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Evaluation of pineapple crush waste meal as an energy feedstuff in the diets of tilapia, *Oreochromis niloticus*

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Abstract

Pineapple crush waste (PCW) was used to replace maize as energy source in the diets of Tilapia, Oreochromis niloticus. Five diets (31.54 – 32.51% crude protein) were formulated in which yellow maize was replaced at varying level with pine apple waste as follows: Diet 1 (100% yellow maize), diet 2 (75% yellow maize,25% PCW), diet 3 (50% yellow maize, 50% PCW), diet 4, (25% yellow maize, 75% PCW), diet 5 (100% PCW). Growth performance of fish was highest in diet 4 for all investigated growth parameters such as average daily growth (0.73g), final body weight (76.21g) and protein efficiency ratio (2.02). Differences in FCR and PER were not significantly different between all diets. Diet 5 with 100% PCW had the least growth performance. Results from the study showed that PCW was better utilized by tilapia fish when the level of its replacement was either equal or slightly higher than that of yellow maize. Tilapia fish did not thrive well when the maize in practical diets was replaced completely with PCW.

Keywords: Pineapple crush waste, energy, aquaculture, maize, tilapia, growth.

Introduction

Entrepreneurs are exploring ways to farm tilapias by high-cost intensive culture using complete feeds, to satisfy rising demand for high quality fish in the developing countries. Fish feeds accounts for over 60% of the variable costs of a fish farm enterprise. Intensification of fish production through aquaculture in Nigeria is however greatly hampered by inadequate supply of balanced diets (Falaye, 1992, 1998). This is largely due to the scarcity and escalating costs of most conventional animal feed ingredients. There is thus a need to search for cheaper alternative nutrient sources to enhance fish culture development in the country. The use of cheaper feedstuffs and agro-industrial by-products had shown good potentials in terms of their nutrient supply as well as reduction in feeding costs.

In many developing countries, the conventional source of energy in fish diets is either maize or other carbohydrate-rich energy feedstuffs (cassava, sorghum, rice). Such ingredients are also usually the major sources of energy for the human population living in these regions of the world (Fagbenro, 1995). Pine apple (*Ananas conosus),* a native to southern Brazil and Paraguay, is grown in all the agricultural zones of Nigeria and it is a major fruit in the fruit juice processing industries. Over the past 100 years, the pineapple has become one of the leading commercial fruit crops of the tropics. During the processing and extraction of juice, a large amount of waste is generated which are discarded, thus becoming pollutants in the water and even in the environment. The major concern for aquaculture is to improve the ratio of tilapia production to food input. This study evaluated the potentials of pineapple crush waste meal as energy food for tilapia, *Oreochromis niloticus,* one of the most important cultured fish species in Nigeria. The five diets were formulated to contain between 31 and 32% crude protein and varying amounts of energy supplied by PCW.

Materials and Methods

Sample collection and processing

Large volume of pineapple crush waste was collected from three pineapple juice production companies in Lagos, Nigeria. The waste was dried in the laboratory (open air) for two weeks before transfer to the oven where it was allowed to dry to constant moisture content at 85°C . The dried waste was ground into powder form using an electric blending machine.

The experimental diets (Table 1) consisted of rations with the maize component replaced at five levels with pineapple crush waste at 0%, 25%, 50%, 75% and 100%). The diets were prepared in form of pellets following the method described by Wee and Ng (1986), oven-dried at 70°C in a Gallenkamp oven for 18 hours, and stored in air-tight polythene bags kept in a deep freezer at a temperature of 8°C until used.

Table 1: *Percentage and proximate composition of the experimental diets (g/100g) fed to O.niloticus fingerlings*

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Yellow maize	30	25	15	5	0
Pineapple crush waste	0	5	15	25	30
Rice bran	12.0	12.0	12.0	12.0	12.0
Fishmeal	20.0	20.0	20.0	20.0	20.0
Soybean meal	30.0	30.0	30.0	30.0	30.0
Vitamin premix	2.0	2.0	2.0	2.0	2.0
Vegetable oil	2.0	2.0	2.0	2.0	2.0
Starch solution	2.0	2.0	2.0	2.0	2.0
Oyster shell	1.5	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5	0.5
Chemical composition (Calculated)					
Crude protein	32.13	31.89	31.54	32.42	32.51
Moisture	10.98	11.65	12.65	11.85	11.97
Ether extract	10.54	11.86	12.04	11.93	10.83
Ash	13.87	13.76	14.85	13.91	13.77
Gross energy(KJ)	5.88	6.34	7.45	6.93	6.91
NFE	26.60	24.50	21.47	23.96	24.01

Experimental procedure and management fish

One hundred fingerlings of tilapia (mean weight, 10.7g) were purchased from a reputable fish farm, acclimatized for 48 hours and stocked in five aquaria at the rate of 10 fish per aquaria. Each aquarium received one of the diets as a treatment, and fish were fed at 4% body weight day^{-1} in two equal portions at 900-1000 h and 1600-1700 h for 90 days. Each dietary treatment was replicated twice. All fish were removed from each aquarium every week and batch-weighed, and the amount of feed was adjusted accordingly. At the end of the feeding trial, five fish from each treatment were killed and used for carcass analyses.

All experimental diets and fish samples were analyzed for their proximate composition according to methods of AOAC (1990) fish growth and nutrient utilization parameters were calculated.

Diet performance evaluation

The diet performance was evaluated according to Olvera-Novoa *et al* (1990) as follows:
Weight gain (%) – (final body weight - initial body weight)/ initial body weight
Specific Growth Rate (SGR%/day) =100[($\log_e$ final body weight- $\log_e$ initial body weight)/ time, days. Average daily gain (ADG) = (final weight-initial weight/ time, days.
Feed Conversion Ratio (FCR) =dry weight of fish fed (g)/fish weight gain
Protein Efficiency Ratio (PER) = fish weight gain (g)/protein fed (g)
Protein Productive Value (PPV) = 100 x (protein gain/ protein fed)

Statistical analysis

All data obtained were subjected to one-way Analysis of Variance (ANOVA) test ($P < 0.05$). When ANOVA revealed significant differences, Duncan's multiple-range test (Zar 1984) was applied to characterize and quantify the differences between treatments using Statgraphics 5 Plus package for Windows (Manugistics Inc. and Statistical Graphics Corp, Maryland, US.).

Results and discussion

All the test diets were accepted and voraciously fed upon by the fish.

In this study, the survival of fish remained all-time high throughout the experimental period. The fish accepted the diets readily, feeding on them voraciously immediately the diets were introduced. This may be due to the sweet taste and good flavour of the pineapple residue.

The percentage and proximate (% by weight) composition of the experimental ingredients is shown in Table1.

A summary of the growth performance and nutrient utilization is presented in Table 2. Fish grew well in all the diets; however the best response obtained was from diet 4 that contained 75% pineapple crush waste (PCW), with a final mean weight gain of 76.21. When compared to the other diets, diet 4 had significantly ($P<0.05$) better weight gain, average daily growth, specific growth rate, protein efficiency ratio and productive protein value. Differences in SGR, FCR, PER and PPV were not significantly different between all the diets. Good PER values (1.94-2.02) were obtained from all the diets with the exception of diet 5 (1.67) that had 0% yellow maize. These PER values are considered very good when compared to the values obtained by Akegbejo-Samsons & Ojinni (2004), Akegbejo-Samsons (1999) and Balogun & Fagbenro (1995). Diet 5 showed the poorest performance, with the lowest weight gain, SGR, PER and PPV. This is due to the fact that most basal energy feeds are low-protein and high energy feed ingredients (Crampton & Harris, 1969). PCW has a lower crude protein value of 3.28 compared to maize that has 9.5. It has also been reported that pine apple contains tannins and pectin (Jaeger *et al*, 1998) which has effects on the growth of fish. Diet 3 with 50% inclusion of both PCW and yellow maize was the second best diet followed by diet 2 with 75% yellow maize and 25% PCW. The carcass composition of the experimental fish showed higher body ether extract and protein values in all the diets (Table 3). Variations in carcass analyses at the beginning and at the end were not significant ($P>0.05$) for all the nutrient components. This was probably due to the fact that all the diets contained similar nutrient levels. The results of this experiment showed that the utilization of diets containing 75% and 50% PCW (diets 4 and 3 respectively) as replacement for yellow maize are best for tilapia culture. Diet 1 with 100% yellow maize did not do so well when compared to diets 2, 3 and 4 that had 75%, 50% and 25% yellow maize respectively. Diet 5 that has 100% pineapple waste had the poorest performance in all the parameters investigated. This is probably due to the fact that pineapple waste had lower values of dietary energy, protein and ash compared to yellow maize. This study showed that inclusion of PCW into fish diets will prove to be highly cost effective when used to replace yellow maize. The cost of PCW is sufficiently below that of yellow maize to make substitution profitable under the current market conditions. Furthermore, PCW has no competitive uses and it is available throughout the seasons of the year in Nigeria. Its uses can be encouraged through effective waste collection network.

Table 3: *Proximate composition of fish carcass (% by weight) before and after feeding trial*

	Initial	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Moisture	81.65	75.01	76.03	76.17	78.81	·75.99
Crude protein	19.66	25.11	25.32	24.86	27.52	25.32
Ether extract	0.45	0.61	0.64	0.59	0.63	0.61
Crude fibre	0.03	0.52	0.55	0.59	0.67	0.59
Ash	1.10	1.30	1.41	1.39	1.29	1.26
Energy (KJ)	3.77	3.88	3.55	3.28	4.93	3.87

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