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RESEARCH ARTICLE

Effects of Increasing Levels of Dietary Cooked and Uncooked Banana Meal on Growth Performance and Carcass Parameters of Broiler Chicken

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ABSTRACT

Discarded banana is a valuable feed ingredient for poultry feed formulations. However, due to the presence of resistant starches, inclusion of more than 10% banana meal in poultry rations reduces the growth performance. The objective of this study was to determine whether higher levels of banana meal could be included in broiler diets if raw banana is cooked before being processed into meal. Discarded banana (Cavendish) collected at harvesting was processed into two types of banana meals. Cooked banana meal was prepared by cooking banana at 100^{o}C for 15 minutes and subsequent drying. Uncooked banana meal was prepared by drying at 80^{0}C for three days. Giving a 2 x 4 factorial arrangement, 144 broiler chicks in 48 cages received one of the eight experimental diets containing either cooked or uncooked banana meal at 0, 10, 20 or 30% *ad libitum* from day 21-42. Birds fed cooked banana meal were significantly heavier on day 28 and 35. Live weight on day 42, weight gain, feed intake or feed conversion efficiency were not affected either by the type or level of banana meal and their interaction. Cooked banana meal increased the weights of the crop and liver significantly. Weight of the small intestine, proventriculus, gizzard abdominal fat pad and the fat free tibia ash contents were not affected by the dietary treatments. It was concluded that uncooked banana meal produced using peeled raw banana can be included up to 30% in nutritionally balanced broiler finisher diets without any adverse effects on performance.

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INTRODUCTION

Feed cost is the highest recurrent cost item in poultry production and thus has a major impact on the profitability of the industry and affordability of poultry products for the consumers. Increasing demand for cereals by human food sector and the drain of maize for bio-fuel production are the main factors for sharp increase in poultry feed prices during the last few years. Increased feed ingredient prices have severe negative impacts on livestock production and the consumption, particularly in developing countries (Scanes, 2007; Beken and Şahin, 2011; Hussain *et al*., 2011). Under these circumstances, screening, evaluation and utilization of alternative and cheaper feed ingredients for poultry feeding is of importance.

A range of materials such as snack food by-products (Van Wyhe *et al*., 2012), distillers dried grains with solubles (Masa'deh *et al*., 2011), canary seeds (Newkirk *et al.,* 2011), foxtail millet (Goodarzi Boroojeni *et al.,* 2011), yam peel meal (Ezieshi *et al*., 2011) and false yam (Dei *et al*., 2011) have been studied as alternative energy feed ingredients for poultry feeding.

Banana sepientum L is widely used all over the world as a fruit or sometimes as an important energy source (Honfo *et al.,* 2011). Babatunde (1992) estimated that 30-40% of total banana production is available for livestock feeding due to being rejected for export, accidental damages in the field and domestic waste**.** However, high levels of dietary banana meal reduced the performance of poultry (Babatunde, 1992). In this context, means of using high levels of banana meal in poultry rations are of importance.

Even though green banana contains as high as 74% starch on dry matter basis (Babatunde, 1992), around 25% of which is less-digestible resistant starch (Muir and O'Dea, 1992). Cooking banana with plenty of water reduced the resistant starch content (Muir and O'Dea,

1992). We hypothesize that higher levels of banana meal could be included in broiler diets without having adverse effects on growth performance, if raw banana is cooked before being processed into meal. The present study tested the above hypothesis.

MATERIALS AND METHODS

Day-old broiler chicks (Cobb) were bought from a commercial hatchery. Brooding was done for 14 days on a deep littered (paddy husk) electrical brooder. From 1-20 days of age, birds were fed with a commercial broiler starter ration (CIC Feeds, Sri Lanka). On day 20, 144 chicks with similar average body weight were allocated into 48 floor pens. Three chicks were housed in each pen with a drinker and a feeder.

Discarded Cavendish type banana was collected from Dole Lanka Export Company in Buttala, Sri Lanka. Selected banana was at well mature but un-ripe stage. Two types of banana meals were prepared. In preparing cooked banana meal, banana was cooked in hot water (100°C) for 15 minutes. Subsequently, cooked banana was peeled, sliced into small pieces, dried at 80°C for 3 days and then ground to get cooked banana meal. In preparing uncooked banana meal, banana was peeled, cut into pieces, oven dried at 80°C for 3 days and then ground.

Eight broiler finisher rations were formulated incorporating either cooked or uncooked banana meal at 0, 10, 20 and 30%. All diets met the nutrient requirements given by NRC (1994). Crude protein (CP) content of the banana meals as determined by Kjeldhal method were used in ration formulation. The level of amino acids and minerals of the banana meals were not considered in ration formulation. Ingredient composition and calculated nutrient compositions of the diets are given in Table 1.

Table 1: Ingredient composition and calculated nutrient composition of the diet

Ingredient (g/kg)	Level of banana meal (g/1000 g)			
	0	100	200	300
Yellow maize meal	390	322	210	135
Soybean oil meal	261	294	326	362
Rice bran	119	71	46	9
Banana meal	0	100	200	300
palm oil	90	95	110	115
Coconut poonac	70	48	38	10
Fish meal	35	35	35	35
Shell powder	23	23	23	23
DCP	6	6	6	5
Salt	2.5	2.5	2.5	2.5
Vit min mix	2.5	2.5	2.5	2.5
DL Methionine	1	1	1	1
Calculated nutrient composition				
[1]MEn (Kcal/Kg)	3200			
CP	200			
[2]Non phytate P	3.5			
[2]Ca	9			
[2]Lysine	11			
[2]Methionine	7.4			

[1]The ME_n of the banana meals were calculated using the formula; $ME_n(MJkg^{-1}) = 0.1551 \times \%$ crude protein $+ 0.3431 \times \%$ fat $+ 0.1669 \times \%$ starch $+ 0.1301 \times \%$ total sugar (expressed as sucrose) (Anonymous,1986). The sugar and starch contents of the banana; as given by Adeniji *et al.* (2007). [2]Without considering nutrients coming from banana meal.

The experiment followed a completely randomized design in factorial arrangement. The main treatment factors were two types of banana meal (cooked and uncooked) and four dietary banana meal inclusion levels (0, 10, 20 and 30%). Experimental diets and water were provided *ad libitum* from day 21-42.

Rate of digesta passage of eight randomly selected birds from each treatment combination were determined on day 36 as described by Washburn (1991).

Eight randomly selected birds from each treatment combination were slaughtered on day 42. Weights of the liver, gizzard, crop, small intestine, abdominal fat pad and the length of the small intestine were determined. Tibias were analyzed for fat free tibia ash as described by Kim *et al*. (2009).

Data were analyzed as a completely randomized design in 2 x 4 factorial arrangement, using GLM procedure of SAS (1989). Significant means were compared using DMRT procedure.

RESULTS AND DISCUSSION

Proximate composition, pH and bulk density of the two types of banana meal are given in Table 2. The proximate composition of the two types of banana meal was not significantly different. The proximate components of the banana meals were similar to those values reported by Adeniji *et al.* (2007). The CP contents of banana meals were lower than that of the commonly used cereals and their by-products in poultry feeds (NRC 1994). Furthermore, the protein profile of banana was found to be deficient in lysine, methionine and tryptophane (Emaga *et al*., 2011). Therefore, the protein value of banana meal is assumed to be low.

Table 2: Proximate composition of the two types of banana meal

Analysis parameter	Cooked banana meal	Uncooked banana meal	Probability
Dry matter %	90.5	87.4	NS
CP %	2.3	2.3	NS
Fat %	0.37	0.38	NS
Crude fiber %	4.2	4.0	NS
Ash %	2.88	3.04	NS
pH	4.98	5.08	NS
Bulk density(g/cm^3)	0.66	0.65	NS

NS; P>0.05

The ME value of banana meal calculated using the formula given by EEC Directives (Anonymous, 1986) and the starch and sugar composition values given by Adeniji *et al* (2007) was as high as 2624 Kcal/Kg. The high energy value and the low fibre content of the banana meal suggest that it could be a good energy feed ingredient for poultry feeding.

The type or level of banana meal had no significant effect on feed intake (Table 3). However, increase of the dietary banana meal level from 10 to 30% improved the feed intake linearly ($p<0.01$); feed intake (g) = 2935 + 8.8 x banana meal level (%). Birds eat to satisfy their energy requirement and thus increase the intake when the energy content of the diet was decreased (Kamran *et al.*, 2008). Therefore, it seems that the actual ME content of banana meal was lower than what was calculated and used in ration formulation (2624 Kcal/Kg) and birds consumed more feed to satisfy their energy requirement. The increased feed intake of banana meal given birds suggested that banana meal does not contain anti-nutrients that reduce the feed intake of broilers. These findings are in line with Adeniji *et al.* (2007) who found that banana contained low levels of anti-nutrients such as tannins, phytates and oxalates.

Table 3: Effects of four levels of cooked and uncooked banana meal on growth performance of broiler chicken from day 21-42

Type of banana meal	Uncooked				Cooked				SD	Probability		
Level of BFM (%)	0	10	20	30	0	10	20	30		Type	Level	Type*Level
Live weight (g)												
21d	847	867	849	837	855	842	861	852	9.3	NS	NS	NS
28 d	1415	1487	1461	1425	1467	1473	1496	1506	21	0.01	NS	NS
35 d	1996	2069	2024	1976	2082	2007	2116	2112	35	0.01	NS	0.04
42 d	2392	2439	2393	2388	2418	2484	2471	2541	57	0.07	NS	NS
Weight gain	1545	1572	1543	1551	1562	1642	1609	1689	54	0.07	NS	NS
Feed intake	2967	2970	3090	3216	3119	3074	3139	3181	70	NS	NS	NS
FCR	1.92	1.89	2.00	2.07	1.99	1.87	1.95	1.88	0.05	NS	NS	0.09

NS; P>0.05.

Table 4: Effects of four levels of cooked and uncooked banana meal on some carcass parameters of broiler chicken

Type of banana meal	Uncooked				Cooked				SD	Probability		
Level of banana meal (%)	0	10	20	30	0	10	20	30		Type	Level	Type*Level
Visceral organ weight (% of empty carcass)												
Crop	0.47	0.49	0.50	0.44	0.64	0.65	0.52	0.72	0.2	0.01	NS	NS
Proventriculus	0.75	0.56	0.61	0.67	0.65	0.66	0.65	0.71	0.05	NS	NS	NS
Gizzard	2.2	1.9	1.9	2.0	2.0	2.0	1.9	2.0	0.1	NS	NS	NS
Small intestine	5.8	5.4	6.1	5.8	5.8	5.9	6.1	6.1	0.39	NS	NS	NS
Liver	2.9	2.5	3.1	2.7	3.6	3.2	3.2	2.8	0.19	0.005	0.03	NS
Abdominal fat	2.4	1.9	1.9	1.9	2.5	2.2	2.0	2.6	0.3	NS	NS	NS
Length of small intestine[1]	10.8	9.9	10.4	10.9	9.5	10.2	10.5	11.2	0.48	NS	NS	NS
Digesta retention time (min)	149	141	131	131	149	144	137	126	9	NS	NS	NS
Tibia ash (%)	57	58	56	58	58	59	56	59	1.3	NS	NS	NS

NS; P>0.05; 1; as a % of empty carcass.

No mortalities were recorded during the experiment. The level of banana meal had no significant effects on the growth performance parameters. However, the body weight of the birds fed cooked banana meal on day 28 (1485 g) and 35 (2079 g) were significantly (P<0.05) higher than those fed uncooked banana meal (1445 and 2016 g, respectively). Even though the feed intake or the feed conversion ratio was not affected by the type of the banana meal, body weight on day 42 and weight gain of the birds fed cooked banana meal (2478 and 1625 g) were tended (P=0.07) to be higher than those fed un cooked banana meal (2403 and 1552 g). It was hypothesized that the negative effects of resistant starch of banana could be mitigated by cooking. However, results of this experiment suggest that cooking of banana had positive effects on feed intake only during 21-28 day and on body weight up to day 35. The type x level interaction was significant for live weight on day 35. At lower banana levels (0, 10 or 20%) cooking had no significant effect. The LS means comparison showed that at 30% dietary banana meal, birds fed cooked banana meal were significantly heavier than those fed uncooked banana meal. It is suggested that relatively younger birds were benefited from cooking banana before being processed. Even though cooking had statistical trend (P=0.07) of improving the performance parameters such as body weight on day 42 and weight gain, it was noted that cooking incurs additional financial and energy costs and is practically cumbersome. It is not clear why cooking did not produce positive effects.

Babatunde (1992) showed that high dietary banana meal reduced the performance of poultry. However, the growth performance data of this experiment clearly showed that if mature fruits are used and the rations are nutritionally balanced, banana meal can be used up to 30% without affecting the growth performance negatively.

Effects of four levels of cooked and uncooked banana meal on some carcass parameters of broiler chicken are shown in Table 4. The percentage weight of the crop of the birds fed cooked banana meal (0.63%) was significantly (P<0.05) higher than those fed uncooked banana meal (0.47%). The percentage liver weight was significantly higher for the birds fed cooked banana meal (3.2%) than those fed uncooked banana meal (2.8%). Birds fed the control diet also had higher liver weight than those fed 10 or 30% banana meal. Reason/s for above organ weight changes is/are not clear.

Presence of anti-proteolytic substances was found to cause pancreatic hypertrophy (Gallinger *et al.,* 2003). Suggesting that banana meal does not contain anti-proteolytic factors, inclusion of banana meal had no effect on the weight of the pancreas. Banana is low in phytate (Adeniji *et al.,* 2007). Also, the rations were balanced for phosphorus without considering the P originating from banana meal. Due to the above two reasons, the tibia ash contents were similar across all treatments.

Despite the fact that birds fed diets with banana meal ate more feed, the percentage of abdominal fat was not affected by type or level of dietary banana meal. This further suggests that the actual energy level of banana meal could be lower than assumed and birds fed banana meal diets have increased their intake to satisfy their energy requirement.

Presence of viscous polysaccharides such as beta glucans and arabinoxylans in the feed ingredients reduced the rate of digesta passage leading to a range of adverse effects (Slominski, 2011). The rate of digesta passage in this experiment was not affected either by the type of or the level of the banana meal. This suggests that well mature banana used in this experiment contained little non starchy polysaccharide levels.

Conclusion: It was concluded that uncooked banana meal produced using peeled raw banana can be included up to 30% in nutritionally balanced broiler finisher diets without any adverse effects on performance.

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