UTILISATION OF HOUSEFLY (*MUSCA DOMESTICA)* MAGGOT MEAL IN THE DIETS OF JAPANESE QUAILS (*Coturnix coturnix japanica*)

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ABSTRACT

The experiment was conducted to evaluate the effect of replacing housefly maggot (Musca domestica) meal (HFM) with fish meal (FM) on the performance of Japanese quails (Coturnix coturnix japanica). Two hundred (200) one week old Japanese quails were randomly assigned to five dietary treatments of forty birds with four replicates of 10 birds per replicate in a completely randomized design. The diets contained maggot meal (MM) substituting 4% fish meal (FM) at graded levels of 0, 25, 50, 75, and 100% and were designated as T1, T2, T3, T4 and T5 respectively. The data obtained were analysed using GenStat Version 17.1 and means were separated using Tukey HSD. Results obtained from the experiment revealed that the inclusion of maggots in the diets of quails significantly ($p<0.05$) affected body weight gains (BWG), feed intake (FI) and cost per weight gain (C/BW). Nutrient digestibility of the birds indicated that CP, and EE were not significantly ($p<0.05$) affected by the experimental diets. This study has shown that house maggot meal (HMM) could replace an expensive conventional animal protein (fishmeal) in feed formulation for quail, but further investigations are needed to explore its full potential as protein substitute in other livestock.

Keywords: Housefly maggot, Replacement, Nutrient digestibility, Growth, Japanese quails,

INTRODUCTION

Global demand for animal protein foods is growing rapidly due to increase in population and socio-economic changes. This is observed particularly in developing countries (Godfray *et al.*, 2010). The conventional sources of feed protein for non-ruminant animals (fish, groundnut and soya bean meals), are not ecologically and economically sustainable (Barona *et al.* 2010; FAO, 2012). Therefore, the search for the least-cost ingredients and exploration for the replacement of the expensive feed raw materials with cheaper alternatives in the formulation of livestock ration is of optimal importance. Insects could provide an alternative animal protein source because they grow and reproduce easily and, they have favorable feed conversion efficiency (Veldkamp *et al.*, 2012). The most promising insect for protein production appears to be the common housefly. The housefly maggots are easy to rear; and can be produced by smallholder farmers and poor rural communities on small-scale production systems on farms (Nzamujo, 1999).

Researches in maggot meal concluded that its nutritional composition is suitable, and can serve as a replacement for other protein sources normally used in feeding animal. Nutritional parameters of housefly maggots (HFM) varied widely, with crude protein content ranging from 37.5% to 63.1% (Ogunji, *et al.*, 2008); lipid content ranges between 25.3 to 54.8%. Ogunji *et al.* (2008) reported that the biological value of maggot meal was equivalent to that of whole fish meal and that the larvae contained no anti-nutritional or toxic factors sometimes found in alternative protein sources of vegetable origin. The Japanese quail (*Coturnix coturnix japonica*) has the potential to serve as an exceptional and inexpensive source of animal protein due to the unique characteristics and advantages it has over other species of poultry. The birds attain early sexual maturity, have short generation interval and grow fast, attaining market between 5-6 weeks of age. Quail meat and eggs are renowned for their high quality protein, high biological value and low caloric value. The birds are very hardy and highly resistant to many poultry diseases (Edache *et al.*, 2005,). This study aims at evaluating the performance quail (*Cortunix cortunix japonica*) fed diets of varying proportions of maggot meal as a replacement for fish meal.

MATERIALS AND METHODS

This study was conducted at the Teaching and Research Farm of Faculty of Agriculture, Bayero University, Kano; in the Sudan Savanna geographic region of Nigeria.

Housefly (*Musca domestica*) Maggot Meal Production

Maggots were collected from Hasri Farms located at Hotoro, Nassarawa Local Government of Kano state. The maggots were harvested from the collecting pit of the farm. The maggots were washed, weighed blanched in hot water (100°C) for 1min and oven dry for 48h at 65C°. Impurities were removed and the dried maggots were re-weighed and milled into powder with a blender to form maggot meal.

Experimental Design and Bird Management

The experiment was laid in completely randomized design (CRD) in which 200 day-old one week old Japanese quails (*Coturnix coturnix japonica*) were randomly assigned to five 5 treatments, of 40 birds each; with each treatment having 4 replicates of 10 birds. Five isocaloric and isonitrogenous diets (Table 2) were formulated with maggot meal to replace fish meal at 0, 25, 50, 75 and 100%. The diets were designated as T1, T2, T3, T4 and T5 respectively. Proximate analysis of fish (FM) meal housefly maggot meal (HMM) and the formulated diets was carried out using (AOAC, 2006) methods at Animal Science Department Laboratory, Bayero University, Kano. Each replicate of ten birds were randomly transferred to colony cages measuring 124 x 92 x 65 cm (L x B x H). The cages were housed in well ventilated room. Heat was provided during the brooding period with the use of charcoal pot. Feed and water were offered *ad libitum*; and routine medication and good hygiene were observed. Individual body weights of the birds were recorded at the beginning of the experiment and weekly thereafter, while feed intake was recorded daily. Daily body weight gain of birds and feed conversion ratio was computed weekly. Mortality was checked daily and recorded. Four birds per treatment were used for the digestibility trials at the end of the experiment. Cost per kg body weight of the birds was calculated using the formulae below:

$$Cost\ per\ kg\ body\ weight\ (₦/\text{kg}) = \frac{Total\ cost\ \ of\ feed\ intake}{Final\ body\ weight}$$

Data Analysis

Data collected were subjected to analysis of variance using GenStat Version 17.1 (2015). Significant differences observed between treatment means, were separated using Tukey HSD.

Ethical Approval

The procedures used for husbandry and care of the experimental birds were according to:
FASS (Federation of Animal Science Society (2010)).

RESULTS AND DISCUSSION

Proximate composition of the experimental diets for Japanese quails *(Coturnix coturnix japonica)*

The proximate analysis of the experimental diet as shown on Table 1 revealed no significant differences (p>0.05) in the nutritional content.

Table 1: Proximate Composition of Experimental Diets

Parameters (%)	Diets					SEM
	T1	T2	T3	T4	T5	
DM	91.40	91.53	91.97	9.23	91.72	3.14
Crude protein	23.79	23.53	23.69	23.78	23.81	1.01
Ether Extract	4.35	3.76	3.82	4.08	5.44	0.62
Ash	10.05	10.45	10.41	10.50	10.25	0.47
Crude fibre	3.99	3.80	3.55	3.76	3.43	0.79
Nitrogen Free Extract	49.23	49.99	40.50	49.61	49.02	3.82
*ME (kcal/kg)	2980.10	2950.19	2970.08	2971.14	3061.96	46.76

* ME = 37 x % CP + 81.1 x % EE + 35.5 x % NFE (Pauzenga, 1985

The performance indices of quails fed varying proportions of HMM are presented on Table 2. Birds fed diets containing maggot meal were statistically (p<0.05) similar in body weight gains (BWG) but significantly differ (p<0.05) from the control group. There is paucity on studies of the performance of quails fed housefly maggot meal. However, Widjastuti *et al.* (2014) reported FI to significantly increase at only 25 and 50% level of inclusion of black soldier fly (*Hermitia illucens)* maggot meal as replacement for fishmeal. This also, was the findings of Ikhlas *et al.* (2010) who fed diets with DMLM (defatted yellow mealworm (*Tenebrio molitor*) meal) in place of fishmeal. However, Ikhlas *et al.* (2010) findings showed no significant differences (p<0.05) in FI of quails fed diets formulated with 10 and 15% black soldier fly maggot meal.

Table 2: Performance of Japanese quail (*Coturnix coturnix japonica*) Fed Diets Containing Various Levels of Housefly (*Musca domestica*) Maggot Meal

Parameters	Treatments					SEM
	Control	T1	T2	T3	T4	
IBW (g)	21.17	21.14	21.25	21.03	21.03	0.292
FBW (g)	167.10^{b}	171.24^{a}	172.50^{a}	172.61^{a}	172.75^{a}	1.753
BWG (g)	145.93^{b}	150.10^{a}	151.25^{a}	151.58^{a}	151.72^{a}	1.825
LWG(g/b/d	4.17	4.29	4.32	4.33	4.33	0.052
FI (g)	633.64^{b}	638.30^{b}	646.31^{a}	650.33^{a}	652.50^{a}	1.745
FCR	4.43	4.25	4.28	4.31	4.35	0.090
C/BW (₦/kg)	610.26^{a}	583.38^{ab}	571.30^{bc}	561.14^{bc}	547.77^{c}	6.692
Mortality (%)	9.44	9.44	9.44	6.67	6.67	3.592

Means with different superscript within the same row are significantly different (P< 0.05.)

The FCR in this study did not significantly (>0.05) differ among the experimental groups. FCR was found to improve significantly (p<0.05) as the larval meal in the quail's diet increased. Cost per body gain (C/BW ₦/kg) significantly (p<0.05) decreased with increase of maggot meal in the diets. However, Studies in Cost per body gain (C/BW ₦/kg) for quails fed insect meals were not found.

Table 3 present the result of nutrient digestibility of quails fed various proportions of HMM to replace fishmeal. Inclusion of maggot meal in the quail's diet significantly affected (p<0.05) the digestibility of crude fibre (CF) and nitrogen free extract (NFE) only. In the present study, apparent digestibility was better in birds fed the experimental diets than in control group. Digestibility of insect meal was found only from the reports of Widjastuti *et al.*(2014) who replaced soybean meal with black soldier fly maggot meal at 0, 10 and 15%. The authors found that the digestibility of only EE was statistically (p<0.05) affected by the inclusion of the larval meal. Overall, birds in the control group showed least performance for all parameters studied while those in the 100% maggot meal inclusion recorded the highest performances value. This indicates that replacing fishmeal with housefly maggots improves performance indices and at the same reduces feed cost. The improvement can be attributed to the quality of the protein which is on par with rendered meat meal (Cho and Kim 2010), bone meal as well as fish meal (Odesanya, 2011); and is superior to GNC and soybean meal (Hwangbo *et al.,* 2009; Odesanya, 2011; Nigerian Institute of Animal Science (NIAS), 2017; Inaoka *et al*., 1999).

Table 3: Nutrient Digestibility of Japanese Quail (*Coturnix ccoturnix japanica*) Fed Diets Containing Various Levels of Housefly (*Musca domestica*) Maggot Meal

Parameters %	Treatments					SEM
	Control	T1	T2	T3	T4	
DM	80.32	76.21	76.68	77.48	78.37	2.114
CP	91.02	92.72	94.80	93.58	92.85	0.906
EE	96.53	96.89	96.35	96.97	97.02	0.280
NFE	86.63^{b}	89.27^{ab}	87.65^{ab}	87.80^{ab}	89.94^{a}	0.741
CF	66.77^{a}	48.58^{b}	48.12^{b}	63.01^{a}	45.02^{b}	3.066
Ash	62.61	67.06	66.71	68.73	63.12	3.891

Means with different superscript within the same row are significantly different (P< 0.05).

CONCLUSION AND RECOMMENDATIONS

The potential of house fly maggots as an alternative protein source for livestock is high as shown from this study. Increased in the performance indices of quails with increase maggot meal inclusion in their diets is sufficient proof that maggot meal enhances nutrient utilization and reduces cost of production than the fishmeal based diet. To fully exploit this novel rich protein, as a replacement for conventional protein ingredients in livestock diets in semi-arid Nigeria there is need for further studies on all aspects of housefly maggots' production and utilization.

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