EFFECTS OF FEEDING VARYING LEVELS OF FEED MILL WASTE (FMW) ON THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS

Benante, V., Atuahene, C.C., Quaye, B., Opoku, O., Agyei, P. and Adu-Amankwah, P.
Department of Animal Science, Faculty of Agriculture,
Kwame Nkrumah University of Science and Technology (KNUST).
P. O. Box UP 244, Kumasi, Ghana.

ABSTRACT
An experiment was conducted with Cobb-500 commercial broiler chicken to investigate the effect of feeding varying levels of Feed mill waste (FMW) on their growth performance and carcass characteristics. One hundred and forty-four out of a total consignment of one hundred and fifty broilers were randomly allocated to four dietary treatments in a completely randomized design. The dietary treatments were T1, a Control diet with 0% FMW, T2 (5% FMW), T3 (10% FMW) and T4 (15% FMW). Experimental diets and water were given ad- libitum for a period of five (5) weeks after three (3) weeks of brooding. Growth performance were measured during the rearing period and afterwards, carcass characteristics were evaluated. There were no significant difference (p>0.05) among all the treatments (T1 to T4), for all the growth parameters studied. Numerically, daily and total feed intake for the control group (T1) was higher than all the other treatment groups. In terms of the daily and total weight gains, treatment T2, T3 and T4 had numerically higher mean values than the control group (T1). The trend was the same for FCR. Feed cost/kg diet and feed cost/kg weight gain decreased as the inclusion levels of FMW increased across the various treatments from the control group (T1) to T4. There were no mortalities during the experiment. It was concluded that FMW can be incorporated in broiler diets at an inclusion level of up to 15% without any adverse effect on growth performance and carcass characteristics. The inclusion of FMW could reduce the feed cost and the cost of producing a kg weight gain.

INTRODUCTION
Poultry production in Ghana has experienced a decline over the years due to a myriad of problems. The unpredictable rise in the cost of poultry feed is chief among them (Ravindran, 2013). The continuous rise in the feed cost is as a result of humans competing with animals for the same limited feed ingredients (Abdullah *et al.,* 2009). This rise in feed cost goes a long way to increase the cost of production and so makes poultry production unprofitable and so unattractive to farmers, since feed alone constitute about 60-70% of the total cost of production (Anaeto *et al*., 2009). With this increasing trend in conventional feed cost, there is every need to get alternative sources of feed ingredients particularly those of energy and protein origin, since protein and energy sourced ingredients are usually expensive. In order to reduce feed cost and eventually the production cost, alternative feed ingredients which can equally replace the levels of these conventional feed ingredients either wholly or partially must be identified. One of the non-conventional feed ingredients that is readily and locally available to replace maize in broiler rations is feed mill waste (FMW). Feed mill waste is a by-product from the feed mill industry, and includes leftovers from the milling and mixing

Table 1: Composition of experimental diets

Ingredients (%)	Dietary Treatments			
	T1 (0% FMW)	T2 (5% FMW)	T3 (10% FMW)	T4 (15% FMW)
Maize	60	55	50	45
Feed mill waste	0	5	10	15
Soybean meal?	23.4	23.4	23.4	23.4
Wheat bran	10	10	10	10
Concentrate	4.1	4.1	4.1	4.1
Oyster shells	2	2	2	2
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100
Analyzed chemical composition				
Moisture	12.5	13	12.8	12.5
Crude fibre	7	6	5	5
Ash	6.3	6	5.8	5.8
Crude fat	10.5	11	10.3	11
Crude protein	19.7	20.0	21.5	19.3
*ME (kcal/kg)	3163.9	3142.52	3121.14	3099.76

**ME= Calculated metabolizable Energy*

of feedstuffs, which is usually swept and bulked together by mill operators. Feed mill waste comprises of bit and pieces of ingredients that can make a complete diet and so the tendency of it having reasonable amounts of the various nutrients is high.

Mill waste (FMW) is known to be of high protein and energy content and is capable of replacing maize in broiler diets (Boras *et al.,* 2006). Therefore, the objective of the study was to feed varying levels of FMW to broiler chickens to assess its effect on the growth performance of broiler chickens and their carcass characteristics?

Specific objectives of the study

i) Evaluate the effects of substituting maize with feed mill waste on the growth performance and carcass characteristics of broiler chickens.
ii) Compare the economics of producing broiler at different inclusion levels of feed mill waste.

MATERIALS AND METHODS

Location and period of study

The study was conducted at the Poultry Section of the Department of Animal Science, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi. The trial lasted for five weeks after three weeks of brooding.

Experimental birds

A total of one hundred and fifty (150) Cobb-500 day old broiler chicks were purchased from Akate Farms and were used for the study. The chicks were brooded on a floor litter for a period of three (3) weeks in a brooder house. A broiler starter diet containing 22.04% crude protein and 3004 kcal/kg metabolisable energy was fed to the birds *ad libitum* during the brooding period. Water was also given *ad libitum* during this period. At the fourth week one hundred and forty-four (144) out of the total of one hundred and fifty (150) birds were selected and weighed for the experiment.

Source of FMW

The Feed mill waste (FMW) which was used for the experiment was obtained from Boris B's Feed Mill at Sewua Junction, along Atonsu road - Ashanti Region of Ghana.

Experimental diet

The experimental diets contained maize, soybean meal, broiler concentrate, wheat bran, oyster shells and common salt. Birds in the control treatment group (T1) were fed basal diet without the inclusion of FMW. The experimental treatment groups (T2, T3 and T4) had substitution of maize with FMW in the proportion of 5%, 10% and 15% in the diets respectively. The detailed composition and analyzed chemical content of the formulated diets is shown in Table 1

Experimental design

The birds were allocated to four (4) dietary treatments using the Completely Randomized Design (CRD). There were 3 replicates in each treatment with each replicate containing twelve (12) birds.

Chemical analysis

A proximate analysis of the feed mill waste and the experimental diets were carried out at the Nutrition Laboratory, Department of Animal Science, Faculty of Agriculture using the standard procedure of the Association of Official Analytical Chemist (AOAC, 1990).

Housing and management

The birds were kept on wood shavings (depth=2.5cm) in deep litter pens to a. The wood shavings were changed as and when it got wet so as to enhance better aeration and ensures clean litter throughout the study. The birds were given access to their respective diets and water *ad libitum* throughout the feeding trial.

Vaccination and medication schedule

Vaccination of the birds were carefully carried out according to a well-planned programme. The birds were vaccinated against Newcastle and Gumboro diseases. The various doses were given according to the manufacturers specifications. Other prophylactic measures were put in place to prevent disease outbreak.

Parameters measured

The parameters measured were feed intake, weight gain, feed conversion ratio and carcass characteristics.

Feed intake and weight gain

Average daily feed intake per bird was recorded by subtracting the feed left from the feed given the previous day, and dividing it by the total number of bird per replicate. This was done using an electronic computing scale. Average weight gain per bird was also determined for each replicate by subtracting the previous weight from the current weight, dividing it by the total number of birds in that replicate using an electronic computing scale.

Feed conversion ratio (FCR)

Feed conversion ratio was computed as the total feed intake divided by the total weight gain.

Carcass analysis

At the end of the experimental period, three birds were selected based on the average weight of the group from each replicate. The birds were individually weighed and then slaughtered by rupturing the jugular vein and were bled completely. The bled and de-feathered weights were taken. After evisceration, the following weights were taken; shank, wings, drumstick, thigh, breast, neck, full and empty gizzard, liver, heart, full and empty intestines.

Statistical analysis

The data obtained was subjected to analysis of variance using Minitab (version 18.1). The difference in means were separated using Tukey's pairwise comparison at 95% confidence level.

RESULTS AND DISCUSSION

Table 4 below shows the chemical composition of the experimental material (FMW). The calculated ME energy level of the FMW was 2992.4 Kcal/kg which is lower than the energy content of maize (3920 Kcal/kg) ME indicating that the energy content of experimental diets will decrease as the inclusion level of FMW increases. But the diet with the highest inclusion level of FMW (15%) had a calculated ME content of 3099.76 Kcal/kg which is within the energy requirement of broilers ie 2874.2-3723.02 Kcal/kg as stated by Ahiwe *et al*., (2018). However the crude protein content of the FMW was 14.45%

which is higher than that of maize (6-10%) but closer to that of wheat brand both of which are commonly used in poultry diets in Ghana (Dameke, 2018; Baah *et al*., 1999). This gives an indicating that FMW has the potential of partially or may be wholly replacing this ingredients in a broiler ration. The low fiber and fat content will make FMW a viable feed ingredient for poultry and other livestock as there will be no fibre digestibility issues because according to Bedford (1996), high fibre diets are less well digested and utilized by monogastric animals like poultry.

Table 4: Proximate composition of FMW (%) as-fed

Items	Composition (%)
Moisture	11.75
Ash	6.5
Crude protein	14.45
Crude fat	4.75
Crude fibre	3.43
Nitrogen free extract	59.12
*Metabolisable energy, kcal/kg.	2992.4

**calculated*

Feed intake and weight gain

The values recorded for all the parameters mentioned in Table 5 were not significantly (p>0.05) different. Numerically, daily and total feed intakes for the control group (T1) were higher than that of the treatment groups (I.e T2, T3 and T4). There was a trend towards a decrease in feed intake as the inclusion levels of the FMW increased in the diet. This finding agrees with the findings of Oke (2013) who recorded no significant difference when he included bread waste in the diet of broilers but saw numerical reduction in feed intake when the inclusion level of bread waste increased in the diet.

In terms of daily and final weight gains, the treatment T2, T3 and T4 had numerically higher mean values than the control group (T1). The similarities in weight gains among the birds of all treatments in the study could imply that FMW inclusion in the diet of the broilers was accepted by the birds and that they were able to feed sufficiently and then assimilated the nutrients for body weight gain.

Feed cost/kg diet, FCR and feed cost/kg weight gain

The feed conversion ratio (FCR) observed for the birds on FMW inclusion diets and those on the control diet were similar (P> 0.05), indicating that FMW is a viable feed for broiler birds. Feed cost per kg diet decreased as the inclusion levels of FMW increased across the various treatments from the control group (T1) to T4, this trend could be attributed to the fact that the per kg price of FMW is lower than that of maize and as such the partial replacement of maize with FMW will translate into the reduction of the cost of the diet. This implies that farmers will be better off on every percentage increase of the FMW in the diet, because in a typical broiler diet formulation maize constitute about 65% of the diet (Baurhoo *et al*., 2011) and so a reduction of maize in the feed will reduce the feed cost which will in turn reduce the overall cost of production and perhaps maximize profit. Feed cost per kg weight gain on the other hand also decreased as the inclusion of FMW increased across the various treatments. This gives an indication that when 15% of FMW is incorporated into broiler diet, farmers will pay less as far as feed is concerned for the same kg weight gain.

Carcass characteristics

No significant (P>0.05) difference was observed between the treatments for all the carcass traits measured. Nevertheless, in numerical terms, birds of the control group (T1), recorded higher mean values as compared to treatment T2, T3 and T4.

The non-significant (p>0.05) differences observed in the weights of the carcass characteristics indicates that the physiological and anatomical functions of these organs were not affected by the various inclusions of FMW in the diets, this further indicate that the FMW may not have non-digestible substances or toxins at levels that could tamper with the normal physiological and anatomical functions of these organs in broilers.

Radwan (1995) recorded no significant (p>0.05) difference among carcass traits in a similar study he conducted when he incorporated bakery by-product into Baladi chick diets at level 10, 20, 30 and 40%.

Table 5: Effects of FMW on growth performance and economics of production of broiler birds

Parameter	Dietary Treatments T1 (0% FMW)	T2 (5% FMW)	T3 (10% FMW)	T4 (15% FMW)	P–value
Daily feed intake (g)	165.2	163.6	162.8	161.5	0.09
Total feed intake (g)	5,798.6	5, 727.0	5,699.5	5,652.0	0.09
Initial weight (g)	655.3	694.0	640.7	659.6	0.59
Daily weight gain (g)	54.0	55.9	54.8	54.3	0.68
Total weight gain (g)	1,888.3	1,957.6	1,917.7	1,901.1	0.68
Final weight (g)	2543.5	2651.5	2558.4	2560.6	0.59
FCR	3.07	2.93	2.97	2.97	0.79
Feed cost/ kg (GH¢)	1.22	1.18	1.14		1.10
Feed cost/kg weight gain (GH¢)	3.66	3.35	3.24		3.15

^{ab}*Mean values within the same row with different superscripts are significantly (p<0.05) different*

Table 6: Effects of FMW on carcass characteristics of broiler chicken

Carcass Trait	Dietary Treatment T1(0%FMW)	T2(5%FMW)	T3(10%FMW)	T4(15%FMW)	P-value
LW(g)	2281	2270	2143	2128.3	0.79
BW(g)	2200	2183	2083	2075	0.42
DW(g)	2063	2050	1933	1916.7	0.88
EW(g)	1700.0	1733	1747	1763.3	0.99
SHANK (g)	87.97	80.57	78.50	71.67	0.32
WINGS (g)	95.63	90.47	86.03	82.03	0.63
DRUM STICK (g)	231.1	219.9	214.3	210.4	0.81
THIGH (g)	250.6	235.1	229.57	222.97	0.44
BREAST (g)	496.5	490.8	473.8	464.8	0.95
NECK (g)	93.1	90.20	88.07	81.23	0.67
FULL GIZZARD (g)	65.67	63.80	62.67	61.93	0.34
EMPTY GIZZARD (g)	44.00	43.99	43.07	42.73	0.33
LIVER (g)	39.37	34.20	33.47	33.100	0.12
HEART (g)	12.10	10.92	10.43	9.90	0.29
FULL INTESTINE (g)	106.97	106.5	105.03	104.06	0.97
EMPTY INTESTINE (g)	76.63	75.10	74.9	74.4	0.834

LW: live weight,
BW: bled weight,
DW: defeathered weight,
EW: eviscerated weight

CONCLUSION

It is concluded that farmers can add feed mill waste at an inclusion level of up to 15% when formulating feed for their broilers since at this level of inclusion no detrimental effects on the growth performance and carcass characteristics of the birds were recorded. It rather helped in reducing the feed cost and the cost of producing a kg weight gain.

RECOMMENDATION

It is recommended that further research should be carried out to ascertain the optimum inclusion level of the FMW in the diet of broilers. Since it is likely that FMW can be a variable product, there is the need for it nutritional profiles be fully characterised.

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