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Inclusion of Honey Bee Slum Gum in Broiler Chicken Feed

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ABSTRACT

An eight week feeding trial was conducted to evaluate the effect of inclusion of honey bee slum gum meal (HBSM) in broiler diets. HBSM was mixed with Maize in a ratio 1:4 and milled to obtain maize honey bee slum gum meal (MHBSM). Five diets were formulated where 0, 25, 50, 75 and 100% of maize was replaced by MHBSM in broiler starter and finisher diets. Data were collected on feed intake, weight gain, feed conversion efficiency, carcass characteristics and organ weight. Results showed that diet has no effect on the feed intake, weight gain and feed efficiency in the first two weeks. Between week 3 and 8, birds fed 0%, 25% and 50% MHBSM were comparable in terms of feed intake, weight gain and feed efficiency, while those fed 75% and 100% MHBSM showed significant ($P<0.05$) depression with respect to the same parameters. Pancreas weight of birds fed 75% and 100% MHBSM were higher ($P<0.05$) than those fed other diets. It was concluded that broiler chicks can tolerate up to 100% MHBSM (11.2% HBSM) in the first two weeks and up to 50% MHBSM (5.2% HBSM) up to the finishing phase.

Key Words: Slum gum; Apicultural products; Carcass characteristics; Feed intake; Weight gain

INTRODUCTION

Recycling of agricultural waste is important for economic and ecological reasons. In the apicultural industry, one of the major wastes is slum gum, which is obtained after melting the honeycomb into wax. Melted slum gum can be poured on fire wood to start fire and to attract bee swarms (Bradbear, 2009). Experiences in south western Nigeria have shown that slum gum are good breeding materials for apicultural pests, most especially the wax moth, (*Galleria melonella*) and hive beetle (*Aethenia tumida*). Many local bee keepers in developing world are not used to wax production. This has been attributed to lack of technical knowledge as well as non availability of local market for bee wax. In most of these places, honey comb is therefore, thrown away after honey extraction, which often renders the areas prone to pest infestation and resultant effect of great financial cost in pest control and loss of income accruable from sales of wax.

In a former experience, it was observed that when combs infested by wax moth were offered to cockerel, they ate both the insects and the combs. That observation motivated this study. Honey comb often times contain pollens, brood lining and eggs, which are potential sources of protein and energy. Slum gum is composed of a mixture of dead bees, cocoons, honey, beeswax and propolis (Tew, 1992). Cereal grains, which constitute the major source of energy are becoming expensive in most developing countries of the world due mainly to declining production as well as stiff competition for its use by man and livestock. The use of honey bee slum gum to replace part of maize: which accounts for between 50-55% (Afolayan *et al*., 2002) in poultry diet may be a way of solving the problem of high off-farm input prices most especially feed prices in poultry production. Several authors (Agunbiade *et al*., 2002; Onu & Madubuike, 2006; Amerah & Ravindran, 2008; Oladunjoye *et al*., 2010) have investigated the potential of incorporating several agro allied by-products into animal feeds with the primary aim of reducing feeding costs.

The objective of the present work was to evaluate the effect of honey bee slum gum meal on growth parameters of broiler chicken with the ultimate target of preparing ground for integrating bee keeping into small scale poultry production.

MATERIALS AND METHODS

Experimental location: The study was carried out at Brooder House Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Sources and processing of honey comb: Bee combs were collected from Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Apiary Unit and a

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private farm in Ogbomoso. Wax processing was done according to Segeren (1997). Honey comb was collected after extraction of honey. Four kilogram of comb were washed in clean water and afterwards, loaded in a clean cheese cloth. The content was then placed in 15 L aluminium pot on stone pebbles in the pot to prevent the slum gum from touching the bottom of the pot and 6 L of water was added. The content was then heated until the slum gum melted around 80-90^{0}C. The water and wax was then decanted and sieved to separate the two contents. Wax processing was repeated till sufficient honey bee slum gum was obtained. The average yield of slum gum from honey comb after wax processing was approximately 35% of the comb. This was then taken to the laboratory for proximate analysis.

Experimental diets: Honey bee slum gum was mixed with dry maize in ratio 1:4 and then milled with hammer mill to obtain what was referred to as maize honey bee slum gum meal (MHBSM). This was done to facilitate thorough mixing with other ingredients. Five diets were formulated, where 0, 25, 50, 75 and 100% of maize was replaced by MHBSM. This amounted to 0, 2.8%, 5.6%, 8.4% and 11.2% HBSM, respectively in the finisher diets. The diets were fed to the birds in mash form and offered *ad libitum*.

Laboratory analysis of feeds and HBSM: Feeds and HBSM were analyzed for proximate composition using the methods of AOAC (1990).

Bird management and experimental design: Two hundred days-old Anak 2000 broiler chick were purchased from a hatchery within Ogbomoso township of Nigeria. The birds were divided into five groups of forty birds each and the groups assigned to the five diets in a completely randomized design. Each treatment was replicated four times at the rate of 10 birds per replicate. Birds were housed in deep litter pen of 1.2 m × 1 m with the floor covered with wood shavings to the depth of 6 cm. Feed and water were served *ad libitum.* Vaccination and medication of the birds were carried out according to the standard practice in modern day poultry production. Birds were offered starter feed for the first period (0-4 weeks) and finisher feeds from then (4-8 weeks). Light was provided for 24 h during brooding (0-4 weeks), thereafter the birds were restricted to 12 h daily light. The temperature was monitored and adjusted during brooding period, while at finishing period the average daily temperature was 27.5^{o}C.

Data collection: Feed intake and body weight were recorded weekly. Feed consumption, weight gain and efficiency of feed utilization were used as a measure of chick's performance. Feed was served at 8.00 am daily. Feed intake was measured weekly using sensitive weighing scale. This was estimated as feed served at the beginning of the week and the left over at the end of the week. Weight of the birds was taken at the commencement of the experiment and weekly thereafter. Weight change was estimated as the difference in the weight of the birds in two successive weeks. Feed conversion efficiency was determined from the record of feed intake and weight gain. The study lasted for 56 days.

Mortality: This was determined as the number of dead birds in a group as percentage of total number of birds in the group. Feed efficiency was corrected by mortality.

Carcass analysis: Eight birds per treatment were randomly selected for carcass analysis at the end of experiment. Animals were fasted for 24 h and immediately afterward euthanized by jugular vein cut and weighed. Carcasses were opened and internal organs (liver, pancreas, heart, gizzard, proventriculus) carefully excised clean of blood and weighed using electronic weighing scale. Carcasses were scalded dressed and weighed. The weights of the carcass and organs were expressed as the percentage of the live weight of the birds.

Statistical analysis: Data were analyzed by one-way analysis of variance (ANOVA) using SAS Software (SAS Institute 2000) with the linear additive model:

$$Y_{ij}=\mu+\tau_i+\varepsilon_{ij}$$

Where: Y_{ij} is the jth observation of the ith treatment
μ is the population mean
τi is the treatment effect of the ith treatment and
ε_{ij} is the random error.

RESULTS

The proximate composition of HBSM is presented in Table I. The gross composition of diets is presented in Table II. The crude protein, crude fibre, ether extract, ash and nitrogen free extract were 9.37%, 0.45%, 54.94%, 1.75% and 23%, respectively. The experimental diets met the requirements of the birds at both the starter and finisher phases.

Feeding of HBSM had no significance (P>0.05) effect on the feed intake of the bird in week 1 and 2 (Table III). However, birds fed 75% and 100% MHBSM (diets 4 & 5) consumed significantly (P<0.05) less feed than those fed 0%, 25% and 50% MHBSM (diets 1, 2 & 3, respectively) in week 3. Between weeks 4 and 8 (finishing phase), birds that were fed diet 3, 4 and 5 consistently consumed significantly (P<0.05) less feed than those fed diets 1 and 2.

Diet had no effect on the body weight gain of the birds in the first 2 weeks of the study (Table IV). However,

Table I: Proximate composition of honey bee Slum gum meal

Parameter	%
Dry matter	90.4
Crude protein	9.37
Crude fibre	0.45
Ether extract	54.9
Ash	1.75
Nitrogen free extract	23.8

Table II: Gross composition of experimental diet (%)

	Starter diet					Finisher diet				
Ingredient	**Control 1**	**2**	**3**	**4**	**5**	**Control 1**	**2**	**3**	**4**	**5**
Maize	56.0	42.0	28.0	14.0	0	52.0	39.0	26.0	13.0	0
MHBSM	0	14.0	28.0	42.0	56.0	0	13.0	26.0	39.0	52.0
Soya bean meal	26.0	26.0	26.0	26.0	26.0	23.0	23.0	23.0	23.0	23.0
Fish meal	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0
Wheat offal	9.25	9.25	9.25	9.25	9.25	17.8	17.8	17.8	17.8	17.8
Oyster shell	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Bone meal	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0
NaCl	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Methionine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Premix	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Crude protein	20.8	20.6	20.5	20.4	20.4	19.4	19.3	19.2	19.1	19.0
Metabolizable Energy (Kcal/g)	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.7	2.7	2.7
Crude fibre	3.5	3.4	3.2	3.2	3.0	3.8	3.6	3.5	3.42	3.4

MHBSM = Maize honey bee slum gum meal mixture

Premix composition: Vitamin A, 200,000,00 IU, Vit. D_3 40,000,00 IU Vitamin E (Mg) 460, Vitamin K_3 (Kg) 40, Vitamin B_1 (Mg) 60, Vitamin B_2 (Mg) 120, Niacin (Mg) 1,000, Calcium pantothenate (Mg) 200, Vitamin B_6 (Mg) 100, Vitamin B_{12} (Mg) 05, Folic acid (Mg), 20, Biotin (Mg) 1, Chlorinechloride (Mg) 8,000, Manganese (Mg) 2,400 Iron (Mg) 2,000, Zic (Mg) 1,600 Copper (Mg) 170, Iodine (Mg) 30, Cobalt(Mg) 6, Selenium (Mg) 24, Anti-oxidant (Mg) 2,400

Table III: Feed intake of Broiler chicken fed honey bee slum gum meal-based diet (g/bird/week)

	Level of MHBSM in the diet (%)						
Week	**0**	**25**	**50**	**75**	**100**	**SEM**	**P**
1	205.	208	204	203	207	5	0.6
2	281	282	284	281	275	10	0.63
3	332a	337a	335a	312b	285c	12	0.03
4	499[a]	495[a]	473[b]	454[b]	432[c]	13	0.33
5	608[a]	605[a]	565[b]	543b[c]	521[c]	25	0.036
6	698[a]	695[a]	672[b]	651b[c]	632[c]	22	0.38
7	742[a]	740[a]	718[b]	698b[c]	678[c]	23	0.021
8	749[a]	738[a]	647[b]	645[b]	621[b]	30	0.032

MHBSM = Maize honey bee slum gum meal mixture

[abc]*Means with different superscripts along the same row are significantly different P<0.05*

Table IV: Body weight gain of Broiler chicken fed honey bee slum gum meal-based diet (g/bird/week)

	Level of MHBSM in the diet (%)						
Week	**0**	**25**	**50**	**75**	**100**	**SEM**	**P**
1	120	117	116	116	116	8	0.54
2	93.8	93.5	94.2	90.5	90.2	7	0.66
3	128[a]	126[a]	125[a]	99.3[b]	85.8[c]	10	0.032
4	150[a]	152[a]	148[a]	138[b]	124[c]	7	0.025
5	409[a]	405[a]	402[a]	379[b]	361[b]	20	0.031
6	305[a]	304[a]	302[ab]	288[b]	274[b]	15	0.028
7	326[a]	323[a]	322[a]	309[b]	306[b]	10	0.026
8	514[a]	513[a]	510[a]	470[b]	482[b]	15	0.031

MHBSM = Maize honey bee slum gum meal mixture

[abc]*Means with different superscripts along the same row are significantly different P<0.05*

between week 3 and 8, body weight gain of bird that were fed diet 4 and 5 were significantly (P<0.05) lower than that of the group fed diets 1, 2 and 3. It appeared that birds were able to tolerate up to 100% MHBSM in the first two week and up to 50% MHBSM in their diet between 3 and 8 weeks without any adverse effect on growth.

Dietary treatment had no significant effect (P>0.05) on the feed conversion efficiency in the first two weeks of the experiment (Table V). Birds that were fed diet 4 and 5 however showed depression in the feed efficiency in weeks 3 and 8 of the study.

No significant difference was observed in the dress weight, liver, gizzard, small intestine and large intestine of the bird (Table VI). However, live weight and pancreas were significantly affected by the dietary treatments. Birds that were fed diet 4 and 5 had significantly (P<0.05) less final live weight than those fed diet 1, 2 and 3. The pancreas of birds fed diet 3, 4 and 5 were however, larger (P<0.05) than that of groups fed diets 1 and 2.

Table V: Feed conversion efficiency of Broiler chicken fed honey bee slum gum meal based diet

	Level of MHBSM in the diet (%)						
Week	**0**	**25**	**50**	**75**	**100**	**SEM**	**P**
1	0.39	0.37	0.38	0.37	0.36	0.05	0.31
2	0.22	0.22	0.22	0.22	0.24	0.04	0.23
3	0.26[a]	0.24[a]	0.24[a]	0.20[b]	0.20[b]	0.03	0.03
4	0.35[a]	0.40[a]	0.41[a]	0.23[b]	0.24[b]	0.08	0.04
5	0.40[a]	0.45[a]	0.38[ab]	0.30[b]	0.20[c]	0.08	0.03
6	0.49[a]	0.48[a]	0.46[a]	0.31[b]	0.20[c]	0.06	0.04
7	0.45[a]	0.49[a]	0.46[a]	0.37[b]	0.30[c]	0.05	0.03
8	0.49[a]	0.49[a]	0.47[a]	0.42[b]	0.33[c]	0.04	0.03

MHBSM = Maize honey bee slum gum meal mixture

[abc]*Means with different superscripts along the same row are significantly different P<0.05*

DISCUSSION

A promising aspect of reducing animal production costs is feeding manipulation. However, this must be done with caution on the effect of such manipulation on the growth parameters and the productivity of the animal. This study investigates the effects of inclusion of honey bee slum gum into broiler's feed on its growth parameters.

Onu and Madubuike (2006) reported that broiler chicks could tolerate up to 20% dietary inclusion level of cooked wild cocoyam without any deleterious effects and that it was

Table VI: Carcass characteristics and organ weight of Broiler chicken fed honey bee slum gum meal-based diet

	Level of MHBSM in the diet (%)						
Week	**0**	**25**	**50**	**75**	**100**	**SEM**	**P**
Live weight(kg)	2.0[a]	1.85[a]	1.83[a]	1.43[b]	1.28[b]	0.25	0.04
Dressed weight (% live weight)	83.2	83.0	81.1	80.5	80.7	4.4	0.07
Liver (% live weight)	1.32	1.33	1.32	1.31	1.30	0.05	0.08
Pancreas (% live weight)	0.14[b]	0.15[b]	0.16[ab]	0.17[a]	0.18[a]	0.02	0.03
Gizzard (% live weight)	2.42	2.40	2.63	2.81	2.43	0.56	0.42
Small intestine (% live weight)	3.43	3.56	3.36	3.68	3.12	0.70	0.31
Large intestine (% live weight)	0.24	0.25	0.25	0.26	0.27	0.06	0.36

MHBSM = Maize honey bee slum gum meal mixture

[ab]*Means with different superscripts along the same row are significantly different P<0.05*

economically profitable as regards the cost of feed per kg weight gain. Amerah and Ravindran (2008) reported that the economics will favor whole wheat in a broiler mixed feeding system due to lowered processing cost.

The crude protein and ash content of HBSM were comparable to the values reported for maize (Ravindran *et al*., 1996). The crude fibre and nitrogen free extract were however, considerably lower. Ether extract value of HBSM was higher than that of any known feed ingredient. This was not likely to be oil but wax, which is equally soluble in ether and determined as ether extract. The fact that birds fed with 25 and 50% MHBSM (diets 2 & 3, respectively) compared with those fed control diet indicate the optimum level of inclusion of HBSM. Egbunike *et al.* (2009) reported that final live weight and weekly weight gain were not significantly affected by protein source (fish meal or groundnut cake), when cassava peel was incorporated into broiler feed. Earlier work by Agunbiade *et al.* (2002) had reported that up to 15% cassava peel can be incorporated into broiler feed. Recently, Oladunjoye *et al.* (2010) reported that cooked breadfruit (*Artocarpus altilis*) can replace up to 65% maize in broiler feed at both starter and finisher phases, without any adverse effects on growth performance and carcass quality. The depression that was observed in the feed intake of the bird could be due to reduce palatability as a result of change in the texture of the feed. The fact that feed intake of the bird were not affected in the first two weeks of the study could suggest that effect of HBSM on feed intake is cumulative.

The low weight and poor feed conversion efficiency observed in bird fed 75% and 100% MHBSM can be attributed to poor feed utilization occasion by sticky nature of HBSM, which could have increased the viscosity of digesta, preventing the proper mixing of the digestive enzymes (Ward, 1996) with the digesta. The poor utilization of wheat and barley-base diet has been attributed to non soluble polysaccharides, which increase the viscosity of the intestinal lumen of the birds (Low & Longland, 1989). Birds that were fed diet 1, 2 and 3 were able to tolerate HBSM in their diet through physiological adjustment.

Bigger pancreases that were observed in the birds fed 50%, 75% and 100% MHBSM can be attributed to viscous condition created by HBSM. Patridge and Wyatt (1995) attributed the bigger pancreas of the bird fed grains containing water soluble non starch polysaccharide to viscous condition of the gut content, which gave rise to feedback mechanism. The viscous environment that could result from feeding gel-like HBSM can impede the movement of nutrients to mucosa sites for proper digestion and absorption (Fengler *et al*., 1988).

CONCLUSION

The results of the study suggest that feeding of HBSM to broiler had some nutritional benefits at both starter and finisher phases. The birds can tolerate up to 50% MHBSM for good growth performance. However, there is the need for further research into the best form for inclusion of slum gum into poultry feeds before it can be recommended for small scale resource-poor poultry farmers.

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