J. Environ. Sci. & Natural Resources, 5(1): 47- 53, 2012 ISSN 1999-7361

Growth Performance Meat Yield and Profitability of Broiler Chickens Fed Diets Incorporating Cassava Tuber Meal

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Abstract
A total of sixty, 14-day old broiler chickens (Cobb-500) of either sex were used in this study to assess the effects of processed cassava tuber meals (0, 15, 30, and 45 gkg^{-1}) on growth responses, meat yield, and profitability of boilers; rearing from day 14 to day 33 of ages. The experimental diets were iso-caloric and iso-nitrogenous in nature, and were supplied the broilers *ad libitum* throughout the trial period. Broilers fed on control diet (i.e. exclusion of CTM) achieved higher ($P<0.01$) body weight, while the broilers offered diets with the highest amount (45 gkg^{-1}) of CTM had the lowest body weight. Increased ($P<0.01$) feed intake was observed in the treatments of 21 d and 28 days of age when broilers fed diets with the supplementation of CTM, but no significant differences was found among the dietary treatments in the feed consumption of the broilers during 33 day of age. FCR differed significantly ($P<.01$) throughout the trial period, broilers fed diets without supplementation of CTM had the superior FCR than the others. Mortality was unaffected by all the dietary treatment groups. Moreover, different body parts (feather, head, neck, wing, viscera) and meat yields (thigh, drumstick, breast, back, giblet, dressing) were not influenced by treatments. Live weights were unaffected by all the dietary groups with/without incorporation of cassava tuber meals (CTM) up to day 21 and day 28 of ages. Statistically significant ($P<0.01$) decreased live weight was observed among the treatments in 33-day old birds.

Key words: Broiler, Cassava tuber meal, Growth performance, Meat yield

Introduction

Poultry industry is one of the most profitable ventures of agriculture in the today's world, owing to its potentialities of providing nutritious meat within shortest possible. Its meat is very nutritious, tasty, mild flavor, tender, easy to chew or grind, blended well with other foods, and easy to digest. According to the annual report of WHO, 55 g of animal protein is required for each person in a day, whereas only 15.6 g can consume (Huque, 2008). To reduce the gap between demand and supply of animal protein, poultry can play an important role. As a result, poultry industry has been expanding vastly in the last few decades to meet the challenge (Saleque, 2000).

Feed cost is comprised 65-75 % of total production cost (Singh, 1990; Banerjee, 1992). Maize and wheat have traditionally been the ingredients of choice for the supply of carbohydrate, i.e. energy source for monogastric animal diets (PAN, 1995). The constant competition for wheat and maize among livestock, chickens, and human beings increases the cost of grains (USAID, 2005). The high cost of feed hardly permits remunerative and profitable poultry farming. The use of cereal products as livestock feed is increasingly unjustified in economic terms. Therefore, there is a need to exploit cheaper energy sources, to replace expensive cereals for poultry rearing (Raihan and Mahmud, 2008).

Nutritionists suggest that use of cheaper unconventional locally available dietary ingredients reduces the production cost (Rahman and Reza, 1983; Hossain *et al.* 1989). Substantial efforts have been made, in the past few decades, to replace cereals with other carbohydrate sources, such as sorghum **(**Rajasekher, 2000**)**, lentils, cassava tuber meal (Garcia and Dale, 1999**),** leucaena root meal (Bhatnagar *et al*., 1996) in poultry feed. Among them cassava (*Manihot esculenta*) achieved a particular attention for its high production yield and high content of starch. It is an important food crops grown in the tropics (Hahn, 1989; Phillips *et al.* 2004), a significant source of energy for 500 million people mainly in Africa (FAO, 2000; Mroso, 2003) and very appropriate for purpose of poultry feed. It's tubers are very rich in starch (69.89 %) with an energy value of more than 3000 MJ of metabolizable energy per kg (Kirchgessner, 1985), and also contains 1.70 % of ash, 2.55 % of CP, 27.75 % of CF, and 0.12 % of EE on a DM basis (Sriroth *et al.* 2000). Under tropical conditions, cassava is the most productive crop in terms of stability of production and high yield (fresh tuber yield, 40-60 tones/ha) whereas maize and wheat yielded2 0-25 tons/ha and

15-20 tonsha^{-1}, respectively (FAO, 1995). On contrary, due to the inclusion of cyanogenic glucosides in cassava root can easily convert to toxic HCN and depress the chick growth performance (Oke, 1978). However, it was reported that proper processing conditions can reduce HCN level in tolerance level (Padmaja, 1995). Thus, in the study we focused on the processing CTM properly, and incorporated to broiler diet and finally evaluated the effects of CTM on growth performance and meat yield of boiler.

Materials and Methods

Analysis of total HCN

Total HCN (ppm) in the CTM was analyzed using the enzymatic picrate paper kit developed by Bradbury *et al.* (1999). The absorbance was measured at 510 nm using a spectrophotometer, immersing the picrate papers to the sample in 5 mL distilled water for 30 minutes.

Processing and formulation of diet

Tubers were freed from dust, sliced and crushed, and socked in water, then dried in sunlight for 3 days. CTM was prepared by grinding cassava tuber slices in a Mortar and Pestle. All ingredients were weighed and then thoroughly mixed by hand according to the Table-1.

Table 1. Ingredients and chemical compositions of formulated dietary treatments.

Ingredient (gkg^{-1})	**Treatment group**			
	T_1	**T_2**	**T_3**	**T_4**
CTM	0	15	30	45
Maize	575	411.7	251.0	89.30
Cassava	0	150	300	450.00
Soybean meal	208.6	225.0	223.0	221.10
Protein concentrate	90.8	94.6	111.7	128.80
Rice polish	100	100	100	100
Oyestershell	15.6	9.0	5.7	2.30
NaCl	2.6	2.4	2.00	1.70
Adivit GS(SMF Pharmaceutical)	3.0	3.00	3.00	3.00
Choline chloride	0.7	0.60	0.70	0.70
DL-methionine	0.7	0.7	0.30	-
Coccicure (Reneta)	0.5	0.5	0.50	0.50
Navacox (Navana)	0.5	0.5	0.50	0.50
Toxin binder	2.00	2.00	2.00	2.00
Total	1000	1000	1000	1000
Nutrient content				
ME(kcalkg^{-1})	3000	3000	3000	3000
CP	21	21	21	21
CF	4.22	3.87	3.47	3.08
Ca	1.18	1.00	1.00	1.00
Av.P	0.45	0.50	0.57	0.66
Na	0.18	0.18	0.17	0.16
Lys	1.14	1.16	1.19	1.22
Arg	1.29	1.30	1.30	1.29
Meth	0.50	0.48	0.46	0.43
Meth+Cyst	0.80	0.77	0.73	0.68

Dietary treatment groups of boiler

This experiment was carried out at the Poultry Farm of Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. A total of sixty, 14-day old commercial broilers (Cobb-500) having similar weights of 336.25±2.698 kg/b were collected from "Narish Poultry Farm", Shreepur, Gazipur. 900 cm^2 of floor space was provided for each broiler. Continuous photo period of 23:30 hours was provided including the natural light and electrical bulb; and a dark period of 00:30 hour every day. Broilers were randomly distributed into four dietary treatment groups (T_1, T_2, T_3, and T_4) with three replications. The experimental diets were iso-caloric and iso-nitrogenous in nature, and were supplied the broilers *ad libitum* for 20 days of trial period.

Processing and evaluation of broiler meat

Broilers were fasted from feed and water for twelve hours prior to kill. After completion of bleeding, the slaughtered broilers were immersed in hot-water at 51-55 °C for 120 seconds in order to facile removal of feathers. Head, shanks, viscera, oil gland, kidneys, and lungs of the carcass were separated. Heart and liver were also removed from the remaining viscera; and quickly the gall bladder was cut off from the liver; and the pericardial sac and arteries were excised from the heart. The gizzard was removed by cutting from proventriculus and then cutting both incoming and outgoing tracts. Then, split was opened with knife, emptied and washed and the lining was removed by hand. Blood weight was calculated by deducting the slaughtered weight from the live weight of broilers after complete bleeding. Feather weight was calculated by deducting the complete defeathering broiler weight from the slaughtered weight of broilers. The weight of head, neck, viscera, heart, liver, gizzard, thigh meat, drumstick meat, back meat, and breast meat were determined individually by using the sensitive weighing balance. Dressing yield was calculated by subtracting the weight of blood, feathers, viscera and shank from the live weight. Giblet weight was the total weight of liver, heart, gizzard, lung and spleen. Dressed weights of broilers were calculated deducting the weights of head, neck and giblet from carcass

Statistical analysis of the data

All recorded and calculated data were statistically analyzed by MSTAT statistical computer package program in accordance with the principles of Completely Randomized Design. Least Significant (LS) differences were calculated to compare variations among diets where ANOVA showed significant differences.

Results and Discussion

Effects of drying and soaking time on total HCN content of CTM

Cassava tubers were harvested twelve months after planting. The tubers were peeled, immediately washed with tap water and sliced.

Soaking time

Fig. 1 showed the effect of soaking time on total HCN content of CTM. Highest amount of HCN (58 ppm) was found in the fresh tubers. It was observed that HCN content decreased sharply with soaking time. It reduced to 45, 28, and 15 ppm after 5, 10 and 20 hours soaking respectively. Further increasing the soaking time, the level of HCN content decreased very slowly and leveled up at12 ppm.

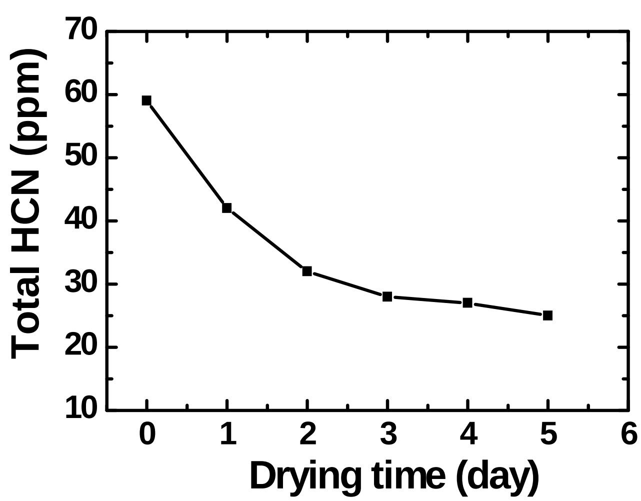

Fig. 1. Total HCN content as a function of drying time.

Drying time

The different drying periods in sunlight resulted in a significant differences in the total HCN content, shown in Fig. 1. Initially, as increased the drying time the HCN content was decreased sharply. 1 day and 2 days dried CTM contained 42 and 32 ppm CTM respectively. After that, HCN content reduced slowly on 3, 4, and 5 days drying.

a) Effects of CTM on growth performance of broiler

The cassava root slices were soaked in water for 20 hours and dried in sunlight for 3 days subsequently. As a result, the level of HCN was reduced as low as 10 ppm. The processed CTM was incorporated at a level of 0, 15, 30, and 45 g/kg by substituting the costly maize; and other ingredients were added in a proportion to balance iso-caloric and iso-nitrogenous diets, shown in table-1.

Live weight

Fig. 3 showed the live weight of broilers of different treatment groups. It was observed that highest live was found in control group (T_1) and decreased slightly with CTM level. However, it was statistically insignificant up to 28 d of ages (Table 2, Fig. 2), then differed significantly (P<0.01) among different dietary treatment groups during 33 days of age. Live weights were 1235.29[a], 1174.40[b], 1125.6[c], and 1081.14[d] g for the dietary treatment groups of T_1, T_2, T_3, and T_4 respectively at 33 d of ages. Linear fashion decreased with CTM dietary may be due to the high level of fiber content in CTM, which reduced the digestibility of protein and subsequently affected the growth of broilers (Akintala *et al.*, 2002).

Table 2. Effects of dietary treatments on live weight, feed intake, feed conversion ratio, and mortality.

	Age (day)	**Treatment group**				**SED and significance[+]**
		T_1	**T_2**	**T_3**	**T_4**	
Live weight (g/b)	21	632.15	626.84	615.41	594.73	14.666[NS]
	28	960.58	958.33	937.45	907.09	23.620[NS]
	33	1235.29[a]	1174.40[b]	1125.6[c]	1081.14[d]	30.267[**]
Feed intake (g/b)	21	558.55[d]	580.68[c]	604.74[b]	609.35[a]	11.193[**]
	28	750.33[c]	856.82[b]	879.78[a]	880.72[a]	25.569[**]
	33	523.23	518.72	503.76	481.76	26.459[NS]
Feed conversion ratio (FCR)	21	1.90[d]	2.00[c]	2.16[b]	2.36[a]	0.077[**]
	28	2.28[d]	2.59[c]	2.73[b]	2.82[a]	0.036[**]
	33	1.91[d]	2.40[c]	2.68[b]	2.77[a]	0.077[**]
Mortality rate	21	0.00	6.67	0.00	0.00	4.707[NS]
	28	0.00	6.67	0.00	0.00	4.707[NS]
	33	6.67	6.67	0.00	0.00	6.657[NS]

Data represent mean values of three replicate groups consisting of 15 broilers each replicate during d 14 to 33 days. [a,b,c,d] Means bearing uncommon superscripts in a row are significantly different at**P<0.01; NS: Non significant, P>0.05; and Standard Error of the Difference (SED)'s are against 10 error degrees of freedom.

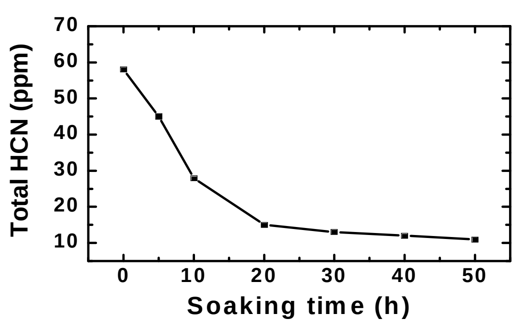

Fig. 2. Total HCN content as a function of soaking time

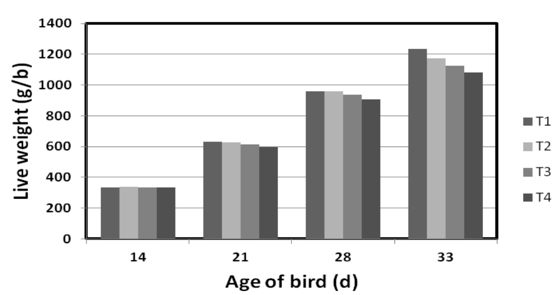

Fig. 3. Live weight of boiler as a function of age. Legend indicates the treatment groups

Feed intake

It was observed that feed intake was slightly increased with dietary CTM (Table 2). The highest feed intake was found in T_4 treatment group, whereas the lowest feed intake was found in T_1 control group regardless the age of birds. Furthermore, feed intakes of 21-day age broilers were 558.55^d, 580.68^c, 604.74^b, and 609.35^a g for T_1, T_2, T_3, and T_4 treatment groups respectively (Table-2). It was 750.33^c, 856.82^b, 879.78^a, and 880.72^a g for 28-day of age; followed by a declined at 33-day of ages. It might be due to the palatability/other factors. (Tewe, 1993; Onyimoyi and Ugwu, 2007; Onjoro *et al*., 2001; Maust *et al*., 2000).

Feed Conversion Ratio (FCR)

Feed conversion ratio (FCR) demonstrated the clear differences among the dietary treatments of CTM with ages of broiler, shown in Table-2. For all ages, the FCR were getting higher with the inclusion of CTM diets. The highest FCR was obtained in the T_4 group and the lowest in T_1 group regardless of ages. During 33-day of ages it was 1.91^a, 2.40^c, 2.68^b, and 2.77^a for T_1, T_2, T_3, and T_4 treatment groups respectively. It indicated that CTM suppressed the growth of boiler regardless of age (Table-2).

Mortality (%)

In this present study, percentage of mortality was insignificant among the dietary treatment groups (Table-2), suggested that CTM did not cause any fatal to boilers (Akintala et al. ,2002).

b) Effects of CTM dietary on meat yield of boiler

Meat yield characteristics

The meat yield characteristics of broiler regardless of dietary treatments were preserved the similar characteristics and insignificant in terms of statistical analysis (P>0.05), shown in Table-3, indicating that dietary supplementation of CTM and feeding time did affect notably on the characteristic of meat (Awojobi and Adekunmi, 2002).

Table 3. Meat yield characteristic of 33-day old broilers.

	Treatment group				SED and significance[+]
	T_1	**T_2**	**T_3**	**T_4**	
Live weight (g/b)	1234.00^a	1174.00^b	1125.00^c	1080.00^d	**
Blood	3.69	4.15	4.49	4.42	NS
Feather	7.46	7.19	7.80	7.83	NS
Head	2.64	3.09	2.91	2.67	NS
Neck	2.45	2.01	2.06	2.00	NS
Giblet	6.14	6.06	6.00	6.24	NS
Thigh	9.20	9.26	9.92	9.74	NS
Drumstick	8.40	8.27	8.93	8.85	NS
Wing	8.02	8.30	8.38	8.83	NS
Breast	10.73	10.82	10.42	10.27	NS
Viscera	8.61	8.78	9.29	9.09	NS
Back	9.60	9.86	9.74	9.82	NS
Dressing yield	51.03	51.61	52.35	52.19	NS

Data represent mean values of three replicate groups consisting of 15 broilers each replicate during d 14 to 33 days. [a,b,c,d] Means bearing uncommon superscripts in a row are significantly different at**P<0.01; NS: Non significant, P>0.05; and Standard Error of the Difference (SED)'s are against 10 error degrees of freedom.

c) Effects of CTM dietary on profitability of boiler

Production cost and profitability

Feed cost was evaluated based on the current market price of the ingredients, considering 26 Tk for maize and 12 Tk for CTM. Productivity of cassava is almost three times higher than maize and wheat. It is expected that the inclusion of cassava meal in poultry ration will decrease the cost of the poultry rearing. Cassava meal will become cheaper when it will be cultivated commercially. On the contrary, for low content of protein in CTM, additional concentrated protein should be incorporated to ensure adequate protein, thus increased the cost of the ration some extent. Table-4 shows the feed per boiler rearing up to 33-day of age. Feed cost reduced linear fashion from 60.02 Tk/kg for control diet to 53.83 Tk/kg for 45 g/kg of CTM supplement. It was expected that inclusion of CTM, the price of the feed will be decreased by half. However, due to the incorporation of additional concentrated protein, it was not lowered much as anticipated. Moreover, because of higher amount of feed intake with CTM levels, reduced the net profit of per kg meat of boile, they were: 9.01, 3.67, 1.74, and 1.51 (Tk/kg) for T_1, T_2, T_3, and T_4 respectively (Maust *et al.*, 2000).

Table 4. Production and profitability of boiler rearing (33 days).

	Treatment group				SED and significance[+]
	T_1	**T_2**	**T_3**	**T_4**	
Feed cost (Tk/b)	60.02[a]	60.84[a]	58.17[b]	53.83[c]	0.797[**]
Feed cost (Tk/kg)	48.59[c]	51.81[a]	51.68[a]	49.79[b]	1.070[**]
Total cost (Tk/b)	118.58[a]	119[a]	116.23[b]	111.89[c]	1.320[**]
Total cost (Tk/kg)	95.99[c]	101.33[b]	103.26[a]	103.49[a]	1.111[**]
Meat price (kg/b)	105	105	105	105	0.000[NS]
Sale (Tk/b)	129.71[a]	123.31[b]	118.19[c]	113.52[d]	0.900[**]
Profit (Tk/b)	11.13[a]	4.31[b]	1.96[c]	1.63[c]	0.190[**]
Profit (Tk/b)	9.01[a]	3.67[b]	1.74[c]	1.51[c]	0.190[**]

Total cost includes feed cost, vaccine cost, and rearing cost. Taka (Tk) is the local currency; 1 dollar = 70 Tk (approximately).

Conclusions

Unconventional feed ingredient cassava tuber meal was evaluated as an alternative carbohydrate supplement in boiler rearing by substituting the costly maize. With the introduction of CTM, feed cost decreased linearly. No significant mortality was recorded throughout the experimental trial period. The meat yield characteristics of broiler regardless of dietary treatments were preserved the similar characteristics. However, the high content of fiber and low content of protein inhibited the growth performance, thus decreased the profitability of boiler rearing.

Acknowledgments

Thanks to Professor Md. Solaiman Ali Fakir, Ph.D. for his constant help to accomplish this work and cassava tuber meal was collected from his experimental field, Department of Crop Botany, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

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