Original Research Article

Effect of Substituting Poultry Waste Meal for Maize Corn in the Diet of the African Clariid Catfish, Clarias gariepinus (Burchell 1822) Juveniles.

Comment [A1]: Does the inclusion of poultry waste meal in diets reflect the growth of Clarias gariepinus juveniles?

ABSTRACT

1 2 3

4

5

6

12 13

> The objective of this study was to evaluate the bird residue meal (PWM) on Clarias gariepinus growth of juveniles. The growth response of Clarias gariepinus juveniles of average weight 6.5g fed poultry waste meal (PWM) was studied for 70 days. The poultry waste meal comprised the droppings from the layers pen, some maggots, broken eggs and feeds that fell during the course of feeding. The proximate analysis of PWM had crude protein value of 9.795, crude fibre 8.700, ash 25.174, moisture 10.794, carbohydrate 44.286 and fat 1.250 respectively. Five diet were formulated; which were Diet A (Control: with 0% inclusion level of poultry waste meal, B (25%), C (50%), D (75%), and E with 100% inclusion level (total replacement with poultry waste meal). The water quality parameters cen every fortnight. The result showed that the and weights were best diet was the Control which gave the best mean weight gain (9.227g), specific growth rate (1.247), protein efficiency ratio, PER (0.692), and the lowest feed conversion ratio (2.003) when compared with the other diets. The lowest growth and nutrient utilization acement of maize. However. Tthere were no significant differences (p≥0.05) between the control and all other diets in the values recorded for growth and nutrient utilization, even up to 100% substitution of maize with PWM. The cost of feed production decreased with increase in inclusion levels of PWM in the diets. The results of the study showed that the use of PWM could be considered in the diet of C. gariepinus even up to 100% substitution level-since there was no significant differences (p≥0.05) among all the diets in terms of growth and nutrient utilization.; and considering the huge cost of maize and competition for its use whereas PMW is obtainable at little or no cost.

Comment [A2]: This did not occur because there was no statistical difference between the treatments. put this information

14 15

16

17

Keywords: [poultry waste meal, substitution, maize, Clarias gariepinus, juveniles]

Comment [A3]: choose keywords you don't have in your title or abstract

1. INTRODUCTION

18 19

Fish is one of the most highly consumed proteins because it is relatively cheap and has little or no religious or regional bias [1], therefore the demand for it is on the increase even as human population is increasing. Capture fisheries was relied upon in the past to meet fish demand but recent trends all over the world points to a decline in landing from capture fisheries which is an indicator that fish stock have approached or even exceeded point of maximum sustainable yield [2], hence further increase in capture fisheries are not **Comment [A5]:** a global level? better to exclude this information ... just let the fishing consumption is increasing over time by the characteristic of its meat

Comment [A4]: need to be better structured

anticipated under the current global condition [3]. With this trend, Aquaculture has become
the proposed solution to bridge the fish demand-supply gap.
A major aspect of aquaculture is feeding. Fish nutritionists have demonstrated increasing
interest in researches focused on reducing the cost of the most expensive ingredients by
alternative autriant equations can be accounted in the second secon

31 alternative nutrient sources such as replacing fish meal or other conventional feedstuffs with 32 either plant protein sources or other unconventional feedstuffs [4, 5, 6]. Maize is one of such 33 expensive and conventional ingredient because there is great competition for its use by both 34 the human food and animal feed industries. For fish culture project, the optimum dietary 35 requirement at a reduced production cost is essential in order to achieve maximum profit, 36 therefore reducing feed cost is a major challenge in aquaculture nutrition. This 37 therefore is focused on the use of poultry waste meal as a replacement for maize, which is 38 expensive, in the diet of African catfish Clarias gariepinus juveniles so as to reduce feed 39 cost.

Poultry waste meal (PWM) is an agricultural waste and a potential feedstuff which could be a source of protein or energy depending on its composition. [7] observed that agricultural wastes' compositions tend to vary as it will depend on the system and type of agricultural activities from which they are obtained and they can be in the form of liquids, slurries, or

solids. [7] further stated that these agricultural wastes are the non-product outputs of production and processing of agricultural products that may contain material that can benefit man or can be collected and processed for beneficial use at minimal cost. The poultry waste meal used in this study comprised of left over feeds, broken poultry egg parts and poultry feaces which was found on analysis to have proximate composition similar to the yellow maize.

The African Clariid catfish, *Clarias gariepinus* (Burchell, 1822) is one of the most popularly cultured fish species in Nigeria because of its many aquaculture potentials [8, 9]. Information on the effect of poultry waste meal when incorporated into fish diets are scarce. <u>Herefore this study was carried out to investigate the growth and nutrient utilization of the African Clariid catfish *Clarias gariepinus* fed with poultry waste meal.</u>

This study therefore is focused on the use of poultry waste meal as a replacement for maize, in the diet of African catfish *Clarias gariepinus* juveniles so as to reduce feed cost.

59 60 61

58

40 41

42

43 44

- 62
- 63

64

3 2. MATERIALS AND METHODS

The study was carried out at the Department of Fisheries and Aquaculture Management,
 Ekiti State University Ado-Ekiti, Nigeria Research Laboratory.
 The dietary ingredients: Fish meal, soybean meal, vitamin premix, bone meal and starch

were purchased from Metrovet Veterinary Shop, G.R.A. Ado Ekiti and Mercy Agricultural
 Business Services, Ado Ekiti.

71 2.1 Collection and Preparation of Poultry Waste Meal

The poultry waste was collected from Ekiti State University Poultry Farm. The poultry waste comprised of poultry droppings of layers, some maggots, some broken eggs and feeds that fell during the course of feeding. The poultry waste was sun dried at a temperature of 28°C for three days and then grinded to flour using grinding machine. The grinded poultry waste was then taken to the laboratory for proximate composition before being incorporated into the experimental diets.

78

Comment [A6]: Is this information directly related to your study? I think it's best to remove this paragraph or direct it to your research.

Comment [A7]: such that ?

Comment [A8]: There are already studies on the growth characteristics of the species, you can write a little more about it

Comment [A9]: number of animal ethics committee in experiments Comment [A10]: it is not necessary

79 2.2 Preparation of Experimental Diets

The dietary ingredients were measured as contained in Table 1 with poultry waste meal (PWM) substituted for maize at inclusion levels 0%, 25%, 50%, 75% and 100% for diet A (control), B,C,D and E respectively. Starch was added to act as a binder and it was pelletized with a locally fabricated pelleting machine of 3mm die size. The pellets were sun dried and packed in well labeled air tight containers and stored in a cool and dry place.

Comment [A11]: in its composition is an energy ingredient, to be a substitute for corn ??

85 86 87

88 89 90

91 92

	Table 1. Gross	Composition o	f Poultry Waste	Meal (PWM) Die	ets (g/100g)		Comment [A12]: What is the reference of the nutritional requirements for the species?
	Levels of	<mark>A (</mark> 0% <u>,</u> ₽WM)	<mark>₿ (</mark> 25%		D(75%	E (100%	Formatted: Font: Not Bold
	inclusion		<u>PWM</u>)	<u>PWM</u>)	<u>PWM</u>)	<u>PWM</u>	Formatted Table
	FISHMEAL (65.5%)	32.00	32.00	32.00	32.00	32.00	-
ļ	SBM (45%)	31.5	31.5	31.5	31.5	31.5	
	YELLOW MAIZE (10%)	28.5	22.8	17.1	11.4	5.7	
l	PWM (9.8%)	-	5.7	11.4	17.1	22.8	
	VEG. OIL	2.5	2.5	2.5	2.5	2.5	
	BONE MEAL	1.00	1.00	1.00	1.00	1.00	
	*VIT. PREMIX	2.00	2.00	2.00	2.00	2.00	
I	STARCH	2.5	2.5	2.5	2.5	2.5	

93 94 95

*Each kg contains: Vit. A: 4,000,000/U; Vit. B: 800,000/U; Vit. E: 16,000mg; Vit. K3: 800mg; Vit. B1: 600mg; Vit. B2: 2,000mg; Vit. B6: 1,600mg; Vit. B1: 8mg; Niacin: 16,000mg; Caplan: 4,000mg; Folic Acid: 400mg; Biotin: 40mg; Antioxidant: 40,000mg; Chlorine chloride: 120,000mg; Manganese: 32,000mg;

Iron: 16,000mg; Zinc: 24,000mg; Copper: 32,000mg; Iodine: 320mg; Cobalt: 120mg; Selenium: 800mg manufactured by DSM Nutritional products Europe Limited, Basle, Switzerland.

97 Limited, Basie, Switzerland. 00 Where: SBM = Soybean meal, PWM = Poultry waste meal

100 2.3 Procurement of Fish

101 One hundred and fifty juvenile *Clarias gariepinus* of average weight of 6.5g were purchased

102 from Federal Ministry of Agriculture GRA, Ado Ekiti. The fish were starved for 24hours and

103 allowed to acclimate to the new environment after which Coppens was used to feed it for 104 three days prior to the beginning of the actual feeding experiment.

105 Ten fish were randomly stocked per aquarium in triplicate groups for each treatment and fed

106 twice daily to satiation at 8.00 to 9.00 and 17.00 to 18.00 hours for 70days. Weighing of fish

107 in each aquarium was carried out in batches every fortnight and feed was adjusted to 108 accommodate the increase in body weights of the fish. Faeces and feed remnants were

109 siphoned out every day to prevent fouling.

110

111 2.4 Determination of Growth Performance of test fish

- 112 Growth performance was determined as follows [10]:
- 113 i Weight gain = final weight of fish (W_2) -Initial weight (W_1)
- 114 ii Specific growth rate (SGR) = Log_e final weight- Log_e initial weight x 100
- 115 Rearing period (Days)
- 116 iii Protein efficiency ratio (PER) = <u>fish weight gain (g)</u>
- 117 Protein consumed (g)

118 iv Feed conversion ratio (FCR) = weight of feed (g)

119 Fish weight gain (g)

120 2.5 Proximate Analyses

121 The proximate analyses of poultry waste meal (PWM) and that of the fish after the 122 experiment were determined using the method of [11]. Parameters determined were: 123 moisture content, crude protein, lipid, ash, crude fibre and NFE (carbohydrate).

124 2.6 Cost of experimental diets

125 The cost of producing 1kg of the different feeds with PWM at different inclusion levels was 126 calculated and compared with the production cost of 1kg of the control diet which has no 127 PWM. Costing was done according to the prevailing market prices of ingredients that were 128 used in diets at the time of the experiment.

129 2.7 Statistical Analysis

Data on growth parameters were subjected to one - way analysis of variance (ANOVA) to
test for significant difference in the means while means which were significantly different
were separated using Duncan's multiple range test. Analysis was performed using the SPSS
(Statistical Package for Social Sciences) version 21. Significant level was set at p≥0.05_-and
values were expressed as Means±SD.

135 136

137 3. RESULTS

138 3.1 Proximate Composition of Poultry Waste Meal

139The result of the proximate composition of poultry waste meal is shown in Table 2. The140poultry waste meal had a crude protein content of 9.795, Fat content of 1.250, Crude fibre of1418.700, moisture content of 10.794, Ash content of 25.174 and Carbohydrate of 44.286

142 143 144

1 1 5

Table 2. Proximate Composition of Poultry Waste Meal (%) Dry Weight

145	FAI		1.200
146	CRUDE FIBRE	8.700	
147	PROTEIN		9.795

Comment [A13]: why only two feeds ?? at this stage should feed more often. justify

Comment [A14]: already exists in the table, no need to repeat in the text

148	MOISTURE	10.794
149	ASH	25.174
150	CARBOHYDRATE	44.286
151		

- 152 153 154 Laboratory analysis, 2019

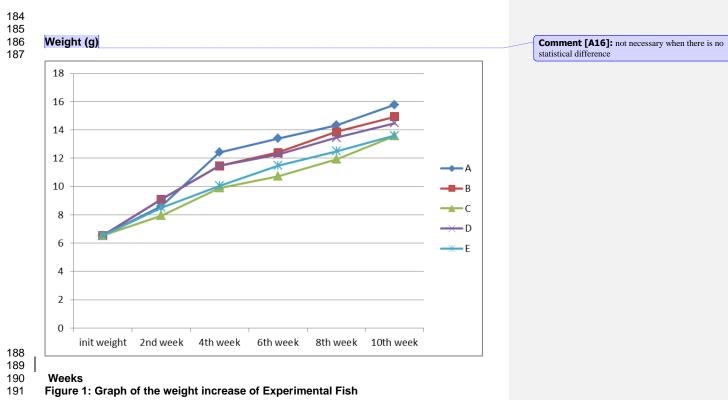
3.2 Growth and Nutrient Utilization of the Experimental Fish

Table 3 shows the growth and nutrient utilization of the experimental fish. There were no significant differences (p>0.05) between all variables of growth when use the diets containing PWM and control.Final weight was highest in fish fed with diet A (15.780±2.130) followed by the fish feed with diet B (14.940±0.949) while the least was found in fish fed with diet C (13.597±1.364) Weight gain was highest in fish fed diet A (9.227±2.129) while the least weight gain was found in fish fed with diet C (7.047±1.346).All the other parameters followed the same trends with the highest values recorded in control and the least in C. However, there were no significant differences (p>0.05) between the control and all other diets. For FCR, fish fed with the control had the best value (1.880±4.814), followed by the

fish fed with diet B (2.003±0.215). The worst value was recorded in fish fed with diet C

(2.430±0.521). However, there were no significant differences (p>0.05) between all the diets in terms of FCR.

	Table 3. waste meal	Growth and nutrient	utilization of Clar	ias gariepinus feo	d with poultry		Comment [A15]: it is not necessary to put the letters when there is no statistical difference
		A (Contr <u>ol</u> el)	<u>25% PWM</u> B	<u>50% PWM</u> C	<u>75%PWM</u> ₽ ◀	<u>10</u>	Formatted: Centered
	Mean initial	6.553±0.006	6.557±0.006 ^a	6.550±0.000 ^a	6.557±0.006 ^a <	6.	Formatted: Superscript
	weight						Formatted: Centered
l	Mean final weight	15.780±2.130 ^ª	14.940±0.949 ^a	13.597±1.346 ^ª	14.477±1.476 ^a <	13	Formatted: Centered
l	Mean weight gain	9.227±2.129 ^a	8.383±0.947 ^d	7.047±1346 ^a	7.920±1.475 ^a <	7.	Formatted: Centered
	Average daily weight gain	0.1318±0.031 ^ª	0.1198±0.017 ^a	0.1007±0.006 ^a	0.1131±0.025 ^a <	0.1	Formatted: Centered
l	Specific growth rate (SGR)	1.247±.0.203 ^a	1.183±0.102 ^ª	1.040±0.148 ^a	1.127±0.146 ^a <	1.	Formatted: Centered
I	Protein efficiency ratio (PER)	0.692±0.169 ^a	0.630±0.0701 ^ª	0.529±0.101 ^ª	0.594±0.111 ^ª ◀	0.4	Formatted: Centered
	Feed conversion ratio (FCR)	n 1.880±4.814 ^ª	2.003±0.215 ^ª	2.430±0.521 ^ª	2.152±0.393 ^a <	2.	Formatted: Centered



3.3 Carcass Composition of the Experimental Fish

The carcass composition of the experimental fish is given in Table 4. Fish fed with diet B containing 0,25% BWM had the highest crude protein and ash content value (70.173±0.962). while the fish fed with diet A had the least value (59.195±1.318). Fish fed 100% BWM presented higher moisture values than those fed with the control diet. Ether extract and NFE were higher in control diet fed fish. There were significant differences (p<0.05) between the fish fed diet B and all the other diets in terms of crude protein value while there was no significant difference (p>0.5) between the control and diet E. Ash content was highest in fish fed with diet B (5.291±0.004) and the lowest was found in fish fed with diet D (4.856±0.009). In term of ash content, there were significant difference (p<0.05) between the control and diet B and D but there was no significant difference (p>0.05) between the control and other dicts.

2	υ	О	
-	-	_	

50						
)7	Table 4.	Carcass c	omposition of ex	perimental fish (%	Dry Weight)	Comment [A17]: Standardize
30						
		A Control	В	С	D	E Comment [A18]: adjust
-	Moisture	6.828±0.047 [⊳]	5.890±0.045 ^a	6.607±0.025 ^{ab}	6.829±0.104 [⊳]	7.150±0.754 ^D Formatted Table
	Crude protein	59.195±1.318 ^a	70.172±0.962 ^c	64.083±0.818 ^b	64.998±0.123 ^b	62.098±2.341 ^a
	Ether extract	15.248±0.543 ^c	12.260±0.514 ^ª	14.686±0.675 ^{bc}	13.234±0.320 ^{ab}	14.067±1.115 ^{abc}
	Ash	4.998±0.064 ^b	5.291±0.004 ^c	4.990±0.009 ^b	4.856±0.009 ^a	5.059±0.075 ^b
	NFE	13.730±0.756 ^d	6.411±0.442 ^a	9.684±0.136 ^b	10.082±0.348 ^b	11.619±0.403 [°]
ററ -	Means and sta	andard deviation along the	same column followed by sa	me superscripts are not signi	ficantly different (p>0.05).	

215 3.4 Water Parameters During the Experimental Period

Table 5 shows the result of water quality parameters recorded during the period of the experiment. The temperature and the dissolved oxygen throughout the period of the 216 217 experiment ranged from 26.120-26.272 and 6.266-7.300mg/litre respectively while pH values 218 ranged between 6.300-6.733.In terms of temperature there were no significant differences 219 220 (p>0.05) between the control, diet B,C and E and there were no significant differences 221 (p>0.05) between diets C,D and E. For DO, there was no significant differences (p>0.05) 222 between A,C, and E and no significant differences (p>0.05) between diet B and D. For pH, 223 there were no significant differences among all the diets.

224 225 **Table 5.**

225 226	Table 5.	Water quality parameter d	uring the experiment	ŧ	
220	Treatment	Temp [●] C	DO (mg/l)	рН	
	A	26.133±0.104 ª	6.400±0.100[°]	6.300±0.300 °	
	B	26.120±0.030 *	7.200±0.200⁶	6.500±0.360 *	
	e e	26.20±0.057^{ab}	6.633±0.321 *	6.333±0.493 ª	
	Ð	26.272±0.060 [₿]	7.300±0.100 [⊭]	6.633±0.152 *	
	E	26.200±0.010^{ab}	6.266±0.152 ª	6.733±0.208 *	

227 and standard deviation along the same row followed by same superscripts are not significantly different (p>0.05). 228

229

230 3.5 Cost of experimental diet

231 The cost of replacing maize in the diet of Clarias gariepinus is shown in Table 6. The cost of 232 the diet decreased with increasing level of inclusion of poultry waste meal

233 234

Comment [A19]: Water quality parameters during the experiment should be inserted in the material and methods, only the averages during the experimental period.

Poultry waste meal 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	Table 6: Cost of e	•		~ /1.1	- /• N	- 4 N	Comment [A20]: you can mention how many % of diet cost savings
Poultry waste meal 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	INGREDIENTS	A(N)	B(N)	C(N)	D(N)	E(N)	
Soya bean meal 143.33 1	Fish meal	1080	1080	1080			
Yeliow maize 79.8 63.84 47.88 31.92 15.96 Vegetable oil 25.00 25.00 25.00 25.00 25.00 Denormeal 1.5 1.5 1.5 1.5 1.5 Vitamin premix 82.5 82.5 82.5 82.5 82.5 Total 1418.41 1409.55 1400.71 1391.88. 1383.14 Cost analysis of replacing maize with poultry waste meal showed that the cost of production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. 4. DISCUSSION This study investigated the effect of subclituting poultry waste meal (PWM) for maize in the diat-of the African Clarid catileh. <i>Clarias gariepinus</i> (Reuchell 1822), juvenike The experimental fish species (<i>Clarias gariepinus</i>) readily accepted the experimental diets and showed pividence of good growth as attested to by the final weight gain recorded in the experiment. This is an indication that poultry waste meal could be nutritious and well tilized for conversion to fish in the diets of fish. This is a greenent with the work of [7] who reported that agricultural wastes may contain materials that can be collected and poultry-cum- fish farming that poultry wastes could serve as the main source of food for the adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine [*] and Gala [*] wastes) the device and other nutrition experiment sub an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein ingredient or introduce bias in the results obtained in the experiment substituted ingredient or introduce bias in the results obtained in the experiment substituted ingredient or introduce bias in the results obtained in the experiment the substituted ingredient or introduce bias in the results obtained in the experiment the substituted ingredient or introduce bias in the results obtained in the experiment substituted ingredient ori	Poultry waste meal						
Vegetable oil 25.00 25.00 25.00 25.00 25.00 25.00 25.00 Bone meal 1.5 1.5 1.5 1.5 1.5 1.5 Vitamin premix 82.5 82.5 82.5 82.5 82.5 82.5 Starch 6.25 6.25 6.25 6.25 6.25 6.25 1400.71 1391.88. 1383.14 Total 1418.41 1409.55 1400.71 1391.88. 1383.14 Total 1418.41 140.55 1400.71 1391.88. 1383.14 The study investigated the effect of substituting poultry waste meal (PWM) for maize in the experimental fish species (<i>Clarias gariepinus</i>) readily accepted the experimental files and showed eividence of good growth as atteside to by the final weight jain recorded and processed for onversion to flesh in the diets of fish. This is in agreement with the work of [7] who reported that agricultural wastes wastes (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could convestion of PKM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also							
Bone meal 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 Starch 6.25 6.25 6.25 82.5 82.5 82.5 Starch 6.25 6.25 6.25 6.25 6.25 6.25 6.26 Trial 1418.41 1409.55 1400.71 1391.88. 1383.14 Cost analysis of replacing maize with poultry waste meal showed that the cost of production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. 4 DISCUSSION This study investigated the effect of substituting poultry waste meal (PWM) for maize in the experiment lifts species (Carais gariepinus) readily accepted the experiment lifts beneficial and annihold in the experiment lifts species (Carais gariepinus) readily accepted the experiment lifts and therefield and annihold in the experiment. This is an indication that poultry wastes meal could be nutritious and weight gain recorded in the experiment. This is an indication that poultry wastes meal could be nutritious and weight gain recorded this alth crone period that agricultural wastes may contain materials that can be collected and showed by the result of the study further corroborates the work of [7] who reported that some industrial wastes (biscuit, Indomine ⁶ and Gala ⁶ wastes) what a dequal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth as attested to yellow maize. This is an indication that rould conveniently replace maize in this superiments usually, only feed ingredients with no adverse effects on the fish growth as attested to yellow maize. This is an indication that rould conveniently replace maize in the experiment. The result of the study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine ⁶ and Gala ⁶ wastes) the result of this study. In adverse effects on the fish growth as attested to yellow maize. This is an indication that rould conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to yellow maize. This is an indication that rould procession fore the study throw ar							
Vitamin premix 82.5 82.5 82.5 82.5 82.5 82.5 6.25 Starch 6.25 6.25 6.25 6.25 6.26 Cost analysis of replacing maize with poultry waste meal showed that the cost of production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. 4. DISCUSSION This study investigated the effect of substituting poultry waste meal (PWM) for maize in the experimental fish species (<i>Clarias garlepinus</i>) readily accepted the experimental diets and showed pividence of good growth as attested to by the final weight add very the previous and solutions and the poultry waste meal could be nutritions and well utilized for conversion to flesh in the diets of fish. This is in agreement with the work of [7] who reported that agricultural wastes may contain materials that can be collected and processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-cum- fish farming that poultry wastes call equale growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that agricultural wastes may contain materials that can be collected and processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-cum- fish farming that poultry wastes coll deviaut adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutritin experiments usually, only f	0						
Starch 6.25 6.25 6.25 6.26 6.26 6.26 Total 1418.41 1409.55 1400.71 1391.88. 1383.14 Cost analysis of replacing maize with poultry waste meal showed that the cost of production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. 4. DISCUSSION This study investigated the effect of substituting poultry waste meal (PWM) for maize in the diet of the African Clarid catlish, <i>Clarkas gartepinus</i> (Burchell 1622) juveniles. The experimental fish species (<i>Clarias gartepinus</i>) readily accepted the experimental diets and showed evidence of good growth as attested to by the final weight had weight gain recorded in the experiment. This is an indication that poultry waste meal could be nutritious and weilt who reported that agricultural wastes may contain materials that can be collected and processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-cum. Fish farming that poultry wastes could serve as the main source of food for the fish all through the culture period, bringing about adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in the adverse effects on the fish growth as attested to by the result of this study. In nutrition experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiment, The result of proximate and haematological parameters of the fish. The efferences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually that ovary							
Total 1418.41 1409.55 1400.71 1391.88. 1383.14 Cost analysis of replacing maize with poultry waste meal showed that the cost of production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. Image: Comment (A21): improve discussion by inclusing with head of the level of inclusion of poultry waste meal (PWM) for maize in the discuting which beneficial and autrinoal characteristics exist in PWM, growth factors for species, carcas composition This study investigated the effect of substituting poultry waste meal (PWM) for maize in the discuting which beneficial and autrinoal characteristics exist in PWM, growth factors for species, carcas composition Comment (A22): any ous sure?? Was daily accepted the experimental dists and weight gain recorded and processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-cum- fish farming that poultry wastes could serve as the main source of food for the fish all through the culture period, bringing about adequate growth at litle cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (bicuit, Indomine ⁶ and Gale ⁶ wastes) had equal potentials in replacing maize as an energy supplement when and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that is could be over a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate analysis of PWM in the experiment, T							
 production of 1kg feed reduced as the level of inclusion of poultry waste meal increased. 4. DISCUSSION This study investigated the effect of substituting poultry waste meal (PWM) for maize in the dist of the African Clarid catlish, <i>Clarias gariepinus</i>) readily accepted the experimental fish species (<i>Clarias gariepinus</i>) readily accepted the experimental diets and showed evidence of good growth as attested to by the final weight gain recorded in the experiment. This is an indication that poultry waste meal could be nutritious and well utilized for conversion to flesh in the diets of fish. This is in agreement with the work of [7] this hard processed for beneficial use at minimal cost. It is also a common practice in integrated processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-curn-fish farming that poultry wastes could serve as the main source of food for the ish all through the culture period, bringing about adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that agricultural wastes (biscuit, Indomine[®] and Gala[®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein is experiment with no adverse effects on the fish growth as attested to by the results obtained from laboratory analysis in this study however is in contrast to could conveniently replace maize in this experiment augusting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PVM obtained from laboratory analysis in this study however is in contrast tor	Total						
4. DISCUSSION This study investigated the effect of substituting poultry waste meal (PWM) for maize in the didt of the African Clarid cattich, <i>Clarias gariepinus</i> (Burchell 1822) juveniles. The experimental fish species (<i>Clarias gariepinus</i>) readily accepted the experimental diets and showed evidence of good growth as attested to by the final weight and weight gain recorded in the experiment. This is an indication that poultry waste meal could be nutritious and well utilized for conversion to flesh in the diets of fish. This is in agreement with the work of [7] or the diets of fish. This is in agreement with the work of [7] or the diets of fish. This is in agreement with the work of [7] or the diets of fish. This is an and naming that poultry wastes could serve as the main source of food for the fish all through the culture period, bringing about adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [1] who reported that sagriepinus feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment sually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PVM obtained form laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry. Comment [A23]: got confused, rewrite	production of 1k						
This study investigated the effect of substituting poultry-waste meal (PWM) for maize in the characteristics exits in PWM, growth factors for species, carcass composition of the characteristics exits in PWM, growth factors for species, carcass composition despecies, carcass carcass composition despecies, carc	increased.						
This study investigated the effect of substituting poultry-waste meal (PWM) for maize in the characteristics exits in PWM, growth factors for species, carcass composition of the characteristics exits in PWM, growth factors for species, carcass composition despecies, carcass carcass composition despecies, carc							
This study investigated the effect of substituting poultry waste meal (PWM) for maize in the diet of the African Clarid catfich, <i>Clarias gariepinus</i> (Burchell 1822) juveniles. The experimental fish species (<i>Clarias gariepinus</i>) readily accepted the experimental diets and showed evidence of good growth as attested to by the final weight final meight gain recorded in the experiment. This is an indication that poultry waste meal could be nutritious and well utilized for conversion to flesh in the diets of fish. This is in agreement with the work of [7] who reported that agricultural wastes may contain materials that can be collected and processed for beneficial use at minimal cost. It is also a common practice in integrated poultry-cum- fish farming that poultry wastes could serve as the main source of food for the fish all through the culture period, bringing about adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported to the <i>Clarias gariepinus</i> (seed with positive effects on the growth as attested to by the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of the substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also r	4. DISCUSSION						
poultry-cum- fish farming that poultry wastes could serve as the main source of food for the fish all through the culture period, bringing about adequate growth at little cost with no adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also				the final weight	and weight gai	n recorded	Comment [A22]: are you sure?? Was daily
adverse effect on the fish health. The result of this study further corroborates the work of [12] who reported that some industrial wastes (biscuit, Indomine [®] and Gala [®] wastes) had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also	in the experiment. utilized for convers who reported that	This is an indic ion to flesh in t agricultural wa	ation that poultr the diets of fish. astes may cont	the final weight y waste meal co This is in agree ain materials th	and weight gai ould be nutritiou ment with the at can be col	n recorded us and well work of [7] lected and	growth satisfactory? Comment [A23]: relate your results to the
had equal potentials in replacing maize as an energy supplement when incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul	ation that poultr the diets of fish. astes may cont ninimal cost. It ltry wastes could	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m	and weight gai uld be nutritiou ment with the at can be col ion practice in ain source of f	n recorded us and well work of [7] lected and integrated ood for the	growth satisfactory? Comment [A23]: relate your results to the
incorporated to the <i>Clarias gariepinus</i> feed with positive effects on the growth and haematological parameters of the fish. The result of the proximate analysis of PWM in this study showed that it had crude protein level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on th	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perioo ne fish health. T	ation that poult the diets of fish. astes may cont ninimal cost. It Itry wastes could d, bringing abo The result of this	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further cor	and weight gai uld be nutritiou ment with the at can be col ion practice in ain source of f wth at little co roborates the v	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12]	growth satisfactory? Comment [A23]: relate your results to the
level and other nutrients very similar to that of yellow maize. This is an indication that it could conveniently replace maize in this experiment with no adverse effects on the fish growth as attested to by the result of this study. In nutrition experiments usually, only feed ingredients with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported that	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perior ne fish health. T t some indus	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con biscuit, Indomir	and weight gai uld be nutritiou ment with the at can be col ion practice in ain source of f wth at little co roborates the v ne [®] and Gala	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] [®] wastes)	growth satisfactory? Comment [A23]: relate your results to the control diet
with comparable nutrients compositions are used for substituting the other so that there will be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on th who reported tha had equal pote incorporated to f	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perior ne fish health. T t some indus ntials in rep the <i>Clarias</i> g	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize ariepinus feed	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con iscuit, Indomir as an ener	and weight gai uld be nutritiou ment with the at can be col- ion practice in ain source of f wth at little co roborates the v ne [®] and Gala gy suppleme	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] [®] wastes) ent when	growth satisfactory? Comment [A23]: relate your results to the control diet
be no deficiency symptoms manifesting in the animal being fed as a result of the substituted ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on th who reported tha had equal pote incorporated to f and haematologic The result of the p level and other nutt conveniently replace	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perior he fish health. T t some indus intials in rep the <i>Clarias g</i> cal parameter roximate analys rients very simili- ce maize in this	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize ariepinus feed s of the fish. sis of PWM in th ar to that of yello experiment with	the final weight y waste meal co. This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con study further con siscuit, Indomir as an ener with positive his study showed ow maize. This is a no adverse effe	and weight gai build be nutrition ement with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy suppleme effects on the an indication te ects on the fish	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] [®] wastes) ent when he growth ude protein hat it could growth as	growth satisfactory? Comment [A23]: relate your results to the control diet
ingredient or introduce bias in the results obtained in the experiment. The result of proximate composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to fa and haematologic The result of the p level and other nutt conveniently replace attested to by the r	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias g</i> cal parameter roximate analys rients very simili- ce maize in this result of this stu	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize <i>ariepinus</i> feed s of the fish. sis of PWM in th ar to that of yello experiment with idy. In nutrition	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con siscuit, Indomir as an ener l with positive his study showed ow maize. This is a no adverse effe	and weight gai build be nutrition ement with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy suppleme effects on the an indication t ects on the fish ally, only feed	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] [®] wastes) ent when he growth ude protein hat it could o growth as ingredients	growth satisfactory? Comment [A23]: relate your results to the control diet
composition of PWM obtained from laboratory analysis in this study however is in contrast to the work of [13] who reported a crude protein value of 28.6% on analysis of poultry waste. The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to the and haematologic The result of the p level and other nuttic conveniently replace attested to by the right of the p	This is an indic ion to flesh in t agricultural wa eficial use at r arming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> ga cal parameter roximate analys ients very simili- te maize in this result of this stu- utrients compos	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (to blacing maize <i>ariepinus</i> feed s of the fish. sis of PWM in th ar to that of yello experiment with udy. In nutrition sitions are used	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con study further con siscuit, Indomir as an ener l with positive his study showed ow maize. This is a no adverse effer experiments usu for substituting t	and weight gai build be nutrition ement with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy suppleme effects on the an indication t ects on the fish ally, only feed he other so tha	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] wastes) ent when the growth ude protein that it could a growth as ingredients at there will	growth satisfactory? Comment [A23]: relate your results to the control diet
The differences in values could be due to collection and processing methods. [7] also reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to the and haematologic The result of the p level and other nuttic conveniently replace attested to by the ri- with comparable nut- be no deficiency sy	This is an indic ion to flesh in t agricultural wa eficial use at r imming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> ga cal parameter roximate analys ients very simili- ce maize in this esult of this stu- utrients compose optoms manife	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize ariepinus feed s of the fish. sis of PWM in the ar to that of yell experiment with udy. In nutrition sitions are used esting in the anir	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con study further con siscuit, Indomir as an ener l with positive	and weight gai build be nutrition ement with the at can be col- ion practice in ain source of f with at little co- roborates the w e [®] and Gala gy suppleme effects on the an indication t ects on the fish ally, only feed he other so tha a result of the	n recorded us and well work of [7] lected and integrated ood for the ost with no work of [12] [®] wastes) ent when the growth ude protein that it could a growth as ingredients at there will substituted	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?
reported that agricultural wastes usually tend to vary in composition depending on the	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on tt who reported tha had equal pote incorporated to t and haematologic The result of the p level and other nut conveniently replac attested to by the r with comparable m be no deficiency sy ingredient or introd composition of PW	This is an indic ion to flesh in t agricultural wa eficial use at r urming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> ga cal parameter roximate analys ients very simili- ce maize in this esult of this stu- utrients compos ruptoms manife uce bias in the M obtained from	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize ariepinus feed s of the fish. sis of PWM in the ar to that of yello experiment with dy. In nutrition stitons are used esting in the anir results obtained n laboratory ana	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con iscuit, Indomir as an ener with positive his study showed by maize. This is no adverse effe experiments usu for substituting t nal being fed as in the experimer lysis in this study	and weight gai build be nutrition ement with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy suppleme effects on the an indication the can indication the ally, only feed he other so that a result of the nt. The result of y however is in	n recorded us and well work of [7] lected and integrated ood for the st with no work of [12] [®] wastes) ent when he growth ude protein hat it could a growth as ingredients at there will substituted f proximate contrast to	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?
	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on tt who reported tha had equal pote incorporated to t and haematologic The result of the p level and other nut conveniently replac attested to by the r with comparable nu be no deficiency sy ingredient or introd composition of PW the work of [13] wh	This is an indic ion to flesh in t agricultural wa eficial use at r urming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> ga cal parameter roximate analys ients very simili- ce maize in this result of this stu- utrients compos rmptoms manife uce bias in the M obtained from ho reported a c	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize <i>ariepinus</i> feed s of the fish. sis of PWM in the ar to that of yello experiment with dy. In nutrition itions are used esting in the anir results obtained n laboratory ana rude protein val	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further con study further con study further con is cuit, Indomir as an ener with positive his study showed by maize. This is no adverse effe experiments usu for substituting t nal being fed as in the experimer lysis in this study ue of 28.6% on	and weight gai build be nutritious ment with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy suppleme effects on the an indication the eacts on the fish ally, only feed he other so tha a result of the nt. The result of y however is in analysis of pou	n recorded us and well work of [7] lected and integrated ood for the st with no work of [12] wastes) ent when he growth ude protein hat it could a growth as ingredients at there will substituted f proximate contrast to ultry waste.	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?
	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to the and haematologies The result of the p level and other nutro conveniently replace attested to by the r with comparable nu be no deficiency sy ingredient or introd composition of PW the work of [13] wh The differences in	This is an indic ion to flesh in t agricultural wa eficial use at r imming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> gas cal parameter roximate analys rients very simili- ce maize in this result of this stu- utrients compos mptoms manife uce bias in the M obtained from ho reported a c values could	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize <i>ariepinus</i> feed s of the fish. sis of PWM in the ar to that of yello experiment with idy. In nutrition seting in the anir results obtained n laboratory ana rude protein val be due to collo	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further cor biscuit, Indomir as an ener l with positive his study showed by maize. This is n no adverse effe experiments usu for substituting t mal being fed as in the experimer lysis in this study ue of 28.6% on ection and proce	and weight gai build be nutritious ment with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy supplement effects on the an indication the eacts on the fish ally, only feed he other so tha a result of the nut. The result of y however is in analysis of pou-	n recorded us and well work of [7] lected and integrated ood for the st with no work of [12] wastes) ent when he growth a growth as ingredients at there will substituted f proximate contrast to ultry waste. s. [7] also	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?
	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to the and haematologie The result of the p level and other nutti conveniently replace attested to by the r with comparable nu be no deficiency sy ingredient or introd composition of PW the work of [13] wh The differences in reported that agric	This is an indic ion to flesh in t agricultural wa eficial use at r imming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> gas cal parameter roximate analys rients very simili- ce maize in this result of this stu- utrients compos mptoms manife uce bias in the M obtained from ho reported a c values could	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize <i>ariepinus</i> feed s of the fish. sis of PWM in the ar to that of yello experiment with idy. In nutrition seting in the anir results obtained n laboratory ana rude protein val be due to collo	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further cor biscuit, Indomir as an ener l with positive his study showed by maize. This is n no adverse effe experiments usu for substituting t mal being fed as in the experimer lysis in this study ue of 28.6% on ection and proce	and weight gai build be nutritious ment with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy supplement effects on the an indication the eacts on the fish ally, only feed he other so tha a result of the nut. The result of y however is in analysis of pou-	n recorded us and well work of [7] lected and integrated ood for the st with no work of [12] wastes) ent when he growth a growth as ingredients at there will substituted f proximate contrast to ultry waste. s. [7] also	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?
From the growth and nutrient utilization results obtained in the study, the fish fed the control	in the experiment. utilized for convers who reported that processed for ben poultry-cum- fish fa fish all through the adverse effect on the who reported tha had equal pote incorporated to the and haematologies The result of the p level and other nutric conveniently replace attested to by the r with comparable nu be no deficiency sy ingredient or introd composition of PW the work of [13] wh The differences in reported that agric constituents.	This is an indic ion to flesh in t agricultural wa eficial use at r imming that poul e culture perior he fish health. T t some indus ntials in rep the <i>Clarias</i> gr cal parameter roximate analys rients very simili- ce maize in this result of this stu- utrients compos mptoms manife uce bias in the M obtained from ho reported a c values could cultural wastes	ation that poult the diets of fish. astes may cont ninimal cost. It ltry wastes could d, bringing abo The result of this trial wastes (b blacing maize ariepinus feed s of the fish. sis of PWM in the ar to that of yello experiment with idy. In nutrition stions are used setting in the anir results obtained n laboratory ana rude protein val be due to collo usually tend to	the final weight y waste meal co This is in agree ain materials th is also a comm d serve as the m ut adequate gro study further cor biscuit, Indomir as an ener with positive his study showed by maize. This is n no adverse effe experiments usu for substituting t nal being fed as in the experimer lysis in this study ue of 28.6% on ection and proce by vary in compo	and weight gai build be nutritious ment with the at can be col- ion practice in ain source of f with at little co- roborates the w ne [®] and Gala gy supplement effects on the an indication the can indication the fish ally, only feed he other so tha a result of the nut. The result of y however is in analysis of pou- essing method position depend	n recorded us and well work of [7] lected and integrated ood for the st with no work of [12] wastes) ent when he growth ude protein hat it could growth as ingredients at there will substituted f proximate contrast to ultry waste. is. [7] also ing on the	growth satisfactory? Comment [A23]: relate your results to the control diet Comment [A24]: of what?

differences (p≥0.05) between the results obtained in the control and all the other diets.
Considering the high cost of maize in the market and the fact that PMW could be obtained at
little or no cost, its incorporation could be a way of converting waste to wealth. Incorporating
it in the diet of *Clarias gariepinus* would greatly reduce the cost of feed and consequently the
cost of production and increase the profit margin of farmers. Several authors have also
worked on the replacement of maize with lesser-used ingredients with varying levels of
success [14, 12, 6, 15, 16].

The experimental water condition was maintained at temperature values between 26.12 and 26.27⁰C, dissolved oxygen values between 6.26 and 7.30 mg/l and pH values between 6.3 and 6.7 5. These values were within the standard values recommended for warm water fish culture and supported good fish production [17, 18].

The result of the carcass analysis also showed that the crude protein for all the fish fed the experimental diets were higher than that of the control which showed that they retained protein in their carcass than the fish fed the maize based diets.

297 The cost of replacing maize with poultry waste meal shows that the cost of production of 1kg 298 feed reduced as the level of inclusion of poultry waste meal increased. Profitability and 299 viability of a fish farming enterprise depends largely on the total cost of fish feeds 300 as feeding cost represents the most expensive component of fish farming 301 enterprise therefore the more the inclusion level of PWM in this experiment, the 302 more profitable and viable the project would be. This is in line with the findings of 303 [12] who reported that the use of some industrial wastes (biscuit, Indomine[®] and 304 Gala[®]-wastes) in replacing maize in the diet of Clarias gariepinus all reduced total 305 feed cost per kg by at least 30%. Fish farming sector is currently faced with the challenge of inadequate and prohibitive cost of quality fish feeds therefore it is 306 pertinent that the use of alternative sources of nutrients that ordinarily pass as 307 308 waste and usually discarded such as PWM used in this experiment be explored 309 as it is not competed for like maize. These agricultural wastes could be procured 310 at little or no cost as they are categorized as waste products meant to be 311 discarded. 312

313 5. CONCLUSION

314

This study shows that poultry waste meal could be incorporated into the diet of
African catfish *Clarias gariepinus* as there was no significant difference in the
growth values recorded for the control and all the other experimental diets even up to
100% inclusion level.

Cost analysis of replacing maize with poultry waste meal showed that the cost of
 production of 1kg feed reduced as the level of inclusion of poultry waste meal
 increased. The cost of feed forms the major part of cost of production of fish
 and maize being high in cost will further bring about a hike in cost of
 production.

- 324 Considering the high cost of maize in both local and international markets and the 325 competition for its use in both human foods and livestock feeds, the use of PMW is
- 326 highly encouraged <u>alternative</u> as it will reducinge the cost of production and make

Comment [A27]: material and methods

Comment [A28]: how much?

Comment [A29]: What is the availability of PWM during the year? in sufficient and continuous quantity? and the antinutritional factors present in PWM? Is there a possibility of contaminants in the product?

fish farming more profitable. It will also serve as a way of converting waste towealth.

COMPETING INTERESTS

There is no competing interests.

REFERENCES

1.	Eyo AA. Fish Processing Technology in the Tropics. University of Ibadan Press,
	Ibadan, Nigeria; 2001.
2.	Faturoti EO. Fisheries Potential and Investment Opportunities in Nigeria. Paper
	Presented at the Fisheries Society of Nigeria (FISON) Investors Workshop held at

- Presented at the Fisheries Society of Nigeria (FISON) Investors Workshop held at NIOMR Lagos. April, 22, 1999.
- Ounham RA, Majumdar K, Hallerman E, Bartly D, Mair G, Hulata G, Liu Z, Pongthan N, Bakos J, Penman D, Gupta M, Rothlisberg P, Hoerstgen-Schwark G. Review of the Status of Aquaculture Genetics in the Third Millenium. Technical Proceedings of the Conference on Aquaculture, Bangkok, Thailand, 2001; 137-166.
- Fagbenro OA, Balogun AM, Ibironke AA, Fasina FA. Nutritional Value of Some Amphibian Meals in Diets for *Clarias gariepinus* (Burchell 1822) (Siluriformes: Clariidae). *Journal of Aquaculture in the Tropics* 1993; 8:95-101.
- Adeparusi EO, Olute BW. Effect of Methionine Supplemented Toasted Lima Bean (*Phaseolus lunatus*) Diets on the Growth of Oreochromis niloticus. Applied Tropical Agriculture 2001; 5 (2): 113-117.
- Obe BW. Growth Performance and Nutrient Utilization of Catfish Hybrid
 (*Heterobranchus bidorsalis X Clarias gariepinus*) Fed Fermented Sorghum
 (*Sorghum bicolor*) Waste Meal Diets. International Journal of Applied Science and
 Technology.2014; 4(3):130-136
- 357 7. Obi FO, Ugwuishiwu BO, Nwakaire JN. Agricultural Waste Concept,
- 358Generation, Utilization and Management. Nigerian Journal of Technology359(NIJOTECH) Faculty of Engineering, University of Nigeria, Nsukka. 2016; 35(4): 957360- 964
- Fagbenro OA, Nwanna LC, Adeparusi EO, Adebayo OT, Fapohunda OO. An
 overview of Animal Feed Industry and Dietary Substitution of Feedstuffs for Farmed
 Fish in Nigeria. *In*: Crops: Growth, Quality and Biotechnology (current status and
 future prospects) (Ramdane Dris, editor). WFL Publisher, Helsinki, Finland. 2005;
 91-107.
- Fasakin EA, Davies SJ, Akegbejo-Samsons Y. Efficacy of Maize Gluten
 Supplemented with Crystalline L-lysine in the Diets for the African Clariid Catfish
 Clarias gariepinus (Burchell, 1822) Journal of Animal and Veterinary Advances
 2006; 5 (3): 237-243.
- 370 10. Steffens W. Principles of Fish Nutrition. Ellis Horwood Ltd. England. 1989.
- 371 11. A.O.A.C.(1990). Association of Official Analytical Chemists. Official Methods of
- 372 Analysis, 15thedition. Washington D.C., United States of America. Pp: 1230.

of Fisheries and Aquatic Science, 2013;8: 535-543.

Comment [A30]: update as references, preferably the works of the last 5 years

330 331 332

333

334 335

336

342

343

344 345

346

347

348

349

350

351

^{373 12.} Agbebi OT, Ilesanmi AI, Alegbeleye WO, Odulate DO, Obasa SO,
374 Olaoye OJ. Growth and Haematological Effects of Replacing Maize with
375 Feed Wastes on the Juvenile *Clarias gariepinus* (Burchell, 1822). Journal

377	13. Obasa SO, Alegbeleye WO, Amole JB. Dried Poultry Manure Meal as a Substitute
378	for Soybean Meal in the Diets of African Catfish (Clarias gariepinus) (Burchell 1822)
379	Advanced Fry. Turkish Journal of Fisheries and Aquatic Sciences 2009; 9: 121-124
380	14. Obasa SO, Alegbeleye WO, Akinyemi AA, Idowu AA, Bamidele NA, Adesanya AN.

- Obasa SO, Alegbeleye WO, Akinyemi AA, Idowu AA, Bamidele NA, Adesanya AN.
 Replacement of Maize Meal by Toasted African Breadfruit (*Treculia africana*) seed meal in the diet of *Clarias gariepinus* (Burchell 1822) Fingerlings. Livestock Research for Rural Development LRRD Newsletter 2013; 25 (6)
 Fakunmoju O, Babalola A, Ijimakinde B, Anjola OA, Orowole PF. Effect of
 - Fakunmoju O, Babalola A, Ijimakinde B, Anjola OA, Orowole PF. Effect of Substituting Maize with Bambara (*Voandzeia subterrenea* Thouars) Waste Meal in the Practical Diets of *Tilapia niloticus* Fingerlings. Journal of Fisheries and Aquatic Science, 2016; 11: 185-189.
 - Obe BW. Use of Fermented Wheat (*Triticum spp*) Waste Meal in the Diet of *Clarias gariepinus* Fingerlings. American Academic and Scholarly Research Journal. 2017; 9 (4): 91-100
- Swann L. A Basic Overview of Aquaculutre: History, Water Quality, Types of
 Aquaculute,
 and Production Methods. *Illinois-Indiana Sea Grant Program Extension Bulletin* AS-
- 394 457 and IL-IN-SG-E-90-2. Purdue University. West Lafayette, Indiana. 1990.
- 395 18. Landau M. Introduction to Aquaculture. John Wiley and Sons Inc. New York. 1992.

396

385

386

387

388

389