



REPLACEMENT OF MAIZE WITH GRADED LEVELS OF NOODLE WASTE IN COMMERCIAL DIET OF AFRICAN CATFISH

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ABSTRACT

A study was conducted to determine the suitability of noodle waste as maize replacement in the diet of African catfish juvenile. Four experimental diets were formulated with noodle waste replacing maize at three graded levels (10, 15 and 20%) and the control was without noodle waste. A total of 120 African catfish juvenile (16.49 ± 0.03) were distributed in ten fish per experimental tank ($52.5 \text{ cm} \times 33.5 \text{ cm} \times 21 \text{ cm}$). The water was changed every two days and the feeding was done by hand to satiation twice daily. Diet 2 had the highest mean weight gain ($P < 0.05$) ($92.69 \pm 3.39 \text{ g}$) among the entire group. Similar pattern was observed in specific growth rate. The least significant ($P < 0.05$) feed conversion ratio was recorded by diet 3 (0.98 ± 0.09), the diet also recorded the best protein efficiency ratio (2.31 ± 0.20). The fish were fasted for 24 h to determine the haematological parameters. The PCV peaked ($P < 0.05$) at the inclusion of the test ingredient. However, no pattern was observed ($P < 0.05$) in the cholesterol and triglycerides. The carcass protein was highest ($P < 0.05$) in diet 2, likewise the ether extract. The best growth rate and nutrient utilization was achieved in diet 2.

Keywords: indomie waste, *Clarias gariepinus*, juvenile catfish, blood parameters, carcass composition

INTRODUCTION

Carbohydrates are the most economical source of dietary energy for terrestrial animals; however, the ability of fish to utilize carbohydrate varies among fish (NRC, 1993). The utilization of dietary carbohydrate by fish appears to be related to their digestive and metabolic systems adapted to the different aquatic environment and the dietary carbohydrate level and complexity (Hutchins *et al.*, 1998).

Carbohydrates are used in fish diets primarily as energy sources and for their binding properties (Hemre *et al.*, 2002). Diets used in fish farming contain highly variable amounts of carbohydrates depending on the cultivated species. Even within fish species carbohydrate contents of diets varied substantially (Krogdahl *et al.*, 2004). Developments in nutritional physiology, aquaculture technology and economical constraints have triggered use of cheaper feed ingredients with higher carbohydrate contents.

Grains and grain products are the main carbohydrate sources in diets for cultivated species (Tacon, 1993). Maize is a major carbohydrate source use in animal diet. It is commonly used as energy/carbohydrate source in fish diets; however, competition for its availability and hence increase its

price in the market. This then necessitates research into non-conventional carbohydrate ingredients that will replace maize without compromising fish growth and health.

Instant noodles was first commercialized in Japan in 1958, their popularity was rapid, spreading worldwide (Reungmanee-paitoon *et al.*, 2006). In Nigeria, indomie noodles are the most popular instant noodles brand. Since its introduction in 1988, noodles have had a remarkable impact on the Nigeria culinary landscape. Instant noodles are now eaten in most households across the country (Businessnews, 2006). According to the World Instant Noodle Association, in the year 2007, Nigeria was the 13th largest consumer of instant noodles in the world. Indomie waste is of special importance among the non-conventional feedstuffs. Indomie is produced from wheat flour, refined palm oil, salt, sodium polyphosphate, guar gum, tartrazine, C1 19140 and spices. During the process of packaging the noodles, the waste obtained is sold to livestock industry as indomie waste. Indomie waste has several advantages over other non-conventional feed ingredients. Indomie waste has no anti-nutritional factor and the high energy content of indomie waste makes it a

good substitute for maize and other cereal grains (Eniolorunda *et al.*, 2008).

This study was conducted to evaluate the effect of replacing maize with noodle waste in the diet of African catfish (*Clarias gariepinus*) juveniles using growth, nutrient utilization, haematology and carcass assessments.

MATERIALS AND METHODS

Experimental Procedure

The experiment was carried out at the Nutrition Unit of the Department of Marine Sciences, Faculty of Science, University of Lagos, Akoka.

Source of fish

A total of one hundred and twenty (120) juvenile *Clarias gariepinus* was purchased from Fuard Farms at Cele-Egbe area of Ikotun, Lagos. They were acclimatized for 2 weeks in plastic holding tanks (52.5 cm × 33.5 cm × 21 cm) and fed with 2 mm Coppens feed.

Experimental Setup

There was changing of water every two (2) days with de-chlorinated water from borehole to maintain good water quality (air temperature 29 – 39 °C, water temperature 27.5 - 29.5 °C, dissolved oxygen level of 4.5 - 4.8 mg/l, and pH of 7.3–8.0) (Aderolu and Akpabio, 2009).

Procurement and Processing of Test Ingredients

Adequate quantity of the various ingredient used for the experiment was purchased from Sabina Pad Nigeria limited, opposite Lagos State Abattoir, Oko-Oba, Agege, Lagos, before the commencement of the experiment to avoid fluctuation in ingredient composition.

The noodle waste was crushed and milled into very fine powder and stored at room temperature, separately in water proof cellophane. The other feed ingredients like maize, soybean, groundnut cake, and fishmeal were milled separately and stored for usage.

Feed formulation and Feeding Trials

Noodle waste was used to substitute maize at graded levels (Table 2). Measured quantity of each ingredient in the different diets were taken and properly mixed together. This was then pelletized to 2 mm size, sun-dried, labeled and stored for feeding.

The diets formulated were isonitrogenous and isocaloric. The control diet was without noodle waste, diet 1 (10% maize: 10% noodle waste), diet 2 (5% maize: 15% noodle waste) and diet 3 (0% maize: 20% noodle waste).

The fish were fed to satiation by hand thrice daily at 8.00 a.m., 2.00 p.m. and 6.00 p.m. throughout the experimental period. The fish were weighed on weekly basis after which the mean body weight was determined accordingly.

Haematological Analysis

Fish were randomly selected from each treatment tank and blood samples were collected from the caudal peduncle using a 2 ml syringe as described by Joshi *et al.* (2002). The blood samples were collected in heparinized and plain bottles for haematological and biochemical analysis at Bio-assay diagnostic laboratory, Cele-Egbe, Ikotun, Lagos.

Proximate Analysis

Fish carcass compositions were analyzed after the experiment for crude protein; dry matter and ether extract which were determined according to the Association of Analytical Chemists Method (A.O.A.C., 2000). This was carried out at the Department of Animal Sciences, University of Ibadan.

Growth and Nutrient Utilization Parameters

The parameters were calculated as stated below;

$$(1) \quad \text{Mean Weight Gain (g)} = \left[\text{Mean final body weight} - \text{Mean initial body weight} \right]$$

$$(2) \quad \text{Specific Growth Rate (SGR)} \\ \text{SGR } (\% \text{day}^{-1}) = \frac{\text{In final body weight} - \text{In initial body weight}}{\text{Time (in days)}}$$

$$(3) \quad \text{Average Feed Intake (AFI)} \\ \text{AFI} = \frac{\text{Feed intake during experimental period}}{\text{No of experimental days}}$$

$$(4) \quad \text{Feed Conversion Ratio (FCR)} \\ \text{FCR} = \frac{\text{Dry feed intake}}{\text{Wet weight gain}}$$

(5) Voluntary Feed Intake (VFI)

$$VFI = \frac{100 \times FI}{[(Wi + Wf) \times t]}$$

(6) Protein Efficiency Ratio (PER)

$$PER = \frac{\text{Mean weight gain}}{\text{protein intake}}$$

Cost Analysis

Cost was based on the current prices of feed ingredients in the experimental locality (Nigeria) as of the time of the experiment. The economic evaluations of the diet were calculated from the method of New (1989).

(1) Net Profit Value (NPV)

$$NPV = Sales - Expenditure$$

(2) Incidence of Cost (IC)

$$IC = \frac{\text{Cost of feed}}{\text{Kg of fish produced}}$$

(3) Gross Profit (GP)

$$GP =$$

Net profit value (N) – Investment cost analysis

Statistical Analysis

The data collected throughout the experimental period were subjected to analysis of variance (ANOVA). Duncan’s multiple range tests (Duncan, 1955) were used to determine difference in mean.

RESULTS

The data showing the proximate composition of the test ingredients and test diets are reported in Tables 1 and 2 respectively. The result of the growth parameters, nutrient utilization and economic parameters are reported in Table 3.

Table 1: Proximate Composition of Noodle and Maize

	Noodle	Maize
Dry matter	92.3	88.0
Protein	12.94	10.0
Ether extract	18.05	4.0
Fibre	1.25	2.0
Nitrogen Free Extract	65.00	84.0

Table 2: Gross composition of experimental diets containing graded levels of noodle waste as replacement for maize meal

Ingredients (%)	Experimental Diets			
	CTR	Diet 1	Diet 2	Diet 3
Fish meal (72%)	27.00	27.00	27.00	27.00
Groundnut cake	15.13	15.13	15.13	15.13
Soybean meal	34.97	34.97	34.97	34.97
Maize	20.00	10.00	5.00	0.00
Noodle waste	0.00	10.00	15.00	20.00
Fish premix	0.50	0.50	0.50	0.50
Dicalcium sulphate	1.00	1.00	1.00	1.00
Palm oil	1.00	1.00	1.00	1.00
Vit. C	0.20	0.20	0.20	0.20
Salt	0.20	0.20	0.20	0.20
Calculated Nutrients Value of the Feed				
Crude protein (%)	43.53	43.73	43.83	43.93
Lipids (%)	4.15	5.39	6.00	6.62

Table 3: Growth parameters, nutrient utilization and economic indices of fish fed graded levels of noodle waste

Parameters	Control	Diet 1(10% inclusion)	Diet 2 (15% inclusion)	Diet 3 (20% inclusion)
Average Initial Weight (g)	16.48±0.03	16.51±0.03	16.45±0.10	16.48±0.06
Average Final Weight (g)	100.42±12.05 ^a	87.70±2.47 ^b	109.44±3.40 ^a	108.74±3.90 ^a
Average Feed Intake (g)	95.12±10.82 ^{ab}	102.46±15.09 ^{ab}	114.97±6.19 ^a	91.30±9.70 ^b
Mean Weight Gain (g)	84.00±12.19 ^a	71.12±2.52 ^b	92.69±3.39 ^a	92.32±3.80 ^a
Specific Growth Rate (% day ⁻¹)	1.40±0.09 ^a	1.29±0.02 ^b	1.46±0.02 ^a	1.47±0.02 ^a
Voluntary Feed Intake (g)	22.76±0.58 ^{bc}	27.86±3.75 ^a	25.28±0.67 ^{ab}	20.22±1.81 ^c
Feed Conversion Ratio	1.14±0.05 ^{bc}	1.44±0.19 ^a	1.24±0.03 ^{ab}	0.98±0.09 ^b
Protein Efficiency Ratio	2.00±0.08 ^b	1.59±0.22 ^c	1.83±0.04 ^{bc}	2.31±0.20 ^a
Net Profit Value (₦)	84.32±20.05 ^{ab}	78.74±13.04 ^b	110.21±9.35 ^a	86.99±11.4 ^{ab}
Incidence Cost	0.19±0.01 ^{bc}	0.25±0.03 ^a	0.22±0.00 ^{ab}	0.17±0.02 ^c
Gross Profit (₦)	62.65±17.57 ^{ab}	56.43±10.35 ^b	84.62±8.11 ^a	65.58±9.63 ^{ab}

No significant difference ($P > 0.05$) was recorded in the initial weight of the fish. There was significant difference ($P < 0.05$) in all the growth parameters tested for. The highest mean weight gain was recorded in diet 2 (92.69 ± 3.39 g), though no significant difference ($P > 0.05$) was recorded between the control, diet 2 and diet 3. The least value was however recorded by diet 1 (71.12 ± 2.52). Similar pattern was observed in specific growth rate of the fish. Diet 3 had the highest value of $1.47 \pm 0.02\%$ /day and the least by diet 1 ($1.29 \pm 0.02\%$ /day). The nutrient utilization parameters tested for were all significantly different ($P < 0.05$) across the diets. There was significant drop in the feed conversion ratio (FCR) with increased inclusion of noodle waste. The least FCR was recorded in diet 3 (0.98 ± 0.09) and diet 1 had the highest FCR value (1.44 ± 0.19). The best protein efficiency ratio (PER) was recorded in fish fed diet 3 (2.31 ± 0.20) followed by fish on the control diet (2.00 ± 0.08) and the least PER (1.59 ± 0.22) was recorded with fish on diet 1.

The net profit value (NPV), incidence cost (IC) and the gross profit (GP) were all significantly different ($P < 0.05$). The highest NPV was recorded in group fed diet 2 (110.21 ± 9.35) and the least by diet 1 (78.74 ± 13.04). Similar pattern was recorded in the GP, while there was no significant difference

($P > 0.05$) between the control and diet 3, the highest value was recorded by diet 2 (84.62 ± 8.11) and the least by diet 1 (56.43 ± 10.35).

The haematological and biochemical parameters result are reported in Table 4. All the parameters tested for were significantly different ($P < 0.05$) except the white blood cell. The highest packed cell volume was recorded by fish on diet 2 ($37.00 \pm 0.06\%$) and the least by the control ($34.00 \pm 1.00\%$). There was no significant difference ($P > 0.05$) in the red blood cell of fish on diets 1 and 2, though others were significantly different. The highest blood cholesterol and triglyceride (180 ± 0.20 , 197.50 ± 24.5) was recorded by fish on diet 2 respectively, and the least (135 ± 2.5 , 222 ± 10.00) by those on diet 3. Table 5 showed the carcass composition of fish fed graded levels of noodle waste. There was significant difference in the dry matter, crude protein and the ether extract. The fish on diet 2 recorded the highest carcass crude protein (74.12 ± 0.76) followed by diet 3 (73.16 ± 0.35) and the least by diet 1 (68.43 ± 0.01). Similar pattern was recorded for the carcass ether extract, diet 2 recorded the highest (22.67 ± 0.58) followed by diet 3 (22.33 ± 1.15) and the least by diet 1 (21.00 ± 0.32). Though, ether extract content was not significantly different ($P > 0.05$) between the fish fed the control diet, diet 2 and diet 3.

Table 4: Haematological and Biochemical parameters of fish fed graded level of noodle waste

Parameters	Control	Diet 1(10% inclusion)	Diet 2 (15% inclusion)	Diet 3 (20% inclusion)
PCV (%)	34±1.00 ^c	36.50±0.51 ^{ab}	37.00±0.06 ^a	35.50±0.50 ^b
Hb (g/100ml)	10.95±0.35 ^c	11.80±0.20 ^{ab}	12.00±0.20 ^a	11.45±0.15 ^b
RBC	7.40±0.40 ^c	8.50±0.20 ^a	8.65±0.50 ^a	8.05±0.05 ^b
WBC	11000±400	11500±500	10000±1000	12500±1500
CHOLESTEROL	165.50±6.50 ^{ab}	146.5±13.50 ^{bc}	180.00±20.00 ^b	135±10.00 ^{ab}
TRIGLYCERIALDEHYDE	233±11.00 ^a	231±9.00 ^a	197.50±24.5 ^b	222±10.00 ^{ab}

PCV: Packed Cell Volume, Hb: Haemoglobin, RBC: Red Blood Cell, WBC: White Blood Cell

Table 5: Carcass composition of fish fed graded levels of noodle waste

Parameters	Control	Diet 1(10% inclusion)	Diet 2 (15% inclusion)	Diet 3 (20% inclusion)
Dry Matter (%)	27.50±0.44 ^b	26.10±0.10 ^c	25.95±0.82 ^c	28.45±0.11 ^a
Crude Protein (%)	70.40±0.10 ^b	68.43±0.01 ^c	74.12±0.76 ^a	73.61±0.35 ^a
Ether Extract/Lipid (%)	22.88±0.22 ^a	21.00±0.32 ^b	22.67±0.58 ^a	22.33±1.15 ^a

DISCUSSION

The mechanism responsible for the observed differences in carbohydrate utilization is not known. Although the better carbohydrate utilization by fish may be related to differences in their natural diets (Tian *et al.*, 2010). *C. gariepinus* is omnivorous in nature and it feeds mainly on a diet containing some carbohydrate during the fingerling stages, mainly on zooplankton which contains little digestible carbohydrate. The improved weight gain of the fish fed noodle waste may be associated with beneficial effect of pre-treatment of ingredients used in noodle production which resulted in better nutritional value and digestibility (Abdulrashid and Agunmobi 2009). The improved digestibility could be as a result of the inactivation of the anti-nutritional factors, which interferes with the digestive process (Ghazi *et al.*, 2002). Booth *et al.* (2001) reported positive impact of processing conditions on starch digestibility. Lin *et al.* (1997) reported that a better SGR might have partly resulted from better carbohydrate utilization by snakehead fingerling feeding strategy and carbohydrate source. The present SGR values are comparable to those values of Tian *et al.* (2010) when they tested various dietary carbohydrate levels on *Mystus montanus* (a freshwater catfish).

One of the most common difficulties observed when alternative sources of feedstuffs are used in fish diets is acceptance and palatability (Dominguez *et al.*, 2003). However, the observed significant increase in feed intake up to 15% inclusion showed the better palatability of noodle waste to maize and the drop in

feed intake at 20% could be as a result of higher energy value in noodle waste than maize which had the fish consumed less feed. It could also be as a result of better nutritive value which had the fish reduce their feed intake since all nutritional requirements had been met. The result of the feed conversion ratio of *C. gariepinus* fed noodle waste showed a significant superior value at the highest inclusion level to other test diets including the control. This could be attributed to the improvement in the availability and utilization of nutrients in the noodle waste which has been pre-cooked for human consumption.

Blood parameters are considered pathophysiological indicators of the whole body and therefore are important in diagnosing the structural and functional status of fish exposed to toxicants. Haematological characteristics of most fish have been studied with the aim of establishing normal value range and any deviation from it may indicate a disturbance in the physiological process (Rainzapaiva *et al.*, 2000). The values obtained in this experiment for all the parameters tested were within the normal ranges recommended for *C. gariepinus* (Sunmonu, 2008; Adedeji *et al.*, 2009). Although the carcass protein and ether extract increased after feeding the test diets, there was no appreciable change in body composition in all the treatments. Deposition of high lipid content in the fish fed with higher amounts of noodle waste may be due to the availability of sufficient energy in those diets (Habib *et al.*, 1994). A greater percentage of fatty tissue was

found in the fish fed higher dietary carbohydrate levels as reported by Wee and Ng (1986). According to Tian *et al.* (2010) increasing starch content could influence fat deposition in grass carp. The increased carcass protein could be due to effective protein-sparing effect of noodle waste. Tian *et al.* (2010) reported that the optimal feeding strategy could reduce excretory losses of nitrogen, optimize the amount of nutrients and metabolic fuel made available for growth. Previous haematological studies of nutritional effects brought knowledge that erythrocytes, PCV and Hb are major and reliable indicators of various sources of stress (Rainza-Paiva *et al.*, 2000) and these parameters decrease in the presence of anti-nutritional factors (Osuigwe *et al.*, 2007). Increase in all the parameters tested for were however observed in the present study which was contrary to the work of Aderolu *et al.* (2009) when they fed processed cocoyam tuber as carbohydrate source in the diet of juvenile African catfish (*Clarias gariepinus*).

CONCLUSION

Indomie waste is available all year round and the fear of seasonal variation in proximate composition has been eliminated. The result of the present study could not implicate indomie waste as having any negative impact on growth, nutrient utilization, haematology and biochemical parameters, it could therefore be suggested that indomie waste could replace maize in the diet of *Clarias gariepinus* juvenile without any fear or problem.

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