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Replacement of Fishmeal with Poultry/ Hatchery Waste Meal supplemented with Bloodmeal in the diet of Clariid catfish (*Heterobranchus bidorsalis*) Fingerlings

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Abstract This study examined the replacement of fishmeal with Poultry Hatchery Waste Meal (PHWM) supplemented with Blood meal in Practical diets of Clariid catfish (*Heterobranchus bidorsalis*). Five Iso-nitrogenous diets containing varying levels were formulated. Diet 1, (0 % PHWM) served as control; Diet 2, (25 % PHWM); Diet 3, (50 % PHWM); Diet 4 (75 % PHWM) and Diet 5 (100 % PHWM) as a replacement for fishmeal were fed to three replicate of *Heterobranchus bidorsalis* with an initial weight of 7.17±0.01g. Diet 3, (50 % PHWM) had the best growth response and feed utilization ($p<0.05$) as it had the highest value of weight gain (22.69), feed intake of (26.28), feed conversion Ratio of 1.21, relative weight gain of 22.58 and Specific Growth Rate of 2.89. Diet 3 (50 % PHWM) also had the highest value ($P<0.05$) for Protein Efficiency Ratio (2.09) while 75 % PHWM, had the best net protein utilization (53.06) and was significantly different ($p<0.05$) from other treatments. Therefore, Poultry hatchery waste meal supplemented with blood meal can replace fishmeal totally but will be best at 50 % replacement in diets for *Heterobranchus bidorsalis* without compromising the growth and carcass composition.

Keywords clariid catfish, *Heterobranchus bidorsalis*, Blood meal, fingerlings growth on Poultry hatchery Waste Meal

Introduction

The need to augment fish production from the wild heightens due to increasing demand for fish; there is increased global attention on aquaculture. According to El-Saidy and Gaber (2003); Siddhuraju and Becker (2003); Wu *et al*., (2004), aquaculture has become the fastest-growing food production sector in which fish meal is a primary protein source in fish diets [1-3].

Aquaculture is likely to grow over the next 20years and the rising demand of fishmeal and fish oil could place heavier fishing pressure on the already threatened stocks of wild fish [4]. As the consumption rate of fish as human food increase, the use of fish material for feed production also increases. Currently, up to 36% of the world's total fish catch each year is ground up into fishmeal and oil to feed farmed fish, chicken and pigs [5]. The steady increase in fishmeal consumption and declining fish catches in wild waters can only predict a gloomy future for aquaculture industry unless there is a paradigm shift to use of non-fish materials for fish production. The development of sustainable aquaculture therefore is largely dependent on the establishment of alternative feedstuffs to fishmeal [6]. Since the success of fish farming depend on the provision of suitable and economical fish feeds, we need to use locally available feedstuff especially aquaculture by-products to reduce the price of complete feeds [7]. Hatchery by-product meal results from the processing of poultry hatchery wastes, such as shells of hatched eggs, infertile eggs, dead embryos and dead or culled chicks [8-9]. The objective of this study is to determine the growth responses and nutrients utilization of *Heterobranchus* *bidorsalis* fingerlings fed dietary Poultry Hatchery Wastemeal supplemented with bloodmeal in replacement of fishmeal

Materials and Methods

Study Area: This study was conducted in the Wet Laboratory of Department of Fisheries and Aquaculture Management, Faculty of Agriculture, University of Benin, Benin-city Edo state for Seventy (70) days. One hundred and twenty *Heterobranchus bidorsalis* fingerlings (initial mean body weight of 7.17±0.01g) were obtained from outdoor fish tanks of the Department of Fisheries, University of Benin, Benin city and were stocked randomly at five (3) fingerlings per aquarium in 40 litres of domestic water of university of Benin in the laboratory. Temperature of water ranged from 27-29 ^{o}C and PH of 7.3-7.6. The fingerlings were fed crumbled 2.0 mm size pellet of experimental diets twice daily to satiation between 8.00-9.00 hrs and 15.00-16.00 hrs Feeding was monitored for each unit to ensure that fishes were not underfed or overfed. Experimental units were cleaned daily while changing of total water. Weekly weight gain and feed consumption were monitored for 70 days.

The experimental design consists of five (5) dietary treatments with three (3) replicates each. Diet 1 with 0% PHWM inclusion serves as control; Diet 2 (25% PHWM); Diet 3 (50PHWM); Diet 4 (75% PHWM) and Diet 5 (100% PHWM). The waste was collected from Dans of Fish Farm, Ugbekpe, Ekperi-Auchi, Edo State while The blood meal was collected from the Slaughter Unit of the University of Benin Farm Project in Benin-City, Edo State. The wastes were boiled for 15 minutes to destroy any presence of *Escherichia coli* and *Salmonella sp*, which are readily destroyed by heat. It was then dried in an electric oven in the farm at temperature of over 60 °C for 28 hrs. The waste was then ground finely and dried again. The ground poultry hatchery waste was then taken to the laboratory for proximate composition analysis before being incorporated into diets at various levels.

Table 1: Gross Composition of the Experimental Diets (%) on as fed basis

Ingredients	**Diet 1 0% PHWM**	**Diet 2 25% PHWM**	**Diet 3 50% PHWM**	**Diet 4 75% PHWM**	**Diet 5 100% PHWM**
PHWM	-	7	14	21	28
Fishmeal (65.5% CP)	28	21	14	7	-
SBC (48.0% CP)	39.36	39.36	39.36	39.36	39.36
Yellow maize (9.5% CP)	10	10	10	10	10
Blood meal(80%CP)	10	10	10	10	10
Palm oil	8	8	8	8	8
Bone meal	4	4	4	4	4
Vitamin premix	0.6	0.6	0.6	0.6	0.6
Vitamin E gel	0.04	0.04	0.04	0.04	0.04
Total	100	100	100	100	100

PHWM= Poultry hatchery waste meal, CP= Crude protein.

Chemical Analysis

The various diets, Poultry hatchery waste meal and the experimental fish (initial and final carcass) were analyzed for their proximate composition which include their moisture content, nitrogen, ether extract, crude fibre and nitrogen-free extract (NFE) according to the procedures of Association of Official Analytical Chemists (A.O.A.C., 2000). The nitrogen was converted to protein by multiplying the nitrogen level with a factor of 6.25.

Growth and Feed Utilization Parameters

Determination of parameters such as Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) were carried out. Parameters determined and their formulae include:

1. Weight gain = $W_1 – W_0$
2. Relative Weight Gain (RWG%)=$(W_1 – W_0) / W_0 \times 100$
3. Specific Growth Rate (SGR %)= $\{(\text{In } W_1 – \text{In } W_0)/ T\} \times 100$
   Where;

W_0: mean initial weight (g)
W_1: mean final weight (g)
T: time in 7 days between weightings

4. Feed conversion ratio (FCR)= feed intake (g) / weight gain (g)
5. Protein efficiency ratio (PER)= weight gain (g) / protein intake (g)
6. Net protein utilization (NPU)= $\{(BP_1 – BP_0)/ CP\} \times 100$

Where;
BP_0: Initial body protein content (g)
BP_1: Final body protein content (g)
CP: Protein intake (g)

Sampling was carried out weekly by weighing the whole fish in each replicate.

Statistical Analysis

All analyzed data were tested for significant differences using analysis of variance (ANOVA) test and the means were compared using Genstat 2012 version, all at 5% level of significance.

Result

Table 2: Growth performance and feed utilization of Clariid catfish, (*Heterobranchus bidorsalis*) fed poultry hatchery waste meal (PHWM) based diet

Parameters	TRT1 (0% PHWM)	TRT2 25% PHWM)	TRT3 (50% PHWM)	TRT4 (75% PHWM)	TRT5 (100% PHWM)	SEM
Weight gain(g)	18.20^{b}	12.96^{c}	22.69^{a}	14.79^{c}	7.37^{d}	2.26
Specific Growth Rate (%/day)	2.51^{b}	1.90^{c}	2.89^{a}	2.34^{b}	1.60^{d}	0.17
Relative Weight Gain (%)	19.39^{b}	15.01^{c}	22.58^{a}	17.97^{b}	11.96^{d}	1.30
Protein Efficiency ratio	1.90^{ab}	1.45^{c}	2.09^{a}	1.64^{bc}	1.08^{d}	0.15
Feed Intake(g)	22.01^{b}	21.38^{b}	26.28^{a}	21.74^{b}	16.92^{c}	1.32
Feed Conversion Ratio	1.26^{a}	1.70^{b}	1.21^{a}	1.52^{b}	2.35^{c}	0.23
Net Protein Utilization (%)	30.39^{d}	45.37^{b}	36.85^{c}	53.06^{a}	31.49^{d}	2.85

N/B: Mean Values with the same superscript on the same row are not significantly different, (P> 0.05)
TRT: Treatment

Result showed that Weight gained by *Heterobranchus bidorsalis* fingerlings after 70 days was significantly higher (P<0.05) in Diet 3 (22.69) while Diet 5 (7.37) recorded the least value and was significantly depressed (P<0.05).

The Specific growth rate was significantly higher (P<0.05) in Diet 3 (2.89), Diet 1 (2.51) and Diet 4 (2.34) were not significantly different from each other. While Diet 5 (1.60) had the least Specific growth rate. The Relative Weight gain of fish fed with 50% PHWM (22.58) was significantly superior (P<0.05) among all treatments. There was no significant difference in control Diet (19.39) and 75% PHWM (17.97), while fish fed with 100% PHWM (11.96) has the least relative weight gain and was significantly depressed (P<0.05). The Protein Efficiency Ratio for Diet 3 (2.09) was significantly superior (p<0.05) to other diet with Diet 5 (1.08) having the least ratio and thus significantly depressed (p<0.05). The Net Protein Utilization was highest in Diet containing 75% PHWM with a value of 53.06 while there were no significant differences in the Net Protein Utilization of the control Diet and Diet 5 Feed Intake by fish fed 50% PHWM was significantly higher (p<0.05) than all other treatments. Diet 1, 2 and 4 were not significantly different from each other. However, Fish fed with 100% PHWM recorded the least amount of feed intake and was significantly depressed (p<0.05) There was no significant difference in the Feed Conversion Ratio (FCR) of fish fed 0% PHWM (1.26), 50% PHWM (1.21). However, since the lower the FCR the better the feed, Diet 3 (1.21) had the best FCR. Similarly, fish fed with 100% PHWM was significantly depressed (P<0.05).

Discussion

The crude protein content of the poultry hatchery wastemeal of 35.58%CP was lower than the crude protein content of the hatchery waste of 48.25% reported [10] and 62.82% [11]. A report by Kundu *et al.*, (1986) and Abiola *et al.*, (2012) recorded a crude protein content of 42.26% [12-13]. Rasool *et al.*, (1999) reported similar value of 44.25% crude protein content for poultry hatchery waste meal on broilers [14]. Khan and Bhatti, (2001) reported an average of 45.47% [15]. It indicates that there are factors which affect the crude protein content, for instance, the proportion of egg shells, processing technique, particularly the temperature and treatment period and so on. [15]. The fat content of 15.23% was lower than the 20.28% reported by Aydin and Gumus (2012) [16] but it was however higher than the report of Aliu *et al.*, (2014) [10] which reported a low fat content of 5.45%. This may have led to the higher concentration of fat in the fish carcass as the fat content exceeds the maximum inclusion level of 8% in a normal catfish diet. The ash content of D2, D3 and D4 were all lower than the control D1, while D5 had a higher value than all. Similar trend was reported by Aliu*et al.*, (2014) [10].

The result showed that weight gain response of 18.20g (D1), 12.96g (D2), 22.69g (D3), 14.79g (D4) and 7.37g (D5) was variable as can be confirmed by the works of Aliu *et al.*, (2014) [10] that there was a variable weight gain response when poultry hatchery waste meal was fed to fingerlings of *Clarias gariepinus*. Similar trend was also reported [16-18] that there was variable weight gain response when poultry by-product meal (PHWM) was fed to tilapia, shrimp and trout respectively which may likely be related to ash content as high ash content in poultry by-product meal could reduce protein digestibility in fish [19-20]. Though the weight gain among the diets was variable it was appreciable in Diets containing 0%, 25%, 50% and 75% with a highest value in 50% while 100% PHWM had the least value. This can be confirmed by the report of Aydin and Gumus (2012) were treatment with 50% replacement of poultry hatchery wastemeal by fishmeal recorded the highest value [16]. This is also similar to results in African catfish *Clarias gariepinus* [21], gibel carp *Carassiu sauratusgibelio* [20], and *Tilapia zillii* [22]. From the result above it can be stated that the availability of nutrients to fish may vary considerably, depending on a variety of factors including fish species, ingredient quality and processing conditions [23].

It is apparent from the results of this feeding trial that the growth and nutrient utilization of *Heterobranchus bidorsalis* were influenced by the levels of poultry hatchery waste meal inclusion in diets. The feed intake was significantly low in Diet with 100% PHWM (16.92) and significantly high in Diet 3 (26.28) which contains 50% waste. It is followed by the control diet 0% PHWM (22.01), not significantly different from 25% PHWM and D75 % PHWM (21.74). This is Similar to the report of Aydin and Gumus (2012) [16] on the fry of Nile Tilapia.

There were significant differences between treatments in SGR 2.51, 1.90, 2.89, 2.34 and 1.60 for D1, D2, D3, D4 and D5 respectively, similar to findings of Aydin and Gumus (2012) [16] on Nile Tilapia and Aliu *et al.*, (2014) [10] on *Clarias gariepinus* but in contrast to findings in mirror carp [24], gibel carp [25], and tilapia [22] where the SGR was not significantly different from each other. The FCR value of 1.26 (D1), 1.70 (D2), 1.21 (D3), 1.52 (D4) and 2.35 (D5) and PER 1.90 (D1), 1.45 (D2), 2.09 (D3), 1.64 (D4) and 1.08 (D5) were significantly affected by the replacement level; fish fed the 50% replacement diet had the best FCR and PER values, in accordance with Yıldırım*et al*. (2009) [22] and Aydin and Gumus (2012) [16]. The poorer growth rate and FCR of fish could be explained by the method of processing and source of the poultry by-product meal, the quality of other ingredients, poor digestibility, rearing conditions, palatability, or a combination of these factors and also the fish species used in the feeding trial. The poor digestibility may also be linked to the inclusion of bloodmeal in the diets

It is evident that Diet 3 (50% PHWM) has the best growth performance and feed utilization because it has the highest values in weight gain with significant difference ($P < 0.05$), feed intake with significant difference ($P < 0.05$) and has the best FCR with significant difference ($P<0.05$); RWG and SGR were highest in Diet 3; and also had the highest values in PER. This was confirmed by the work of Aydin and Gumus (2012) [16] were treatment with 50% replacement of poultry hatchery wastemeal by fishmeal recorded the highest value. This is also similar to results in African catfish *Clarias gariepinus* [21], gibel carp *Carassius auratusgibelio* [20], and *Tilapia zilli* [22]. However, Metwalli, (2008) [26] reported that poultry hatchery waste meal (PHWM) could replace fishmeal up to 100% in the diet of Nile tilapia (*Oreochromis niloticus*). Also El-Husseiny *et al.*, (2006)

[27] confirmed a 100% replacement by PHWM in the diet of mullet species (*Mugil cephalus* and *Liza ramada*). Paixao *et al.*, (1999) [28] reported that PHWM could replace fishmeal up to 75% commercial feed in common carp diets. Handa *et al.,* (1996) [29] reported that PHWM could replace fishmeal up to 100% in the diet of Soviet Chinchilla rabbit. Akinwumi *et al.,* (2013) [30] reported that PHWM could replace fishmeal up to 100% in the diet of laying Japanese quail. Falaye *et al.,* (2012) [31] reported 100% replacement of fishmeal with toad meal in the diet of *Clarias gariepinus* fingerlings and Aliu *et al.,* (2014) [10] also reported 100% replacement of fishmeal by PHWM in the diet of *Clarias gariepinus* fingerlings.

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