NUTRITIONAL EVALUATION OF HOUSE CRICKET (*BRACHYTRUPES PORTENTOSUS*) MEAL FOR POULTRY

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Abstract

This study was conducted to evaluate the nutritional value of house cricket meal (HCM) as an alternative feedstuff for poultry. The proximate chemical composition, amino acid (AA) content and total metabolisable energy (TME) of HCM were determined. The protein quality of HCM was evaluated using protein efficiency ratio (PER) and net protein ration (NPR) methods. Treatment diets consisted of basal diet (N-free), basal + HCM, basal + soy bean meal (SBM) and basal + fish meal (FM) and were arranged in a completely randomized design. The crude protein (CP) content of HCM was 60.4% and the value was higher than that of either SBM or FM. Total metabolisable energy value for HCM was similar to that of corn but was much lower than that of SBM. Total amount of tryptophan, tyrosine and valine in the HCM were 2.8, 2.4 and 3.2%, respectively. These values were higher than those in SBM and FM. The percentages of lysine, methionine and cysteine in HCM were 2.4, 0.5 and 0.8%, respectively. These values were similar to those in SBM (2.9, 0.6 and 0.7%) but lower than FM (4.5, 1.7 and 0.8%). Chicks fed HCM diet recorded higher ($p<0.05$) weight gain than chicks fed SBM but slightly lower than chicks fed FM. The PER values for HCM, SBM and FM were 3.42, 3.11 and 3.71, respectively. NPR values for HCM, SBM and FM were 3.66, 3.29 and 3.96, respectively. The PER and NPR values of HCM were higher ($p<0.05$) than that of SBM but slightly lower than that of FM. The results suggest that the HCM has a substantial amount of protein and energy which could to be included in poultry diets.

Keywords: house cricket meal, crude protein, true metabolisable energy, protein quality, poultry

INTRODUCTION

The poultry production in Malaysia is too dependent on imported feedstuffs especially protein feed ingredients. Presently, local production of soybean and other beans to be used as protein feed ingredients are not economically feasible. The current supply of local fish meal is small and future production is expected to decrease due to limited availability of trash fish. Therefore, alternative protein sources for livestock in the country should be explored and studied so that they could replace some of the imported protein feed ingredients. Among potential protein sources that could replace soybean meal and fish meal is insect protein. Insects can be used to produce cheaper proteins from non-food animals. Insects are rich in protein, with reported protein contents ranging from 44-70 percent (Ramos–Elorduy, 1987). One of the local insects that have potential to be used as protein source for poultry diets is house cricket. House crickets are being sold in most pet shops and tropical fish shops as fishing bait and food for birds, reptiles and aquarium fish. The house cricket is easily adapted to domestic rearing and has not been seriously studied as a potential source of nutrients for non-ruminants in the country. Comprehensive studies on the potential of cricket meal as protein source for poultry or other livestock species have not been conducted. The objective of the study was to determine the chemical composition, true metabolisable energy ad protein quality of house cricket meal.

MATERIALS AND METHODS

Eight weeks old house crickets were bought from an insect breeding farm in Kuala Selangor, Malaysia. The crickets were sacrificed by placing them overnight in a freezer at -20^{o}C for 24 hours. All crickets were washed with tap water and then dried in the oven at 60^{o}C for 48 hours. The crickets were freeze-dried in liquid nitrogen then grounded to 60 mesh size.

The crude protein (CP), ether extracts (EE), crude fiber (CF), ash, gross energy (GE), calcium (Ca) and phosphorous (P) for HCM and other feed ingredients were analyzed according to the procedures of AOAC (1990). Amino acids (AA) were determined with Biochcrom 30 Amino Acid Analyzer from United Kingdom after hydrolysing with 6 N hydrochloric acid for 22 hour at 110°C.

TME was conducted by adapting the method of Parsons et al. (1982). Seven caecectomized roosters were used in this experiment and placed in individual cages. All roosters were fasted for 24 hours and during the fasting period, all the endogenous excreta produced were collected. After 24 h fasting, all seven roosters were force-fed using crop-intubation and each cockerel received 15 g of HCM. During 48 hours after forced feeding, excreta from all roosters were collected. Feathers and debris were removed from all excreta collected and then dried in the oven for 48 h at 60ºC. GE for endogenous excreta and excreta were determined by using a bomb calorimeter. Calculation of TME was done using the following formula: ME = GE intake – (GE excreta + GE endogenous droppings).

One hundred and twenty one-day-old crossbred broilers were used in this study. Feed and water were given *ad libitum*. The chicks were fed a 24% CP corn-SBM pretest diet during the first 7 days post-hatching. Following an overnight period without feed, the chicks were weighed and allotted to dietary treatments as described by Sasse and Baker (1973).Treatment diets consisted of basal diet (N-free), basal + HCM, basal + SBM and basal + FM. All treatment diets contained 10% CP except the basal diet. The chemical compositions of the experimental diets are shown in Table 1. Three groups of ten chicks per cage were assigned to each treatment. The protein quality was determined using PER and NPR. The formulae used for net protein ratio (PER) and net protein ratio (NPR) calculations are shown below:

$$\text{Protein Efficiency Ratio} = \frac{\text{Body weight gain (g)}}{\text{CP intake (g)}}$$

$$\text{Net Protein Ratio} = \frac{\text{BW gain (g) – BW gain (g) of chicks fed N-free basal diet}}{\text{CP intake}}$$

All data from the experiments were analysed using ANOVA procedure of Statistical Analysis System (SAS) (SAS Institute, 1990) for completely randomised designs. Statistical significances of differences among treatments were assessed using the Duncan's multiple-range test.

RESULTS AND DISCUSSION

The CP percentage of HCM was 60.4% (Table 2) and was higher than that of SBM but slightly lower than FM (McDonald et al., 1995). The HC contained higher percentages of protein as compared to other insects, such as in Mormon cricket (*Anabrus simplex*) (DeFoliart *et al*., 1982), Field cricket (*Gryllus testaceus*) (Wang *et al*., 2005) and Lepidoptera larvae (Landry *et al*., 1986), but was somewhat lower than the protein contents of silkworm pupae (68%) as reported by Wei and Liu (2001).

TME value for HCM was 13.03 MJ/kg (Table 2) and this value was similar to that of corn (13.40 MJ/kg) but much higher than that of SBM (9.60 MJ/kg). The high value of TME in HCM in this study was probably attributed to high level of fat content (22.7%). TME value for HC was also higher than that of Field cricket, 12.39 MJ/kg (Wang *et al*., 2005). The high TME value in HCM is comparable to conventional energy supplements of most grains.

The amino acid composition of HCM is shown in Table 3. Percentages for tryptophan, tyrosine and valine in HC were 2.8, 2.4 and 3.2%, respectively. These values were higher than those of SBM (0.6, 1.4 and 2.4%) and FM (0.7, 1.8 and 3.0%). The values for histidine (0.9%), leucine(2.9%), methionone (0.5%), threonine (1.5%), tryptophan (2.8%) and cysteine (0.8%) for HCM were almost similar to the corresponding values of SBM and FM. The percentages of lysine, methionine and cysteine in house cricket were 2.4, 0.5 and 0.8%, respectively. These values were quite similar to those in SBM (2.9, 0.6and 0.7%) and in FM (4.5, 1.7 and 0.8%) except for lysine, indicating that the essential amino acids in HCM were adequate for poultry. However, these values were lower than the values in Field cricket (4.79, 1.93 and 1.01%) as reported by Wang *et al*. (2005). Thus, HC has an advantage on amino acid composition compared with other insects reported because it contains high quantities of AA.

Chicks fed the basal diet (N-free) lost weight during the assay period, whereas chicks fed HCM, SBM and FM had a positive weight gain response (Table 4). The chick's growths were significantly affected by protein source in their diets. These results suggested that the protein of HCM could support normal growth in chicks. Chicks fed HCM diet recorded higher ($p< 0.05$) weight gain than those chicks fed SBM but slightly lower than those chicks fed FM diet and the differences were not significant. The PER and NPR values of HCM were significantly higher ($p< 0.05$) than that of SBM but slightly lower than FM. The lower PER and NPR values of HCM compared to FM were probably due to higher crude protein content and slightly lower amino acid digestibility.

Besides that, it was ascertained that the protein of HCM had no adverse effect as a feedstuff.

Table 1. Chemical composition of treatment diets

Components	Treatment diets			
	Basal	Basal + 16.56% HCM	Basal + 22.47% SBM	Basal + 16.95 % FM
ME (MJ/kg)	11.70	11.79	11.45	11.87
Crude protein (%)	0	10	10	10
Calcium (%)	1.0	0.8	0.8	0.9
Phosphorus (%)	0.7	0.7	0.5	0.6

ME=metabolisable energy; HCM=house cricket meal; SBM=soy bean meal; FM=fish meal

Table 2. Chemical composition of HCM, SBM and FM (% as fed DM basis)

Proximate analysis	Content %							
	Dry Matter	Crude protein	Crude fibre	Fat	Ash	Ca	P	TME (MJ/kg)
HCM*	89.55	60.4	8.3	22.7	5.4	1.4	1.0	13.03
FM**	89.50	59.95	0.5	4.8	20.5	5.1	2.9	15.00
SBM**	89.45	44.0	5.8	1.0	6.5	0.3	0.7	9.06
Corn**	-	-	-	-	-	-	-	13.40

*Results from laboratory analysis, ** McDonald *et al.*, 1995
HCM=house cricket meal; FM=fish meal; SBM=soy bean meal; TME=total metabolisable energy

Table 3. Amino acid profile of HCM, SBM and FM

Amino acid	(% dry matter basis)		
	HCMl*	SBM**	FM**
Arginine (Arg)	2.2	3.2	4.0
Histidine (His)	0.9	1.1	1.3
Isoleucine (Ile)	1.6	2.5	2.7
Leucine (Leu)	2.9	3.4	4.4
Lysine (Lys)	2.4	2.9	4.5
Methionine (Met)	0.5	0.6	1.7
Phenylalanine (Phe)	1.6	2.2	2.3
Threonine (Thr)	1.5	1.7	2.6
Trytophan (Try)	2.8	0.6	0.7
Valine (Val)	3.2	2.4	3.0
Cysteine (Cys)	0.8	0.7	0.8
Tyrosine (Tyr)	2.4	1.4	1.8

* Results from UPM laboratory analysis, ** McDonald *et al.*, 1995
HMC=house cricket meal; SBM=soy bean meal; FM=fish meal

Table 4. Mean values of weight gain, gain to feed ratio, protein efficiency ratio and net protein ratio

Dietary treatments	Weight gain (g)	Gain:feed (g:g)	PER	NPR
Basal diet	- 6.2	-	-	-
Basal + HCM	88.5^{b}	3.14^{a}	3.42^{a}	3.66^{a}
Basal + SBM	81.7^{a}	3.42^{b}	3.11^{b}	3.29^{b}
Basal + FM	92.1^{b}	2.70^{a}	3.71^{a}	3.96^{a}

$^{a\text{-}c}$Means within a column with no common superscript differ significantly
PER=protein efficiency ratio; NPR=net protein ratio

CONCLUSION

House cricket meal has substantial nutritional value for poultry. The HCM contained not only high amount of protein but had the advantage on the composition of amino acids for poultry, especially the percentage of tryptophan, tyrosine, valine and cysteine. House cricket meal also had a higher TME value which was equivalent to that of corn. The PER and NPR values were higher than SBM suggesting that it could replace SBM as a protein source in poultry diets. House cricket mean has the potential to be a new protein source for poultry in this country, or at least would be extremely beneficial as a complement to a domestic animal diet and could be fitted into meal patterns in a variety of ways.

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