fish physiology,
188 blood comprising 1.3 – 7 % of the total body weight it is one of the most important and active
189 components that helps in metabolic processes by ensuring exchange of gas between the environment
190 and organism [17]. Since blood parameters in teleost fishes are influenced by factors such as food
191 selection, ecological habitat, temperature and mode of life, to establish any normal values fishes
192 becomes difficult [8]. However, collection of data for different species as well as similar species
193 under varying conditions will result in establishment of some normal ranges of blood parameters
194 which can be used as a valuable diagnostic aid in fisheries science and aquaculture [18]. Results
195 obtained in this study showed that there was no significant difference ($P > 0.05$) in all the blood
196 parameters evaluated in this study such as PCV, WBC, Hemoglobin, RBC, MCV, MCH and MCHC
197 for both the wild and hatchery broodfish. Studies of hematological parameters in fish is a widely and
198 accepted approach for examining the health status of fish. It is also useful in understanding the
199 relationship of blood characteristics to the fish habitat and fish adaptability to the environment [19].

The non -significant variation observed in this study for wild and hatchery bred broodfish of *H. longifilis* indicates that the two different environment where the fish were collected were in a healthy state. PCV obtained in this study is within the range (33.70 - 49.87) reported by [16] for artificially spawned *H. longifilis* and higher than the range of 22.00 % - 35.50 % reported for juvenile *C. gariepinus* by [20] [21] reported a higher PCV range (51.93 - 53.40) of wild collected *Heterobranchus bidosalis*. WBC was also within the range (4.78 L^{-1} – 6.38 L^{-1}) reported by [5] for Catfish hybrid (Heteroclarias) fed at different feeding levels. Hemoglobin (Hb) is used to assess the functional status of the oxygen carrying capacity of the bloodstream. higher values of haemoglobin indicates higher rate of transportation of oxygen to and removal of carbon (iv) oxide from the body tissues resulting in higher rate of metabolism and growth. In this study, there was no significant difference ($P>0.05$) in the hemoglobin values obtained for wild and hatchery bred broodfish of *H. longifilis*. Hemoglobin values in the present study falls within the range (5.88 – 14.24 g/dL) reported by [22] for *Clarias gariepinus* brood fish raised in water recirculating aquaculture system. The range of RBC obtained in this study for wild and hatchery bred broodfish of *H. longifilis* is higher than RBC range ($2.4 - 2.85 \text{ L}^{-1}$) reported by [5]. Blood parameters of fish is known to increase during follicular maturation, vitellogenic phase and spawning due to gonadotropins release from the hypothalamus of fish [23], [24]. Peptides such as activin and gonadal steroids including estrogens and androgens directly exert their stimulatory effects on the gonadotropins or through the hypothalamus which causes changes in the blood parameters of brood fish [25]. MCV, MCH and MCHC for both male and female broodfish of *H. longifilis* collected from the wild and hatchery were not significantly different ($P>0.05$) and are similar to findings of [26]. Biochemical parameters are also vital parameters that can provide information on the existence, status and degree of sickness in aquatic organisms. According to [27] and [28], biochemical indices is useful in analyzing the health status of farmed fishes as they provide reliable data on metabolic disorders, stress status and other deficiencies. Results of this study revealed that in both male and female broodfish of *H. longifilis* collected from the wild and hatchery, serum biochemical parameters including cholesterol, triglyceride, total protein, albumin, globulin, glucose and urea were not significantly different ($P>0.05$). According to [29], ranges of fish serum biochemistry vary from species to species and may also be affected by various biotic and abiotic factors such as seasonal pattern, water temperature, age, food and sex. Values obtained in this study for serum biochemical parameters is within the range reported by [16] for artificially spawned *H. longifilis*. However, these values indicates that both the wild and hatchery broodfish were in healthy condition. Furthermore, the values obtained for condition factor of male, female and pooled sex of both the wild and hatchery broodfish of *H. longifilis* also indicates that the fishes were in healthy condition.

Conclusion

Hematological and serum biochemical parameters are very useful tools in analyzing the health status of broodfish as they provide reliable information the stress status which could influence broodfish

reproductive performance. Result of this study, along with other findings will provide a reference for catfish breeders and aquaculturists evaluating the health status of hatchery and wild *H. longifilis*.

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