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Effect of substituting Soyabean Meal with Fluted Pumpkin Seed Cake on the Growth and Nutrient Utilization of Heteroclarias (hybrid) Fingerlings in Bali, Taraba State

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Abstract: **A study was conducted to determine the growth performance of hybrid catfish (*Heteroclarias)* fed five iso-nitrogenous (40% CP) diets at varying inclusion levels of *Telfairia occidentalis* (fluted pumpkin) seed cake (FPS). Five diets in triplicate was compounded with same ingredients; fish meal, yellow maize, vitamin /mineral premix, vegetable oil, and starch with varying inclusion levels of *Telfairia occidentalis* (fluted pumpkin) seed cake and soya bean meal (SBM). Diets was designated as D1 (FPC 0% - SBM 100%), D2 (FPC 25% - SBM 75%), D3 (FPC 50% - SBM 50%), D4 (FPC 75% - SBM 25%), D5 (FPC 100% - SBM 0%). The proximate analyses of experimental feeds and fluted pumpkin seed cake were carried out to show any variation present in all parameters. One hundred and twenty *Heteroclarias* fingerlings (mean weight 4.26±0.26 g) were reared in concrete tanks of 2m×2m size. Fish were fed at 5% of their body weight for a period of 90 days. Culture water was monitored and changed every two days while quality parameters (temperature, dissolved oxygen, and pH) was measured fortnightly using standard methods.**

Keywords: **Fluted pumpkin, Seed cake, Growth, Culture.**

I. INTRODUCTION

Fishery is the exploitation of aquatic resources. According to [1], A fishery is typically defined in terms of the people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, purpose of activities or a combination of the foregoing features. The sector remains a major supplier of high-quality animal protein and supports the livelihoods and well-being of more than ten percent of the world's population [1].

Fisheries and aquaculture make reasonable and sustainable contributions to the world's development and prosperity. In the last five decades, world fish food supply has outpaced global population growth, and today fish constitutes an important source of nutritious food and animal protein for much of the world's population. [1]. The sector also provides livelihoods and income, both directly and indirectly, for a significant share of the world's population. Fish and fishery products are among the most traded food commodities worldwide, with trade volumes and values reaching new heights in 2011 and expected to keep on rising, with developing countries continuing to account for the bulk of world exports [2]. While capture fisheries production remains stable, aquaculture production keeps on expanding. Aquaculture is set to remain one of the fastest-growing animal food-producing sectors and, in the next decade, total production from both capture and aquaculture will exceed that of beef, pork or poultry [1]. According to the released data by [3], world aquaculture production of food fish reached 62.7 million tonnes in 2011, up by 6.2% from 59 million tonnes in 2010. Aquaculture contributed 40.1% to the world total fish production and almost all the seaweeds production [3]. The State of World Fisheries and Aquaculture highlights the significant role that fisheries and aquaculture plays in eliminating hunger, promoting health and reducing poverty (Never before have people consumed so much fish or depended so greatly on the

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sector for their well-being) [1]. Fish is extremely nutritious; a vital source of protein and essential nutrients, especially for many low income earners of our global community [2].Fisheries and aquaculture is a source not just of health but also of wealth. Aquaculture has evolved as the fastest growing food producing sector and developed as important component in food security [4]. The main goals of aquaculture industry are to optimize growth and to produce high quality fish [4].

II. MATERIALS AND METHODS

Study area

The research was carried out at The Teaching and Research Farm of the Department of Animal Health and production Technology. Federal Polytechnic Bali, Bali, Taraba State.

Collection and preparation of *T. Occidentalis* (fluted pumpkin) seed cake

Telfairia occidentalis (Fluted pumpkins) was purchased from Jalingo main market, Taraba State, Nigeria. The fluted gourds were dissected to remove the coated seed pods, the pods was broken and the seeds were removed. The seeds were spread in trays of flat surfaces and sun-dried to the minimal

Moisture level. The dried seeds were taken to the laboratory for the extraction of oil; the seed cake were then grinded and mixed with other feed ingredients to make a complete feed.

Diet formulation and preparation

Diets were formulated to contain 40% crude protein using the Pearson's square method. The fluted pumpkin seed cake was incorporated into each of the diets at 0%, 25%, 50%, 75%, and 100% to replace soya bean meal (SBM) in the diets. Diets were designated as D1-D5 depending on the level of inclusion of fluted pumpkin seed cake (FPSC). The diet containing 0% FPSC served as the control. Feed ingredients were weighed according to the percentage composition.

The feed ingredients were milled using a grinding machine and mixed manually (hand mixing). The vitamin and mineral premix added and oil also added to the ingredients and mixed thoroughly. Warm water was added to the premixed ingredients and homogenized before passing it through the pelletized machine. The pelletized feeds was sun dried to a constant weight and kept in an air-tight container prior to use.

Table 1: GROSS COMPOSITION OF EXPERIMENTAL DIETS (%)

Feed Ingredients	Diets D1	D2	D3	D4	D5
FM (72 %)	27.0	27.0	27.0	27.0	27.0
SBM (48%)	27.0	20.25	13.5	6.75	0.0
YM (10 %)	36.0	36.0	36.0	36.0	36.0
FPS (25.2 %)	0.0	6.75	13.5	20.25	27.0
VEG. OIL	3.0	3.0	3.0	3.0	3.0
VITAMIN AND MIN PREMIX	4.0	4.0	4.0	4.0	4.0
STARCH	3.0	3.0	3.0	3.0	3.0
% TOTAL	100.0	100.0	100.0	100.0	100.0

*****Each 5kg of premix contains: vit. A= 20,000,000IU, vit. D3= 2,000,000IU, vi.t E= 200,000mg, vit. K3= 10,000mg, folic acid= 2,000mg, Niacin= 80,000mg, calpan= 25,000mg, vi.t B2= 12,000mg, vit. B12= 9mg, vit. B1= 6,000mg, vit B6= 11,000mg, Biotin= 100mg, Vit. C= 50,000mg, selenium= 100mg, Iodine= 1,000mg, Iron= 30,000mg, Manganese= 50,000mg, copper= 5,000mg, zinc= 30,000mg, antioxidant= 125,000mg.

Experimental design and feeding trials

Hybrid catfish *(Heteroclarias)* fingerlings was purchased from SEBORE FARMS Adamawa State, Nigeria. The fish was acclimatized for 14days, during this period; they were fed the control diet. Prior to the commencement of the experiment, all fish were starved for 24 hours. This practice is to increase the appetite of the fish. The feeding trial was conducted in concrete tanks of 2m×2m. The fingerlings were randomly allotted at the rate of 100 fingerlings per tank into five dietary

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groups designated as D1-D5 with each groups in triplicate. Fish were fed at 5% of their body weight. Feeding was done in the morning between 8:00-09:00 hours and in the evening between 4:00-5:00hours. The experimental period was 90 days.

Weighing of experimental fish

Experimental fish were weighed after acclimatization using an electronic meter machine (Model PB-3002). The weight of fish per tank were recorded. Weighing of experimental fish was done fortnightly throughout the period of experiment. On weighing days, experimental fish were fed after weighing and weighing was done early in the morning (07:00am-09:00am).

The proximate analysis of feed incorporated with the fluted pumpkin seed cake was carried out before the commencement of the feeding trial while that of the fish was carried out at the end of the feeding trial. The following parameters were analysed as shown on table below respectively.

This is the loss in weight that results from drying a known weight of feed sample to a constant weight at 105°C. Clean and well labelled petri dishes that has been oven dried will be weighed as (W1), 5g of the sample will be weighed into the pre weighed dried petri dish as W(2). The petri dishes containing the samples will be transferred into the oven at 105 °C for 3 hours. After 3 hours the petri dishes will be transferred from the oven to the desiccator to cool and will be weighed as (W3). The percentage losses in the weight of the samples during drying will be taken as percentage moisture content, [5].

$$\% \text{ moisture content} = \frac{loss\ of\ weight\ due\ to\ drying}{weight\ of\ sample\ taken} \times 100$$

$$= \frac{W2-W3}{W2-W1} \times 100$$

Ash content

This gives the mineral elements present and the content of organic matter in the feed. Clean and well oven dried crucibles which had been cooled in the desiccator will be labelled and weighed as (W1), 1g of sample will be weighed into the pre-weighed crucible and weighed as (W2). The crucibles will be placed in the muffle furnace and temperature will be increased slowly till it gets to 550 °C. The samples will be left to ash until it becomes whitish in colour. The samples will be removed from the furnace and transferred to the desiccator to cool and will be weighed as (W3), [5].

$$\% \text{ Ash content} = \frac{W3-W1}{W2-W1} \times 100$$

Crude protein content

This is used to determine the amount of nitrogen in the sample; this process involves three stages which are: **Digestion stage, Distillation stage, Titration and Calculation stage.**

0.5g of sample will be weighed into the Kjehdahl digesting flask, 20ml of concentrated H_2SO_4 with Kjehdahl catalyst tablet will be added to the sample and fixed for hours in the digestion unit of Kjehdahl apparatus in the fume cupboard. The digest light green or grey white colour is an evident that the samples have been digested. The digest pure yellow after cooling will change into a colourless liquid and will be transferred into a 100ml volumetric flask and made up to 50ml mark with distilled water. 20ml of 4 % boric acid solution will be pipetted into the conical flask. Three drops of methyl red will be added to the flask as indicator. 5ml of the digest will be made alkaline with 10ml of NaOH (20 %) and distilled. The steam exit of the distillatory chamber will be closed and the change in colour of boric acid solution to green will be timed and made up to 50ml. The filtrate will be titrated against 0.1 HCl and the quantity of acid used will be noted, [5].

$$\% \text{ nitrogen content} = \frac{\text{Titre value} \times \text{molar acid} \times 0.014}{\text{Weight of sample used}} \times \frac{V_1}{V_2} \times 100$$

$$\% \text{ protein} = \frac{\text{titre value} \times 0.1\ HCl \times 0.o4 \times 100 \times 10 \times 6.25}{\text{Weight of sample used}}$$

The crude protein content in fish will be obtained by multiplying the nitrogen content by 6.25. It is assumed that all food protein contains 16% nitrogen, hence 6.25 is a constant, [5].

% crude protein = % nitrogen × 6.25

Crude fibre

2g of the sample will be weighed as (W1) into a 1 litre conical flask and 200ml of 1.25 % of H2SO4 at boiling point will be added and boiled gently for 30 minutes. The mixture will be filtered through muslin cloth and rinsed well with distilled water. The sample will be scraped back into the flask with spatula and 200ml of 1.25 % NaOH (boiling) will be added and allowed to boil gently again for 30 minutes. It will be filtered through muslin cloth and the residue will be washed thoroughly with distilled water and then rinsed ones with 10% HCl. It will be rinsed again twice with ethanol and later rinsed with hexane. Then residue will be scrapped int a crucible, oven dried at 80°C, cooled in the desiccator and weighed as (W2). The residue will be ashed at 300°C in a muffle furnace, cooled and weighed again as (W3), [5].

$$\%\text{Fibre} = \frac{w2-w3}{w1} \times 100$$

Ether extract or Crude lipid

The lipid extraction will be done by soxhlet extractor. Cleaned and dried filter papers will be weighed as W1 and 1g oven dried sample will be added and re-weighed as W2. Round bottom flask will be filled with petroleum ether (40-60 °C) up to ¾ of the flask. Soxhlet extractor will be fixed with a reflux condenser and the source of heat will be adjusted so that the solvent boils gently. The samples will be put inside the thimble and gently inserted into the soxhlet apparatus and extraction under reflux will be carried out with petroleum ether (40-60 °C). After the barrel of the extractor is empty, the condenser and the filter papers will be removed, taken into the oven at 80 °C, for one hour and later cooled in the desiccators and re-weighed as (W3), [5].

$$\%\text{Lipid} = \frac{w2-w3}{w2-w1} \times 100$$

Nitrogen Free Extract (NFE)

This is the difference of the sum of moisture content, ash, crude protein, crude fibre and ether extract from 100. The result or remainder value will give the carbohydrate content of the sample. All the analysis follows the procedure of [5].

% Carbohydrates = (% moisture+ % ash+ % fat+ % protein+ % fibre)

Water quality and management

The water quality was monitored and water parameters (such as temperature, pH, dissolved oxygen and conductivity) was recorded every fortnight before weighing.

1. Water temperature was measured using an electronic thermometer (YSI-DO550 USA)
2. pH value was taken using an electronic pH meter (SEARCHTECH PHX-3C CHINA)
3. Dissolved oxygen values was obtained using an electronic dissolved oxygen meter (YSI-DO-550 USA)
4. Conductivity level was measured using an electronic conductivity meter (SEARCHTECH DOX-307 CHINA)

The culture tanks were washed and culture water was changed every 2 days throughout the experimental period.

Evaluation of growth and nutrient utilization parameters

Growth and nutrient utilization parameters was assessed in terms of body weight gain (BWG), Percentage weight gain (PWG), Specific growth rate (SGR), Food conversion ratio (FCR), Survival rate (SR), and Protein efficiency ratio (PER). The following formulas were used:

Mean Weight Gain (MWG)

MWG=final mean weight-initial mean weight

Percentage Weight Gain (PWG)

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PWG= mean weight gain × 100

Specific Growth Rate (SGR)

$$\mathbf{SGR} = \frac{final\ weight - initial\ weight}{T} \times 100$$

Where: T= Period of experiment

Feed conversion ratio (FCR)

FCR= Total feed consumed (g)

$$\frac{Total\ feed\ consumed(g)}{Weight\ gain\ (g)}$$

Survival rate (SR)

$$\mathbf{SR=} \frac{number\ of\ fish\ at\ the\ end\ of\ experiment}{number\ of\ fish\ at\ the\ onset\ of\ the\ experiment} \times 100$$

Protein efficiency ratio (PER)

$$\mathbf{PER=} \frac{fish\ weight\ gain}{Protain\ gain}$$

III. RESULTS AND DISCUSSION

Table 2: Proximate composition analysis of T. occidentalis (fluted pumpkin seed cake) (%)

S/N	M	A	P	F	L	C
1.	27.07	2.98	18.15	10.80	5.23	35.77
2.	17.17	3.15	21.18	10.53	5.56	42.41
3.	19.20	3.73	22.60	11.20	5.84	37.43
4.	12.14	3.52	22.18	11.77	4.52	45.87
5.	7.96	3.90	24.20	12.00	6.30	45.64

M-Moisture Content, A-Ash content, P-Crude Protein, F-Crude Fibre, L-Crude Lipid, C- Carbohydrate

Table 3: effects of substituting soyabean meal with pumpkin seed cake on the growth of Heteroclarias (Catfish).

Parameters	Treatments				
	D1 FPC 0% - SBM0%	D2 FPC 25% - SBM 75%	D3 FPC 50%- SBM 50%	D4 FPC 75% - SBM25%	D5 FPC 100%- SBM 0%
Final no of Fish	29[a]	29[a]	30[a]	30[a]	29[a]
Total Feed Consume	2775.0b	3705.0a	2750.0c	2775.0b	2562.0d
Final weight gain	2502.7e	4700.0a	4004.0d	4400.0b	4404.0e
Initial weight gain	2122.5c	2492.2a	2002.4d	2182.0b	1850.0a
Feed % protein	18.15e	21.18d	22.6b	22.18c	24.2a

FPC – Fluted Pumpkin Seed Cake SBM – Soya Bean Meal

The table above depicts the effects of substituting soyabean meal with pumpkin seed cake on the growth of Heteroclarias (catfish). The study considered five parameter on five treatments. The results revealed that, the survival rate of the catfish up to consumable stage did not differ among the treatments. In parameter 2 the total feed consumed D2 was significantly ($P<0.05$) higher weights, but D4 and D5 did not differ from each other. D3 and D5 were significantly ($P<0.05$) affected by the diet differences.

Initial weight gain (IWG) also differs ($P<0.05$) significantly among the treatments, where D2 displayed higher (4700.0g), mean growth weight. This was followed by those in D4 (4400.0g), compared D1, D3, and D5 respectively. Similarly final weight gain (FWG) showed significant difference across the treatments. D2, appear to give higher (2472.2g) gain compared to the rest of the treatments. However, D2 appeared to respond to all the diets, except in feed percentage protein where treatments responded higher (22.10g) than any of the treatments.

IV. CONCLUSION

The experiment was aimed at evaluating the effect of substituting soyabean meal with fluted pumpkin seed cake on the nutrient utilization of Heteroclarias (hybrid) fingerlings. Besides, Conventional fish meal can be substituted with pumpkin seed cake at 36% without negative effect on the water quality.

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