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Evaluation of Winged Termites (*Omitermes Meridionalis*) as Sole Sources of Protein in Growing Japanese Quails (*Corturnix Corturnix Japonica*)

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Abstract:

Responses of Japanese Quails (Corturnix corturnix japonica) to Winged Termites (Omitermes meridionalis), as sole source of protein were determined. Growing Japanese Quails (GJQ) were fed Winged Termites (WT) as protein sources in the ration. Eighteen GJQ were first fed conventional quail feed for two (2) weeks and then divided into two homogeneous groups with nine(9) experimental units and three(3) replications for each treatment in a Completely Randomised Design (CRD). The nine (9) GJQ from each of the two(2) groups were randomly assigned to three (3) cages each containing three (3) experimental units. Similarly, the two(2) rations were randomly assigned to the six (6) cages. The cages were labelled by the number of diet and replica as C_1-D_1 for cage 1 assigned to diet 1, C_2-D_1 for cage 2 assigned to diet 1, C_3-D_1 for cage 3 assigned to diet 1, C_1-D_2 for cage 1 assigned to diet 2, C_2-D_2 for cage 2 assigned diet 2 and C_3-D_2 for cage 3 assigned to diet 2. The two(2) groups were fed conventional quail feed and winged termites formulated feed for twenty eight(28) days. Each group was given an adaptive period of two (2) weeks to the treatment before commencement of data collection. Each bird was offered fifty(50g) of feed daily for the entire feeding period.

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The novel treatment (containing 26% protein from soybean as sole source of protein) was used as the control while the other ration (containing 15% protein from WT as sole source of protein) was the test therapy. Parameters evaluated as indicators of the effectiveness of the WT were feed intake (FI), Average weekly weight gain (AWG) and mortality (M). FI was taken as the difference between the weight of feed offered and that of the feed available at the end of each feeding day. AWG was the difference between the average weight of birds of two (2) successive weeks in each cage. Mortality was taken as the number of birds that died from each treatment during the entire feeding period.

When evaluated across treatments, average FI values for quails fed conventional (containing soybean as protein source) and test diet (containing WT as protein source) were 41.33g and 54.36g respectively. AWG for two(2) treatments were the same(1.8g). Results of the study revealed that FI did not differ significantly (P<0.05). Similarly, there was no significant (P<0.05) difference in the AWG between the two (2) treatments. There was no diet related mortality.

Key words: Japanese Quail, Winged Termites, Conventional Quail Feed, Feed Intake, Weight Gain and Mortality.

Introduction

There are many naturally occurring substances that are potential sources of energy and amino acids for poultry and rabbits, but their use is still limited because of uncertainty about their nutritive value and any growth depressants that they may contain. The most commonly used sources of proteins in livestock feeds are grain legumes (particularly soybean) which are becoming increasingly costly. The high cost of conventional feed is also a result of high demand for soya bean which is becoming increasingly important in the manufacture of foods for human consumption. Humans are competing with animals for soya beans as a source of protein. Furthermore, in most developing countries, production for soya bean falls far

below demand and may not be available as a source of protein in livestock manufacturing industries.

An increasing human demand for protein in developing countries and a relatively high cost of imported ingredients has turned the attention of animal nutritionists to the exploitation of non-conventional ingredients and by-products which are available in abundance in these regions. Even though soybean is the most commonly used source of protein in feed manufacturing, other materials are potential substitutes for soybean meal because of the similarity of their amino acid profiles to that of livestock. Other materials of animal origin could totally replace soybean meal without adversely affecting weight gain provided suitable processing methods are established. However, nutrient profiles and inclusion levels need to be evaluated before these materials can be certified fit for inclusion in livestock feeds.

Winged termites are among other insects that swarm in extremely large numbers in certain seasons in tropical regions. These can be harvested and used as sole sources of proteins in livestock feeds. Velmurugu (2011), reported that termites are not only collected from nature, but can also be grown near the family unit and harvested. A simple method of rearing termites on crop residues for family poultry supplementation is practiced in some African countries. According to Wang et al, 2005, field crickets contain not only certain quantities of protein but also considerable amounts of digestible amino acids. The field cricket had an advantage on composition of amino acids for poultry, especially the percentage of lysine, methionine and cysteine, so this organism might be a new source of dietary Nitrogen for poultry.

Though there are different types of poultry reared in Zambia, which include guinea fowl, ducks, turkeys, chickens, pigeons and quails, there is a significant degree of differences in growth rate, survivability and meat quality. However, the quail seems to be the best economically because of its fast growth

giving it a short generation interval. A broiler quail can be sold at 5 weeks compared to 8 weeks for a broiler chicken. Quails reach point of lay at 6 weeks of age and end of lay at 24 weeks of age. Comparatively, they fall within the investment level of the poorest of the poor. Mostly, commercial quail chicks are kept in multitier cages, thereby increasing labour efficiency and better utilization of land space (Neel, 2010).

Objectives

The study was specifically designed:

1. To evaluate use the daily feed intake of Japanese quails (*Corturnix corturnix*) fed on a diet with winged termites (*Omitermes meridionalis*) as an alternative sole protein source.
2. To evaluate weekly weight of Japanese quails (*Corturnix corturnix*) fed on a diet with winged termites (*Omitermes meridionalis*) as an alternative sole protein source.

Materials and Methods

Study site

The study was conducted in Monze District in the Southern Province of Zambia from February 2014 to March 2014. The study area was located between 14 º 11'S latitude and 33 º 46' E longitude. The area lay 1100 m above sea level with a mean annual temperature and mean annual rainfall of 33^{o}C and 800-1000mm respectively.

Animals and diets

Eighteen (18) quails (*Corturnix corturnix)* were first fed on conventional quail feed for two (2) weeks and then divided into two homogeneous groups, each comprising nine (9) birds in a completely randomised design (CRD). The birds from the two

groups were randomly assigned to six (6) cages each housing three experimental units. The two diets: conventional quail feed and the test feed(containing winged termites as sole source of protein) were randomly assigned to the six groups of experimental units. Cages were labelled by a combination of letters and numbers representing replica and diet number where D means diet, C means cage, 1 means conventional diet and 2 means test diet. Hence, C1-D1= cage 1 on diet 1, C2-D1= cage 2 on diet 1, C3-D1=cage 3 on diet 1, C1-D2= cage 1 on diet 2, C2-D2=cage 2 on diet 2 and C3-D2=cage 3 on diet 2. All factors were held the same across all experimental units except for differences in diet for thirty one days. The rations were formulated to contain 17 % CP and 2500 kcal/kg using the Linear Programme with Bounds (BLP88) computer package (1987).

Proximate Analysis

Samples of winged termites and roasted soya bean replicated ten(10) times were analysed at the University of Zambia Laboratory for chemical composition or nutritive value before inclusion in the feed. The samples were ground to pass through a 1mm sieve and analysed for Metabolizable Energy (**ME**), Crude protein (**CP**), Ash (**A**), Dry Matter (**DM**), Ether Extract (**EE**), Crude Oil (**CO**), Moisture (**M**), Available Lysine(**AL**), Calcium (**Ca**) and Phosphorus (**P**). Crude Protein (**CP**), Ash(**A**), Dry Matter(**DM**), Crude Fibre(**CF**), Neutral Detergent Fibre(**NDF**), Acid Detergent Fibre(**ADF**) and Ether Extract(**EE**) were analysed according to methods of AOAC (1990). Metabolizable Energy (**ME**) was determined using Adiabatic Bomb Calorimeter. Available Lysine (**AL**) was analysed according to the methods of Carpenter (1957). Calcium (**Ca**) and Phosphorus (**P**) were analysed using Atomic Absorption Spectrophotometer. Crude Fibre(**CF**), Neutral Detergent Fibre(**NDF**) and Acid Detergent Fibre(**ADF**) were

analysed according to methods of Van Soest (1982). Results of the analysis are shown in Table 1 and Table 2.

Table 1. Chemical Analysis Results for Winged Termite Samples

SERIAL NO.	SAMPLE NAME	ANALYSIS	AV. RESULTS (%)
S/005	WINGED TERMITES	CRUDE PROTEIN	49.38
		CALCIUM(Ca)	0.76
		PHOSPHORUS(P)	0.17
		ASH(A)	6.40
		MOISTURE(M)	6.70
		CRUDE OIL(CO)	44.49
		METABOLISABLE ENERGY(ME)	8415kcal/kg
		AVAILABLE LYSINE(AL)	0.01
		DRY MATTER(DM)	70.50
		ETHER EXTRACT(EE)	1.68

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Table 2. Chemical Analysis Results for Soya Bean Grains

SERIAL NO.	SAMPLE NAME	ANALYSIS	AV. RESULTS (%)
S/006	SOYA BEAN	CRUDE PROTEIN(CP)	39.37
		CALCIUM(Ca)	0.22
		PHOSPHORUS(P)	0.06
		ASH(A)	5.00
		MOISTURE(M)	2.50
		CRUDE FIBRE(CF)	1.00
		METABOLISABLE ENERGY(ME)	8505kcal/kg
		AVAILABLE LYSINE(AL)	0.53
		DRY MATTER(DM)	93.00
		ACID DETERGENT FIBRE(ADF)	13.00
		ETHER EXTRACT(EE)	20.50
		NEUTRAL DETERGENT FIBRE (NDF)	16.00

Tables 1 and 2 reveal that winged termites are superior in Crude Protein(49.38%), Calcium(0.76%), Phosphorus(0.17%) and Ash(6.8%). Soya bean was observed to be superior in Dry Matter(93%), Ether Extract(20.50%), and Metabolizable Energy(8505kcal/kg).

Feeding Trial

Quails were weighed at the start of the feeding trial. The birds were fed on the test feeds for **7**d so that they could adapt to the new feeds before data collection started. Each quail was weighed at the end of the adaptation period and this was taken as the initial weight for the feeding period of 28d. The two grower rations were replicated thrice in the experiment. The quails were offered 10g of feed once daily during morning hours (07.00h) over a 24-hour period and the remaining feed was weighed the following morning (07.00h). The difference was taken as the feed consumed by each quail per day. Quails were weighed individually weekly (every Friday) to obtain weekly body weight from which average daily weight and weekly body weight gains were calculated. Weekly body weights were recorded until the end of the feeding period. Clean water and feed were provided everyday using drinkers and feeders mounted in each cage.

Statistical Analysis

Data were analysed using the General Linear Model (GLM) procedures of Statistical Analysis System **(SAS, 1989).** Treatment means were tested for differences using Least Significant Means(LSM) (Montgomery, 1984).

Results

Average weekly Weight gains for quails fed rations containing winged termites and soy bean did not differ significantly ($p<0.05$). The average weekly weight gains for quails fed rations containing soya bean and winged termites over the 4 week experimental period were; 5.5g/d (S.E=0.78) and 5.6g/d (S.E=0.78), respectively (Table 3).

Table 3: Average Weekly weight Gain(in gms) for Quails

	Replications					
Treatment	C1	C2	C3	**Total**	**Mean**	**SEM**
Conventional Feed	1.8	2.0	1.7	5.5	1.8	0.78
Winged Termite Feed	1.8	1.9	1.9	5.6	1.8	
				$\Sigma y = 11.1$	$\bar{\bar{y}}=3.6$	

Table 4: Analysis of Variance for Average Weekly Weight Gain

Source of Variation	df	Sum of Squares	Mean Square	Fcal	Ftab
Total	5	0.07			
Treatment	1	0.01	0.01	0.67	7.71
Error	4	0.06	0.015		

CV= 53.3%

Figures 1 and 2 show performance of the quails to the two rations in terms of average weekly body weight.

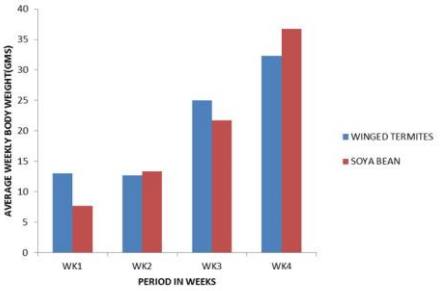

Fig 1: Average Weekly Body Weight for Quails

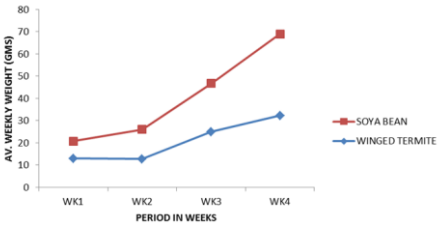

Fig. 2. Response of Quails to the two sources of proteins

Feed Intake

Though mean feed intakes between conventional (0.5g/d; S.E=0.25) and test feed (0.6g/d; S.E=0.25) differed quantitatively, there was no significant ($p<0.05$) difference between the two intakes (Table 4 and 5).

Table 5: Average Daily Feed Intake (in gms) for Quails

	Replications					
Treatment	C1	C2	C3	**Total**	**Mean**	**SEM**
Conventional Feed	0.6	0.4	0.4	1.4	0.5	0.25
Winged Termite Feed	0.5	0.7	0.7	1.9	0.6	
				Σy = 3.3	$\bar{\bar{y}}$=1.1	

Table 6: Analysis of Variance for Average Weekly Weight Gain

Source of Variation	df	Sum of Squares	Mean Square	Fcal	Ftab
Total	5	0.09			
Treatment	1	0.05	0.05	5.0	7.71
Error	4	0.04	0.01		

CV=56.4 %

Discussion

Generally, animals eat according to their size. Larger animals will eat more feed than smaller animals of the same age (Kleiber, 1975). In the present study, average daily feed intakes for quails fed soya bean and winged termite protein based rations were found to be 0.5g/d (S.E=0.25) and 0.6g/d (S.E=0.25), respectively. The present study has revealed that, the average feed intake was higher for winged termites protein based diet than soya bean protein conventional diet. This could be as a result of higher crude fibre content of the test diet since it had high (73.1%) maize-bran content. These results are supported by those of Ranjhan (2001), who indicated that, birds on high fibre diet tend to consume more of the feed to meet their requirements for growth and development. However,

these results are at variance with those of Nielse (2011), who established that high fibre diet reduce hunger, thereby reducing feed intake.

In the present study, feed intake was also observed to vary according to protein source in the diets offered. Variation in levels of feed components affects the overall attractiveness of a feed to animals. Mice were found to consistently prefer feed with high energy and protein content (Vickery et al.1994). In this study average dry matter intake was higher for winged termite protein based ration (0.6g/d; S.E=0.25) than for soya bean protein based ration (0.5g/d; S.E=0.25) though the two intakes did not differ significantly ($p<0.05$).

Differences in dry matter intake observed among the two rations can be attributed to differences in palatability, crude fibre content and anti-nutritional factors present in soya bean. Tannins found in legume grains such as soya bean may reduce intake by decreasing palatability or by negatively affecting digestion. Tannins were reported by Waghorn et al. (1994) to lower protein degradation.

The present study has revealed that quails fed winged termite protein based feed had similar Weekly Weight Gain to those fed soya bean based ration (1.8g; S.E=0.78) indicating that at the degree of processing the soya bean was subjected to, its protein was as easily degradable as the winged termite protein. Though nutritionally it is better for one animal species to feed on another animal because one animal's amino acid profile is closer to that of another animal, the degree of processing of plant protein can greatly improve their availability to animals. The current study shows correlation with those of Kras (2013), who found out that birds fed on high fibre diet presented lower weight gain. Mohiti (2012), also added that inclusion of fibre in the diet decreased body weight gain in broiler breeder hens. Furthermore, findings of this study disagree with those of Hassan (2009), who revealed that grasshopper protein based diet resulted in higher weight gain

and feed intake. Wang et al (2005) and Wang (2007), reported that field crickets could replace legume grains without adversely affecting feed intake and weight gain in broiler chickens.

Another worker (Koeleman, 2013), confirmed that insects as protein rich ingredients in poultry feeds are technically feasible and can be an interesting link in the animal feed chain. The present study revealed that there was no significant ($p<0.05$) difference in the effectiveness of soya bean and winged termites as single sources of proteins in quail diets.

Conclusion

The results observed in this study indicate that the chemical composition of winged termites is superior to soya bean in terms of Crude Protein, Calcium and Phosphorus. However, it was inferior to soya bean in terms of Metabolizable Energy, Dry Matter and Ether Extract. The study further demonstrated that winged termite meal can replace soya bean as a sole source of protein in quail diets without adversely affecting performance of the birds. This is evidenced by the fact that there was no significant ($p<0.05$) difference in both feed intake and body weight gain in birds fed soya bean protein based and winged termite protein based diets. However, more research as regards most suitable inclusion levels is required, since this research did not consider this aspect.

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