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Supplementation of date palm (*Phoenix dactylifera*) seed as feed additive in the diets of juvenile African catfish

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Abstract

The present study was conducted to examine utilization potential of date palm seed (DPS) as feed additive in the diet of African catfish Clarias gariepinus for improved fed utilization. A total of 150 African catfish (weight ranged from 81.1 to 91.3 g) were divided into five experimental groups. The experiment was conducted for 70 days. Experimental diets were identical in all composition except for the variation in DPS inclusion level. Non-inclusion of DPS was used at 0% (control) and other levels are 0.5% (diet 2), 1.0% (diet 3), 1.5% (diet 4) and 2.0% (diet 5). Growth performance and nutrient utilization of African catfish including Weight Gain (WG), Specific Growth Rate (SGR), Protein Efficiency Ratio (PER) and Protein Productive Value (PPV) were significantly (P<0.05) higher than those of fish fed control diets, where DPS supplementation at 1.5% appears to be generally higher than other levels. In the same trend fish fed diets with DPS supplementation produced improved fish carcass values and the haematology of fish was generally better from diets in all DPS fed fish. Overall production performance and subsequent fish quality assessments indicated that the diets containing 1.5% DPS level recorded the best performance in fish compared to other levels including the control diet. Based on the result of the present study, it is concluded that date palm seed supplementation positively influenced growth performance and feed utilization of African catfish as well as ensuring their healthy status.

Keywords: date palm seed, C. gariepinus, supplementation, feed additive, diets.

Introduction

African catfish (*Clarias gariepinus*) is a highly valued and widely cultured finfish species in Africa such as Egypt, Ethiopia, Ghana, Mali and Nigeria) and Asia (China, Indonesia, Malaysia, Philippines and Thailand (Haylor, 1993). The African Catfish is considered one of the best suitable alternatives to tilapia for subsistence fish farming in Africa due to its high productivity under ponds production systems as well as its ability to convert low grade feed made of local agricultural by-products (Hogendoorn, 1983; Sule and Sotolu, 2010). In addition to high growth rate ability, African catfish is known to be disease resistance and can tolerate adverse environmental conditions such as temperature, dissolved oxygen and high salinity levels (Huisman and Richter, 1987; Haylor, 1993). The superior performance of *C. gariepinus* compared to other *Clarias* species in terms of growth rate has probably contributed to the fact that *C. gariepinus* has been widely introduced to areas outside its natural range (Verreth et al., 1993). The excessive use of drugs as either prophylactic or therapeutic treatment against bacterial diseases in aquaculture, have resulted to an increase in antibiotic-resistant bacteria (Teuber, 2001). In recent years, there has been increase in the use of organic-based plant by-products like *Azadirachta indica* leaf extract as component of fish diet in order to fortify fish health status (Harikrishnan et al., 2003). Some of the merits of using such plant materials are possession of antibiotics properties for therapeutic remedies, they are relatively available and they do not impacting residual effects on the fish thereby ensuring human food safety as reported by Teuber (2001). The present study was conducted to determine the effect of date palm seed (DPS) as nutrient additive in the **utilization** and performance of *C. gariepinus* for healthy fish production.

Materials and Methods

- **Experimental fish and culture technique.** The present study was conducted at the Nasarawa State University, Fish Farm Lafia campus. African catfish were obtained from the farm's hatchery section. Average initial body weight of experimental fish ranged from 86.50 to 91.40g. A total of 150 juveniles of African catfish were equally divided into 5 treatments in triplicate groups given rise to fifteen (15) experimental units. Fish were carefully

stocked into 15 concrete tanks of 1.44m³ each. The fish were allowed to acclimatize for 14 days prior to the commencement of the feeding trial when they were all fed the same commercial diet 5% of their body weight that was split into three feeding regimes per day. Following this was the 10-week feeding trial proper during which the tanks were supplied with freshwater from well to maintain good culture media. Water level was reduced in all tanks by one-third and replaced by fresh water in order to achieve recommended acceptable limits for good fish culture according to APHA (1989). During the feeding trial, water temperature and Dissolved Oxygen (DO) were measured using a pH meter and oxygen meter of the YSI model 56 while ammonia and alkalinity were measured on weekly intervals. Dietary treatments were administered in triplicates at 3% body weight of fish for 10 weeks and fish were fed in three regimes daily at 0900, 1200 and 1500hrs.

- **Experimental diets.** Table 1 presents the five isonitrogenous and isocaloric diets that were formulated for the purpose of the experiment. The control diet had no date palm seed (Diet 1) while the other four diets contained DPS at 0.5, 1.0, 1.5 and 2.0% in succession to make diets 2, 3, 4 and 5 respectively. Fishmeal, soybean meal (SBM), wheat bran and indomie waste were use in the preparation of the diets. Date palm was obtained from Lafia central market and was processed to get dried seed separately from the whole fruit as described by Sotolu et al. (2011). The experimental diets were processed by blending the processed ingredients into homogenous mixture and then passing the mixture through a laboratory pellet mill of the California Pellet Mill Co., San Francisco, California, USA. The *proximate composition* of experimental diets as analyzed using the methods of AOAC (2000) is shown in Table 1.

Table 1: Proximate analysis of experimental diets (% dry matter).

Ingredients (%)	Control	0.5% DPS	1.0% DPS	1.5% DPS	2.0% DPS
Crude protein (%)	39.6	39.6	39.5	39.6	39.5
Lipid (%)	5.75	5.82	5.72	5.48	5.86
Ash (%)	13.0	13.6	12.0	13.6	13.6
Crude fibre (%)	3.71	4.21	3.00	3.15	3.46
Ether extract (%)	30.5	31.7	30.6	30.1	30.8
Gross energy Kcal/Kg	2963	2988	2980	2994	2987

Biomix fish vitamin/mineral providing per kg of diet at 5kg per ton inclusion: 20,000 iu, vitamin A, 200 i.u, α-tocopherol acetate 400mg, vitamntin C 100mg, Vit. D3, 200 mg Vit E, 8 mg Vit k3, 20mg Vit B1, 30 mg Vit B2, 12 mg Vit B6, 50 mg Pantothenic acid, 0.8 mg Biotin, 150 mg Niacin, 0.05mg Vit B12, 4.0mg Cobalt, 40 mg Iron, 5.0 mg Iodine, 30 mg Manganese, 4 mg Copper, 40 mg Zinc, 0.2 mg Selenium, 100 mg Lysine, 100 mg Methionine, 100 mg Anti-oxidant.

- **Data collection and analysis.** A sample of 10 fish was taken for determination of proximate composition (initial carcass value) of the experimental fish since. Five (5) fish were sampled for the final carcass composition at the end of the experiment. Fish were killed with an excess concentration of anesthetic (t-amyl alcohol) and then weighed. The fish were then pooled per treatment for chemical analyses. The pooled fish samples were sundried for five days on treatment basis and finely ground in a Thomas Wiley miller. Chemical analysis of diets and fish carcass composition was done for crude fiber, ash, **crude protein**, lipid as well as gross energy content.
- **Determination of fish performance.** Mean fish weight per treatment was determined by dividing total weight (g) of fish in each pond by number of fish in each pond and recorded in triplicates. Weight gain (WG), specific growth rate (SGR), feed conversion efficiency (FCE), protein efficiency ratio (PER), protein productive value (PPV), and energy retention (ER) were calculated using the following equations: WG = Final body weight (g) – initial body weight (g); SGR = [(ln FBW – ln IBW) x100] period day^{-1}; where FBW= final body weight (g), IBW = initial body weight (g) and ln = natural logarithim; FCE was calculated as: feed intake (g)/wet weight gain (g); PER was calculated as: Wet weight gain (g)/protein intake (g) where protein intake= Feed fed X crude protein of the feed; PPV as (retained protein/protein intake) x 100.
- **Haematological study.** Haematological analysis of fish was carried out according to laboratory standard procedures of Svobodova et al. (1991), and Wagner et al. (1997). Initial blood samples were taken before the start of the feeding trial while the final blood samples were taken from the experimental fish at the end of the experiment, all in triplicates. The haematological indices which include; mean cell hemoglobin concentration (MCHC), mean cell volume (MCV), mean cell hemoglobin (MCH) were calculated using the total red blood cell count (RBC) and hemoglobin concentration (Hb) using the methods of Dalcie and Lewis (2001). Statistical analysis: Fish growth performance, feed utilization efficiency and carcass chemical composition were statistically compared using a one-way ANOVA ($p \leq 0.05$) and significant differences among treatment means were identified using the SPSS version 10.0 for windows as described by Steel et al. (1997).

Results

Fish exhibited 100% survival rate in al treatments as no mortality was observed during the 70-day feeding trial of dietary date palm seed (DPS) supplementation. All water quality parameters assessed during the study were within the acceptable range for the culture of African catfish. The water temperature ranged from 26.8 to 29.5°C, dissolved oxygen (DO) from 5.0 to 6.5 mg L^{-1} and pH from 6.4 to 8.0. Tables 2 and 3 show fish performance during the study.

Table 2: Nutrient utilization assessment of African catfish after 70-day feeding trial.

Parameters	Control	0.5% DPF	1.0% DPF	1.5% DPF	2.0% DPF	SEM
Initial body wt. (g fish^{-1})	91.40	88.40	86.50	89.20	91.20	–
Final body wt. (g fish^{-1})	154.11^{a}	154.30^{a}	164.48^{b}	170.53^{b}	172.87^{b}	8.62
Weight gain ((g fish^{-1})	62.71^{a}	75.90^{b}	77.98^{b}	81.33^{c}	81.67^{c}	1.3
Total Feed intake (g)	97.12^{a}	99.74^{a}	96.00^{a}	97.15^{a}	99.17^{a}	3.7
SGR (% day^{-1})	0.75^{a}	0.80^{b}	0.92^{c}	0.93^{c}	0.91^{c}	0.21
FCE	0.65^{a}	0.76^{b}	0.81^{c}	0.84^{c}	0.82^{c}	0. 12
PER (x10^{-2})	1.63^{a}	1.92^{b}	2.08^{c}	2.12^{c}	2.08^{c}	0.04
PPV (x10^{-3})	2.15^{a}	2.02^{a}	2.51^{c}	2.35^{b}	2.24^{b}	0.11
Survival (%)	100	100	100	100	100	–

Mean values on the same row with the same superscript are not significantly different (p >0.05).

Table 3: Carcass and haematology composition of catfish fed date palm seed (DPS) supplementation for 70 days.

Parameters (%)	Initial value	Final fish carcass value at different percent of DPS supplementation					SEM
		Control	0.5%	1.0%	1.5%	2.0%	
Crude protein	54.16^{a}	62.44^{b}	62.13^{b}	63.60^{c}	63.19^{c}	62.92^{c}	0.24
Lipid	4.27^{a}	5.93^{c}	4.22^{a}	5.98^{c}	4.83^{b}	4.96^{b}	0.19
Ash	11.14^{b}	11.02^{b}	10.94^{a}	10.86^{a}	11.60^{b}	10.80^{a}	0.50
Crude fiber	ND	ND	ND	ND	ND	ND	-
Moisture	5.93	5.58	5.73	5.59	5.87	5.59	0.14
NFE	24.50^{b}	15.03^{a}	16.98^{a}	13.97^{a}	14.51^{a}	15.73^{a}	3.59
Hematocrits							
PCV (%)	22.21^{a}	24.44^{b}	25.26^{b}	25.28^{c}	25.78^{b}	25.50^{b}	1.35
HB (g/dl)	5.27	5.42	5.66	5.65	5.74	5.71	0.07
RBC (x10^{12} /l)	1.53^{a}	1.63^{b}	1.64^{b}	1.66^{c}	1.64^{b}	1.66^{c}	3.20
WBC (x10^{9}/l)	130.37^{a}	131.12^{a}	132.57^{b}	135.85^{c}	136.19^{c}	136.35^{c}	0.06
MCV (fl)	145.16^{a}	144.77^{a}	148.20^{b}	149.26^{b}	150.20^{b}	148.10^{b}	3.82

ND – Not detected. Mean values on the same row with the same superscript are not significantly different (p >0.05).

Discussion

The positive trend in the nutrient utilization efficiency (FCR) demonstrated by fish on DPS supplementation could be an indication that date palm seed possess the ability to aid digestion of feed for effective utilization without any detrimental effects. Nutrient utilization efficiency had been attributed to the ability to digest feed well which in turn creates positive influence on growth rate in juvenile carp as revealed by Noh et al. (1994) and Bogut et al. (1998). The work of Mostafa and Ahmad (2009) on the use of dried fenugreek seed as feed additives in Nile tilapia diets further revealed the potential of plant-based material as feed additives for aquaculture purpose which is in line with the earlier submission of Magi and Sahk (2003) that plant additives sources are capable of improving fish performance. The improved growth rate and nutrient utilization demonstrated in the present study could be due to the presence of a range of relevant digestive enzymes in date palm seed (Pascual et al., 2000). Enzymes such as amylase, protease and phytase would enhance growth performance consequent to higher nutrient digestibility and effectiveness of gastrointestinal activities as earlier stated by Al-Qarawi et al. (2003). The improved growth and feed utilization efficiency seen with the DPS supplemented diets is however in contrast to the reports of Gildberg et al. (1995) and Efthimiou (1996) regarding the non influence of probiotics supplementation on growth performance in Atlantic salmon fry and dentex, respectively. Also, Shariff et al. (2001) and McIntosh et al. (2000) found that treatment of commercial probiotic supplementation did not differ significantly ($p \geq 0.05$) when considering either survival or growth rate in *P. monodon* and *L. vannamei*. With respect to survival rate, experimental catfish survival rate was 100% by the end of the feeding trial. This observation may be due to the fulfillment of dietary requirement and healthy fish used in this experiment and favourable experimental conditions. *C. gariepinus* is an omnivore that is capable of efficiently digesting and utilizing diverse feeds and ingredients of both plants and animal origin (Sotolu and Faturoti, 2011). The positive effect of DPS supplementation in the final fish carcass value followed the trend in fish SGR, FCR, PER and PPV since nutrient utilization consequent to high digestibility value has been directly linked with final fish carcass composition (Sotolu and Sule, 2011). These results may be supported by the postulation from Lara-Flores et al. (2003) who found that the Protein Efficiency Ratio and Apparent Protein Utilization recorded the best values with probiotic-supplemented diets in fish as feed additive. Haematology indices are index and reflection of the effects of dietary treatments on the animal in terms of the type, quality and amounts of the feed ingested and available for the animal to meet its physiological, biochemical and metabolic necessities (Ewuola et al., 2004). The observed improvement in the values of most blood parameters assessed (PCV, Hb, Rbc and Wbc) although non-significant difference between them, it could serve as indication that it can be included in fish diet to prevent anaemic condition. This observation is similar to the reports of Al-Maiman (2005) that observed favourable effects of fibers of date palm seed (*Phoenix dactylifera*) on plasma lipids in rats and Harikrishnan et al. (2003) on Cyprinus *carpio*, following herbal treatment. In the study by Mostafa and Ahmad (2009) it was further ascertained that use of plant-based feed additive (fenugreek seed meal) is capable of improving blood parameters which is attributed to a shift of water from the plasma to the muscle cells, thereby increasing the hematocrit concentration.

Conclusion

The present study revealed that utilization of date palm seed as a feed additive is capable of improving fish growth perf mance and nutrient utilization as well as ensuring production of healthy fish on sustainable basis. Supplementation of DPS 1.5% level as feed additive is recommended in catfish feeding for improved fish performance.

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