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EFFECT OF DIETARY *Brassica oleracea* ON GROWTH PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF *Oreochromis niloticus* FINGERLINGS

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ABSTRACT

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The effect of cabbage, Brassica oleracea leaf powder on growth performance, body composition and haematological profile was investigated in Oreochromis niloticus (Nile Tilapia). Fingerlings weighing between 7.55-7.59 g were fed diets supplemented with five concentrations (0.00, 0.50, 1.00, 1.50, 2.00 g^{-1} 100g) of cabbage powder for 56 days. Fish fed supplemented diets showed significant difference ($p<0.05$) in body weight increase and final weight gain. The highest specific growth rate (1.02±0.03% per day) and best feed conversion (1.17±0.03) was recorded in with fish fed 0.05 g per 100g B. oleracea powder diet. No significant difference ($p>0.05$) occurred in the fish carcass moisture, ash, crude lipid and crude protein content among the treatments. There was significant difference ($p<0.05$) in the white blood cell, red blood cell, packed cell volume and haemoglobin counts across the treatment. The results suggest that the inclusion of B. oleracea can improve the nutrient efficiency, growth performance and haematological parameter of O. niloticus fingerlings without negative effects on the fish.

Keywords*: Brassica oleracea, growth performance, oreochromis niloticus*

INTRODUCTION

Nutrition of fish is an important consideration in fish health management of farmed finfish and shellfish (FAO, 2014). The use of nutritionally inadequate feeds can result in reduced growth and production due to stress, loss of fish from nutritional deficiency and from mortality brought on by increased susceptibility of nutritionally compromised fish to infectious diseases (Asimi and Sahu, 2013). With nutritionally balanced feeds, fish might not be able to make use of all nutrients in the feeds. The use of herbal plants and supplements has been tested in aquaculture as an alternative to chemicals to boost feed efficiency in animals in recent years. Plants are natural source of safer and cheaper chemicals. Beneficial effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune responses and antibacterial, antiviral and antioxidant actions (Citarasu, 2010). Natural plant products present a viable supplement in the fish feed for better growth, health and production. Importance of herbal products in aquaculture operations includes growth promoting ability, improvement of immune system, appetite stimulators, increase feed consumption, induce maturation, antimicrobial and anti-stress characteristics that will be of immense use in the culture of fishes (Citarasu *et al.*, 2001; 2002). The use of herbal plants as additives in animal feeds is generating more interest. Herbal products are added in animal feeds to stimulate or promote the effective use of nutrients in the feeds, improve weight gain and feed efficiency in cultured fish (Ghazalah and Ali, 2008; Dada, 2015; Dada, 2017).

Brassica oleracae var. *capitata L.* is an herbaceous green leafy vegetable belonging to the *Brassica* genus, of the *Brassicaceae* family with several other crop species including Brussels sprout, broccoli, cauliflower, kale and kohlrabi (Katz and Weaver, 2003). It has a defined taste and crunchy texture, with a characteristic compact head in which the leaves snug against each other and colours ranging from pale or light green to dark green (Dixon, 2007). *Brassica oleracea* has become established as an important human food crop plant, used because of its large food reserves, which are stored over the winter in its leaves. It is rich in essential nutrients including vitamin C. Cabbage is fairly low in calories, a good source of many minerals (particularly potassium, and relatively high in vitamins A and C, but is also low in protein content (Bewick 1994). It was for this reason that the effect of cabbage (*Brassica oleracea*) on the feed efficiency, growth performance and hematological parameters of *Oreochromis niloticus* was studied.

MATERIALS AND METHODS

Brassica oleracea leaves were purchased from a market in Akure, Ondo State. The outer layer of the vegetable was removed while the other leaves were sliced into short strands. The leaves were dried in a clean tray and sun-dried for five days between the hours of 0900-1700. The dried leaves were ground into fine powder. Amounts of 0 (control), 0.5, 1.0, 1.5 and 2.0 g^{-1} 100g of basal feed were measured and added to a basal feed of 33.75% Crude protein. The basal feed contains fish meal, soyabean meal, corn meal, cod liver oil, vegetable oil, vitamin/mineral premix. All ingredients were milled into small particle size and weighed with a sensitive weighing balance (Metler Toledo PB 8001 London). The ingredients were thoroughly mixed in a Hobart A-2007 pelleting and

mixing machine (Hobart Ltd, London, UK) to obtain a homogenous mass, and corn starch was added as a binder. The resultant mash was pressed out through a 2mm die which was attached to the pelleting machine. The pelleted feeds were sun-dried at ambient temperature (27-30^{0}C) for two days and kept in a polythene bag with the mouth tightly tied.

Experimental set-up and experimental fish

15 plastics tanks (60 litres), each filled with 50 litres of fresh water (water temperature 28.66±0.81 °C, dissolved oxygen 4.55±0.16 mg l^{-1}, pH 7.16±0.01 and conductivity 21.03±0.34 µS cm^{-1}). 150 fingerlings of *Oreochromis niloticus* (7.55 – 7.59 g) were obtained from the fish farm of the Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure. The fish were acclimated to laboratory conditions for 7 days. 10 fish were randomly distributed into the 15 tanks each representing five dietary treatments in triplicates used for the experiment (0.00, 0.50, 1.00, 1.50, 2.00g of *B. oleracea* per 100g of diets). The experiment was conducted in triplicates. Fish were fed at 5% body weight twice daily between 0800 and 1600 hours. The faecal and feed wastes were siphoned every two days before feeding using a siphoning hose. The fish were weighed fortnightly and feed rate adjusted accordingly.

Table 1: Ingredients (g per 100g) and proximate composition (%) of Feed ingredients

Ingredients	Experimental diets				
	D1	D2	D3	D4	D5
Fish Meal (72% CP)	15.0	15.0	15.0	15.0	15.0
Soyabean Meal (48%CP)	45.0	45.0	45.0	45.0	45.0
Corn Meal (10%CP)	25.0	24.5	24.0	23.5	23.0
Cod Liver Oil	4.0	4.0	4.0	4.0	4.0
Vegetable Oil	6.0	6.0	6.0	6.0	6.0
Vitamin/Mineral Premix*	3.0	3.0	3.0	3.0	3.0
Corn Starch	2.0	2.0	2.0	2.0	2.0
Brassica oleracea powder	0.0	0.5	1.0	1.5	2.0
Proximate Composition (%)					
Moisture	7.0	7.3	8.3	9.0	7.8
Ash	9.0	10.0	11.0	11.0	11.0
Ether Extract	22.0	20.0	22.0	22.0	20.0
Crude Protein	34.9	34.9	34.8	34.8	34.7
Crude Fibre	2.0	3.0	2.0	2.0	4.0
NFE	25.1	24.8	21.9	21.2	22.5

*****Vitamin/Mineral Premix- An Hi-Mix product premix

The experiment lasted for 56 days. At the end of the experimental period the following growth and feed utilization parameters were calculated: weight gain (WG), specific growth rate (SGR), food conversion ratio (FCR) and protein efficiency ratio (PER) using the formula described by Heidarieh *et al.* (2012) and mortality were recorded accordingly.

Weight gain (WG) =Final average weight (g) – initial average weight (g)

Specific growth rate-SGR (% per day) = $\frac{\ln Wf - \ln Wi}{days} \times 100$

Where,

Wf is mean final weight and *Wi* is mean initial weight

Feed conversion ratio (FCR) = $\frac{\text{Total feed intake}}{\text{Total weight gained}}$

Protein efficiency ratio (PER) = $\frac{\text{live body weight gained (g)}}{\text{protein intake(g)}}$

Where,

Protein Intake (g) = Protein (%) in feed □ □Feed given (g)/ 100

Survival rate (%) = $\frac{\text{number of fish survived}}{\text{number of fish stocked}} \times 100$

Twelve fish (four fish per replicate) were used for blood analysis and 5ml blood samples from each treatment were collected by cardiac puncture using a 5ml disposable syringes, into treated Bijou bottles. The blood was stored at -40^{0}C prior to analysis. The blood analysis followed the method described by Svobodova *et al.* (1991)

Statistical analysis

Analysis of variance (ANOVA) was used at 95% significance level to test for significant differences between the various treatment means obtained for the growth, survival rate, feed conversion ratio, protein efficiency ratio and carcass composition using the Statistical Package for Social Sciences (SPSS). Duncan's multiple range tests was used to determine which pairs of the treatment means differed significantly.

RESULTS AND DISCUSSION

The best growth response was recorded in the fish fed with diet 2 (0.05g of *B. oleracea* powder per 100g of feed) while the least growth was recorded in the fish fed diet 5 (Table 2). There was significant difference (P<0.05) in

SGR among the treatment. There was increase in the feed conversion ratio (FCR) across the diet as the inclusion level of *B. oleracea* increases. The average FCRs were 1.17, 1.33, 1.40, 1.47 and 1.57 for Diets 2,1,3,4 and 5 respectively. The PER was 0.46, 0.48, 0.50, 0.54 and 0.60 for the fish fed diets 5, 4, 3, 1 and 2 respectively (Table 2). Fish fed diet 3 had the highest carcass crude protein content of 55.10±0.51 while the lowest of 53.03±1.01 in fish fed diet 2 (Table 3).

Table 2: Mean growth performance and feed utilization of *O. niloticus* fingerlings fed the experimental diets for 56 days

Parameters	Dietary treatments				
	D1(Control)	D2	D3	D4	D5
Survival (%)	80 (10.00)bc	100 (0.00)a	80(5.77)bc	76.67(3.33)c	96.67 (3.33)ab
Initial mean weight (g)	7.55 (0.00)b	7.59 (0.01)b	7.55 (0.01)b	7.58 (0.01)ab	7.58 (0.01)ab
Final Mean Weight (g)	12.58 (0.43)b	13.45 (0.17)a	12.18 (0.10)bc	11.98 (0.15)bc	11.64 (0.08)c
Mean Weight gain (g)	5.03 (0.43)b	5.87 (0.19)a	4.63 (0.89)bc	4.40 (0.15)bc	4.07 (0.09)c
SGR (% per day)	0.91 (0.06)ab	1.02 (0.03)c	0.86 (0.01)bc	0.82 (0.03)bc	0.77 (0.02)c
FCR	1.33 (0.09)b	1.17 (0.03)c	1.40 (0.02)ab	1.47 (0.04)ab	1.57 (0.03)a
PER	0.54 (0.03)a	0.60 (0.02)b	0.50 (0.01)bc	0.48 (0.01)c	0.46 (0.01)c
Feed intake (g per fish)	6.70 (0.15)ab	6.85 (0.04)a	6.50 (0.03)bc	6.46 (0.03)bc	6.37 (0.02)c

Values in parentheses are standard errors of means. Means in a given column with the same superscript were not significantly different at $p<0.05$
SGR=Specific growth rate, **FCR**=Feed conversion ratio and **PER**=Protein efficiency ratio

The significant difference ($P>0.05$) recorded in the growth and nutrient utilization indices of fish fed dietary *B. oleracea* powder showed that the inclusion level of the powder has effect on the parameters measured. *B. oleracea* powder increased the growth at 0.50g/100g inclusion compare to the control. As *B. oleracea* powder inclusion increase there was a gradual reduction in weight gain, protein intake and protein efficiency ratio. This might have resulted because of the anti-nutritional factors in the *B. oleracea* powder. According to Ogbede *et al.* (2015), *B. oleracea* powder contained a high level of oxalate. This might be responsible for the reduction in PER, PI, and WG. The use of herbal plants in aquaculture has been increasing rapidly for such different purposes as prevention of diseases and reduction in the application of antibiotics (Sakai, 1999). There was a general White blood cell counts in this present study are higher than the result of Dada and Abiodun (2014) who used *Telfaria occidentalis* extract powder in the diet of *O. niloticus* Haemoglobin which is the oxygen carrying component of red blood cells was highest in fish fed diet 2 (0.05g/100g of *B. oleracea* powder). Differences in the haematological indices in this study could therefore be attributed to the differences in dietary inclusions of *B. oleracea* powder in the diets and initial weight of fish used (Ali *et al.,* 2003). Results showed that the choice of herbal plant and dose have a very great effect on their efficiency on the fish (Citarasu, 2010). There was an increase in the red blood cell count of fish fed diet 2 which might have resulted as a result of increase in the packed cell volume (PCV). The body composition values obtained in this study is similar to the results reported by Dada and Abiodun (2014).

Table 3: Chemical composition of whole body of *O. niloticus* fed with experimental diets

Composition (%)	Experimental diets				
	D1(Control)	D2	D3	D4	D5
Moisture	7.30 (0.35)a	7.17 (0.27)a	6.70 (1.55)a	7.23 (0.53)a	8.67 (0.40)a
Crude protein	54.23 (0.02)a	53.03 (1.01)a	55.10 (0.51)a	53.47 (2.24)a	53.20 (3.18)a
Crude Lipid	4.67 (0.67)a	6.00 (1.15) a	4.67 (0.67) a	5.33 (2.40) a	4.67 (0.67) a
Ash	26.33 (2.41) a	28.00 (0.58) a	29.33 (1.20) a	26.33 (0.67) a	28.00 (2.08) a
NFE	7.47 (2.51)a	5.00 (0.56)b	4.20 (1.11)ab	7.64 (0.66)a	5.46 (2.64)ab

Means in a given column with the same superscript were not significantly different at $p<0.05$

CONCLUSIONS AND RECOMMENDATIONS

This study established the efficiency of *B. oleracea* powder at 0.5g/100g of feed which favours growth, body composition, survival rate and haematological indices. Since *B. oleracea* contains high nutrients and anti-nutrients, it is important to know the method to reducing the ratio of nutrient to anti-nutrients components to provide beneficial effects to the body without decreasing nutrients bio-availability. It suggests that the inclusion of *B. oleracea* powder at the 0.5g/100g in the diet of Nile tilapia would improve the feed utilization and non-specific immune infections.

Table 4: Some Haematological parameters of *O. niloticus* fed the experimental diets

Blood Parameters	Experimental diets				
	D1 (Control)	D2	D3	D4	D5
PCV (%)	21.67 (0.88)b	27.00 (0.58)a	27.00 (1.53)a	22.33 (2.33)b	24.00 (0.58)ab
RBC ($x10^6$/µl)	1.25 (0.20)b	2.24 (0.26)a	2.12 (0.31)a	1.34 (0.39)b	1.73 (0.48)ab
WBC ($x10^6$/ µl)	79.67 (0.24)b	118.33 (2.85)a	107.67 (7.88)ab	82.33 (22.17)ab	95.33 (4.06)ab
Hb (g/100ml)	7.17 (0.24)b	9.23 (0.12)a	8.97 (0.52)a	7.33 (0.78)b	8.23 (0.12)ab

Figures in each row having the same superscripts are not significantly different at P<0.05
Key: PCV: Packed cell volume, RBC: red Blood Cell, WBC: White Blood Cell, Hb: Haemoglobin estimation

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