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EFFECT OF FEEDING COLOCASIA *[COLOCASIA ESCULENTA* (L) SCHOTTL CORM FLOUR AS A -PART OF ENERGY SUPPLEMENT ON GROWTH AND NUTRIENT UTILIZATION IN *CLARIAS GRRIEPINUS (BURCHELL, 1822) FINGERLINGS*

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Abstract

The objective of this study was to compare the nutritive value of boiled *Colocasia esculenta* flour (CECF) with that of yellow maize in practical rations of fingerlings. Boiling resulted in a slight increase in crude protein content. and significant (84.5%) decrease in oxalate content. Five is oproteic (30% crude protein) and isocaloric (15.46 Kjg^{-1}) diets were formulated. The control diet contained maize as the principal dietary energy source, while flour produced from boiled Colocasia corn progressively replaced maize at 5 inclusion levels (0%, 20%, 40% 60% and 80%). The experimental diets were fed to triplicate group of *Clarias gariepinus* fingerlings (mean weight 2.05$\pm$0.5g) at 3% body weight day $^{-1}$. Growth performance expressed as weight gain, specific grown rate (SGR) and nutrient utilization expressed as feed conversation ration (FCR), protein efficiency ration (PER) were assessed. There was a trend of decrease in weight gain with increase in inclusion level of CECF. Weight gains of groups of *C. gariepinus* fed up to 60% inclusion level of CECF were nog significantly ($p>0.05$) different from the group fed the control diet, the same trend was observed for SGR. FCR and other parameters were poorer ($p<0.05$) for those fed diet 4 (80% inclusion level) than those fed the control. Apparent digestibility coefficients (total and protein) were determined. Results show no significant difference (p.0.05) in digestibility coefficients among the different groups, also that carecass composition did not vary significantly ($p<0.5$) among treatments. Results also indicate that CECF is an acceptable ingredient that can replace maize up to 20% inclusion in C. *gariepinus* rations.

INTRODUCTION

Maize is the traditional energy source in the practical diets of livestock and culture fish and it usually accounts for over 55% of the total energy in fish feeds (Adekoya, 1988). This has led to shortage of energy feedstuffs and competitive pricng for maize particularly in the rural areas where maize is also a staple (Fasakin et al 2001). This phenomenon has a potential of causing inflation of feed cost and reduce proticablitty of aquaculture enterprise in most developing countries (Balogun, 1996). The aquaculture industry is interested in reducing their depence on maize in recent years, The decline in the local production of maize has led to attempt to replace or supplement the maize component of fish feed with cheaper non conventional energy sources, for example cassava (Akegbejo, 1999) plantain peels, (Falaye and Oloruntunyi, 1998) fermented planted peels (Adegbesa, 2008) and severally processed breadfruit (Artocarpus altilis) (Ayankola, 2008). Results from these trials have been mixed, while poor growth, reduced feed intake and feed utilization have been reported by Akegbejo (1999), Ayankola (2008) and Adegbesan (2009) have observed normal feed intake and good feed conversion. Poor performance have been attributed to poor absorption efficiency and presence of redidual antinutrional factors.

Colocasia esculenta belongs to a group of plants generally referred to as avoids – a member of the family Areeac. Aroids are grown as roots crops throughout the humid tropics and are major food crops in the Pacific Island (Purseglove, 1972); Bradbury and Holloway 1988). A noteworthy feature of aroids is their ability to grow acridity is generally attributed to the mechanical irritation caused by the needle shaped calcium oxalate raphide embedded in the corm tissues (Sakai, 1979). Fetuga and Oluyemi (1976) observed severe depression in feed intake, weight gain and feed efficiency when 200 to 400g kg-I raw *Colocasia* corm meal was incorporated in diets for starting chicks, also pancreatic enlargement, reduced energy metabolisability and toe ash contents in chicks fed diets containing raw colocasia corm meals were also overcome by processing. This depressing effect was overcome by boiling the corms, the removal of the outer skin could also lower the activity of the oxalate and improve its nutritional value and chick performance (Sunell and Healy, 1979). Peeled, processed colocasia corm meal can be incorporated in chick diets with the addition of calcium, up to 200g kg

The objective of this study therefore was to evaluate the nutritional potential of boiled colocasia corm meal by partially replacing yellow maize in diets of *Clarias gariepinus* (African mud catfish) fingerlings. *Clarias gariepinus* was the experimental animal selected for this study because of its omnivorous food habit and its high market value which currently makes it the most cultured fish species in Nigeria.

MATERIALS AND METHODS

Experimental System and Fish

This experiment was carried out in Fifteen (15) hapas (1m x 0.5m x 0.5m) suspended to % of their volume by bamboo poles in an outdoor concrete cistern (5m x 3m x 1.5m). located at the side of College of Environmental Resource Management (COLERM) building, University of Agriculture, Abeokuta, Nigeria. The cistern was continually supplied with fallowed tap water introduced in splash form for better aeration.

Clarias gariepinus fingerlings (mean weight 2.05 ±.05g) used in this feeding trial were obtained from the fish hatchery complex of the University of Agriculture and acclimated for 2 weeks in a fibre trough of the Department of Aquaculture and Fisheries Management. The fish were randomly distributed to 15 hapas.

Diets Formulation and Preparation

All feed ingredients used in the experiment except CECF were purchased from University- Agro Allied industry Ltd, Kotopo, Abeokuta, *Colocasia esculenta* corm was purchased in bulk as raw tubers from Akomoje, a suburb of Abeokuta. The corms were washed in running water to remove all dirt and soil particles, they were peeled, sliced and boiled in water for about 20 minutes, the slices were mashed, sun dried, ground and sieved to flour.

Five isonitrogenous (30% crude protein) and isocaloric diets (approximately 15.46KJg-^{1} gross energy) were prepared in which boiled CECF replaced yellow maize at five inclusion levels (0%, 20%, 40%, 60% and 80%) (Table 2). Ingredients were properly mixed with hand and the diets were pelletized through 2mm diameter die, sun dried and stored in tagged polythene bags at -20°C. *Clarias gariepinus* fingerlings (means 2.05±.23g) were obtained and randomly distributed at the rate of 10 fish per hapa. The diets were tested in triplicate for an 8 week feeding period. The fish were fed at 5% body weight till the end of the experiment. The fish weighed weekly with an electronic balance (MEDLER 601LB). At the start of the, sacrifice weight, weight and stored frozen at -20c for subsequent initial carcass proximate analysis. At the end of the experiment, five fish were collected from each diet treatment and sacrificed for carcass analysis 1990

Analytical method and Experimental Procedure

Analysis of Experimental Data

Diets were assessed by determining weight gain (g/day), percent weight gain, specific growth rate (SGR), feed conversion ratio

(FCR), protein efficiency ratio (PER) carcass nitrogen utilization (ANU), Fish growth and nutritne utilization parameters were calculated as follows: Weight gain (g/day) = fish weight gain (fresh wt, gain)/time, day)

Specific growth rate (% day) = 100 (log final body weight/tim, day).

Feed converson ratio=(feed intake dry wet, g)/fish wt, g (fresh wt, g)

Protein efficiency ratio = (fish intake dry wt, g)/fish wt, g Fresh wt, g)

Carcass nutrition disposition (mg/day) = 1000 (final fish wt x % final carcass protein) – initial fish wt x initial carcass protein))/(100)/time, days/(6.25)

Apparent nitrogen utilization (%) = 100 CND/nitrogen intake.

Feed ingredients, formulated feeds and carcass proximate composition of experimental fish at the start and end of the experiment were analysed according to the methods of AOAC (1990). Total oxalate contents for the maize and boiled colocasi corn were determined by the method described by Abiza et al (1968). One way Analysis of variance of (ANOVA) were analysed statically describing growth performance and feed utilization and the difference among means tested for significance (p=0.5.05) using Ducan's multiple range test

Water Parameters

The essential physio-chemical parameters were measured using mercury thermometer to determine the temperature of the water, DO meter for dissolved odygen and Jenway pH meter for pH. It ranges between 9.0-9.4. These parameters were measured weekly throughout the experimental period.

RESULT

Table 1 shows the proximate composition of raw, boiled *Colocasia esculenta* corm flour (CECF) and other ingredients. Table 2 shows the composition of the experimental diets and Table 3 shows the growth responses of the fish fed with the five experimental diets. While Table 4 shows the carcass proximate composition of C. *gariepinus* fingerlings fed the different experimental diets. Boiling resulted in a large reduction (293-42.7 mgkg-[1]) in the oxalate content and a slight increase in the crude protein content. Feeds with high (60 and 80%) inclusions level of CECM were noticeably hard. The experiment lasted for a period of 56 days. All the tests were accepted and actively fed upon by the fish. No pathological signs were observed among fish groups fed different experimental diets.

A significant ($p<0.05$) increase in weight gain over the initial values was observed in all dietary treatments. C. *gariepinus* fingerlings fed the control diet showed measurably the best growth performance compared with the groups fed other experimental diets and was significantly superior ($p<0.05$) to the groups fed test diets TD2-TD4. Specific growth rate (SGR) showed similar trend observed for weight gain. Food conversion ratio) FCR and protein efficiency ratio (PER) of the group offish fed the CECM based diets showed no significant difference compared to the group fed the control. The apparent protein digestibility(APDprotein) was high in all treatments and was not significantly different (p<O.O 1), a similar trend was observed for carcass nitrogen deposition (CND). Mortality was low and non differential i.e. it was not related to any dietary treatment but rather to handling. With the exception of diet TD" whole body moisture content was significantly ($p<0.05$) higher in CECM based diets than the control, there was an inverse relationship between moisture and whole body lipid. Carcass protein content of diet 2 was measurably higher than the control and was not significantly higher compared with those diets with increase in inclusion levels of CECM based diets.

Monitored water quality parameter fluctuated little during the experiment.

Dissolved oxygen ranged between 6.2-S.87mgL-[1], pH 7.S-7.7, temperature 24.S - 27.SoC

The monitored pH, temperature and dissolved oxygen range between 9.0 9.4, 23.So - 26.2°C, 12 - 13mgr[l].

DISCUSSION

The partial flow through system employed in this feeding trial sustained the optimum water quality for the culture of *Clarias gariepinus* fingerlings.

Boiled CECM used in this study had proximate and biochemical values (Table 1) similar to previous studies (Ravindran and Blair, 1992; Ravindran *et aL,1996)*. High reduction in oxalate content in boiled CECM was in agreement with earlier studies by Onayemi and Nwigwe (1987); Ravindran *et all'* (996), this observation, they concluded was due to leaching and thermal labiality of oxalate. The slight increase in crude protein content in boiled sample could be due to leaching of water soluble nutrients and the concentration of insoluble nutrients (Bradbury and Holloway, 1988; Ravindran *et a~,* (1996). These values were measurably similar to that of yellow maize used in this study.

Result of the feeding trial revealed that the result obtained demonstrated that maize - basal diet (CD) performed best in terms of growth, FCR, PER of diets containing varying levels of processed colocasia corm meal and that inclusion of graded levels of boiled CECM affected the growth patterns of experimental fish. There was a trend of differences in growth and nutrient utilization parameters. Diets with high inclusion levels (TD_3 and TD_4) resulted in reduced growth of *Clarias*

The exact reasons for the growth depressing effects of boiled CECM is not very clear especially when the nutritive value is considered. Differences in weight gain can be attributed to the utilization of colocasia corm meal since **all** diets were formulated to contain the same crude protein and were actively fed upon by the fish throughout the experimental period.

Generally, the decline in growth rates might be associated with the digestibility of the diets. In this study digestibility was measurably lower though not significantly different (p>O.05) in groups fed the higher levels of CECM than those fed on the control diet. Poor digestibility be due to the presence of residual heat labile trypsin inhibitor (Sumathi and Pattabiraman, 1979). Previous studies by Ravindran ~ ~ (1996) indicated the presence of a level of residual oxalate even in boiled corm. Moy,

,.!t 2.!.(1979) Ravindran *et al;* (1996) had observed poor feed intake and feed uti lization in rats and birds fed rations with variously processed colocasia meal, the same reason could explain the reduced feed intake observed at a stage in the trial.

Calcium oxalates is a major anti-nutritional factor in *(Colocasia esculenta)* corm meal, it affects the absorption and utilization of calcium. In the present study, residual oxalate content in boiled CECM was 42.78mg kg-I, it is possible that this caused the observed growth performance.

Differences in the physicochemical properties of corn and CECM could also be a factor, according to Linebak (1984) corn starch has a lower gelatinization temperature (67 -72°C) than CECM (72-8S°C) (Iwuoha and Kanu, 1994), gelatinization temperature affects viscosity, binding capacity and pellet hardness in starchy ingredients. High binding capacity of CECM resulted in hard pellets which according to Gabaudau, (1979) could result in reduced digestibility and poor feed utilization. However, the result of this experiment shows that processed colocasia corm meal reduced the feed intake and weight gain of *Clarias gariepinus* fed for 8 weeks.

This was similar to the report of Moy E ~ (1979); Tang and Saki (1983) who reported that feeding raw colocasia corm meal also reduces the feed intake and weight gains in rats. Also Fetuga and Oluyemi (1976) observed severe depressions in feed intake, gains and feed efficiency when raw colocasia corm meal was incorporated in diets for starting chicks.

Relative sizes of starch granules could also be a factor, starch granules differ in shape and sizes among plants e.g. it is smaller in maize (1Sflm diameter) (Jane et~. *1992)* than in tubers and root starches which could be up to 100flm in diameter (Hizukuri,

Carcass analysis showed increase in levels of protein and moisture content; with measurable but insignificant (p<O.OS) decline in lipid content

Boiled CECM used in this study had proximate and biochemical values (Table 1) -t;.

similar previous studies (Ravindran and Blair, 1992; Ravindran *et aI,* 1996). High

- reduction in oxalate content in boiled CECM was in agreement with earlier studies by

TABLE 1 :Proximate composition (%) of ingredients.

Ingredients	Crude protein	Ether extract %	Crude fibre %	NFE	ASH%	Total oxalate mg kg⁻¹
Fish meal	72.00	4.1	1.0	4.00	14.8	NO
SBM	42.00	18.0	5.0	26.05	4.6	NO
GNC	45.00	8.80	4.31	30.21	13.08	NO
RawCCF	7.80	0.60	LIO	NO	1.20	293
CCCF	9.00	0.82	0.8	82.2	.9	42.78
Corn	10.00	5.50	1.40	79.60	1.40	NO

ND notdetermined

TABLE 2. Ingredient composition (% dry weight) and proximate composition of experimental diets.

Ingredient	CD	TD j	TD 2	TO)	TD 4
Fish meal	8	8	8	8	8
Groundnutcake	8	8	8	8	8
Soya bean meal	39.96	42.04	43.90	45.58	47.10
Corn	38.54	29.17	20.76	13.17	6.28
Taro		7.29	13.84	19.75	?-5.1 1
Vegetable oil	2	2	2	2	2
*VitJ Premix	1.5	1.5	1.5	1.5	1.5
Methionine	1	1	1	1	l
Lysine	1	1	1	1	I
Chromium iii oxide	.5	.5	.5	.5	.5
Energy KJi'	15.46	15.46	15.46	15.46	15.46
Moisture %	12.20	12.53	13.47	13.45	14.40
Crude Protein %	29.99	30	29.99	30	30
Lipids %	6.64	5.98	4.89	4.02	3.78
Crude Fibre %	8.02	9.07	11.03	12.43	13.09
Ash %	12.34	]].21	12.56	13.24	]2.54

*Radar Vitamin. Premix. Supply /lOOg Diet. Palmat A: 100OTu; Cholecalcifero (D): 1000lu; Gocopherolacetate (E): 1.1 mg; Menacilione (K): 0.02mg; Thiamine B I: 0.63mg; Riboflvin (B 12): 0.5mg; Panthothenic Acid: 1.0mg; Phyridoxine (B6): 0.] 5mg; Cyanocobalamine (B 12): 0.00 l mg; Nicotinic Acid: 3.0mg; Folic Acid O.lmg; Choline: 3l.3mg; Ascobic Acid (C): O.lmg; Iron (Fe): 0.05mg; Cu: 0.25mg; Mn: 6.00mg; Co: 0.5mg; Zn: 5.0mg; Sn 0.02mg.

Table 3 Growth performance and feed utilization by *Clarias gariepinus* fed diets containing

	CD	TD[1]	TD[2]	TD[3]	TD[4]
Initial body wt (g)	2.03±0.01	2.07±0.2a	2.05±0.01	2.04±0.01	2.04+0.03
Final body wt (g)	10.40±0.05	10.05±0.15	8.93±0.612	8.83±0.71a	7.95+0.07
Wt gain (g)	8.37±0.51	7.98±0.17	6.88±0.62	6.79+0.72	5.91+0.10
Specific growth rate (%)	2.92±0.10	2.82±0.05a	2.62±0.62	2.6+0.05	2.43+0.04
PER	2.79±0.05	2.62±0.05	2.17±0.22	2.33+0.11	2.09+0.24
Food conversion ratio	12±0.03	1.29±0.04b	1.43±0.17	1.54+0.05	1.62+0.12
ADC (protein)	83.87±0.41	84.00±1.38a	83.03±0.60	83.98+0.64	84.14+0.86
CND mgddy	4.48+.05	4.57±0.44a	4.19±0.25a	5.89+0.71	5.38+0.48
Survival %	100±0.00	93±1.00a	93±.000	90+1.00	73+15.00

Table 4 Carcass composition of *Clarias gariepinus* fingerlings fed experimental diets

	Initial	CD	TD[1]	TD[2]	TD[3]	TD[4]
Moisture %	68.00+4.00a	70+3.00	70+300bc	78+3.00a	83+2.50	87+400a
Crude protin %	58.0+1.00b	6.35+.50a	63.5+1.50a	62.5+0.50ab	61.5+0.50	60.39+0.18
Crude Lipids %	6.15+0.35	7.10+.00a	7.10.+30a	6.13+0.23b	6.52+0.23	6.11+0.193
Ash %	2.75+0.05B	3.90+.60a	3.90+0.30a	3.77+0.17	3.76+0.46a	.29+0.04a

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