UTILIZATION AND EVALUATION OF CRICKET MEAL AS PROTEIN SOURCE IN LAMB RATION

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ABSTRACT

This study was aimed to evaluate the utilization of cricket (insect) meal as protein source in growing sheep ration. The experiment was conducted using Completely Randomized Design using three treatments with four replicates of local growing sheep (BW 11.24±1.62 kg). The treatments consisted of concentrate containing soybean meal (C), concentrate containing cricket meal with 50% replacement of soybean meal (CM-50) and concentrate containing cricket meal with 100% replacement of soybean meal (CM-100). All the animals were fed 40% forage *Brachiaria humidicola* and 60% concentrate. The parameters measured were nutrient consumption, rumen fermentation, including methane production, nutrient digestibility and blood metabolites level (glucose, triglyceride and total protein). Result showed that there were no significant differences in dry matter, protein and energy consumptions among three treatments. The digestibility of nutrients and blood metabolites were also similar in all treatments. Concentration of total VFA in control (113 $mM.L^{-1}$) and CM-50 (116.33 $mM.L^{-1}$) was significantly lower ($P<0.05$) than in CM-100 (135 $mM.L^{-1}$) treatment. Methane estimated from VFA partial in CM-50 (25.22 mmol) was significantly lower than CM-100 (33.93 mmol).

KEY WORDS: Lamb Ration, Cricket Meal, Fermentation Profiles, Methane Production, Palatability.

INTRODUCTION

Sheep is a small ruminant which have potential to produce meat. With growing population of sheep problems are arising how to overcome the feed requirements. Plant and animal protein may be a good source of protein for animal feed, but animal protein is quite expensive. Feeding management in traditional farming system still have problems, especially for finding the protein sources. Use of cereals as conventional ingredient is more expensive as protein source compared to legumes. It needs to find an alternative protein source especially for poultry and ruminant ration before and just after weaning period (1-4 month) with low price and high quality.

Evidence has accrued over the past 30 years that provides strong support and justification for the sustainable use of insects as a means of protein for use in feed of livestock, poultry, and aquacultured species. In Java (Indonesia) on cricket breeding farm, it is observed that cricket insects after 5-6 cycle of egg production show decreased productivity tremendously and hence they are treated as waste, so it may be a very good cheap source of high protein being payless, Novianti (2003) reported that Indonesian cricket meal has 56-74% of crude protein with around 15-32% of crude fat. Due to the high content of important nutrient (protein and fat), cricket meal has potential to be used as protein source for concentrate on growing sheep ration. Therefore the present study was planned to evaluate the utilization of cricket meal as protein source in growing lamb (post weaning) ration on nutrient consumption, rumen fermentation profiles, nutrient digestibility and blood metabolites profile.

MATERIALS AND METHODS

Twelve post weaning local lambs (11.24 ± 1.62 kg BW, 2 months old) were used in this experiment by using Completely Randomized Design with three treatments. The animals were allotted in individual pens for two months with an adaptation period of one week and divided into three groups; C (control), CM50 and CM100 of four animals in each group. The crickets were oven dried at 60°C and grinded for mixing in concentrate as substituent of soybean meal. Group I (control) animals were fed 40% of forage *Brachiaria humidicola* and 60% of concentrate containing 15 per cent soybean meal without cricket meal, with water *ad libitum.* The other two groups II (CM-50) and III (CM-100) were fed 40% of forage *Brachiaria humidicola* and 60% of concentrate containing 7.5 per cent and 15 per cent cricket meal in place of soybean meal. The nutrient composition of the concentrate was isoprotein (17%), TDN (63%), lipid (2.5 to 3.99 %), crude fiber (23.89 to 24.79%), and NFE (42.68 to 44.36). *Brachiaria humidicola* has 35% of crude fiber and 12% of crude protein.

Parameters such as nutrient consumption, rumen fermentation, including methane production, nutrient digestibility and blood metabolites (glucose, triglycerides and protein) were measured according to standard procedure. Dry matter intake (DMI) was evaluated every day and protein and energy intake were calculated from the DMI times protein and energy content of the ration. One week before the end of the experiment, total fecal collection was done in metabolic cages for measuring the digestibility of dry matter, protein and energy. At the end of the experiment, rumen fluid was sucked from rumen by using stomach tube 2 hours after feeding time, together with blood sampling through jugular vein by using 5 ml syringe. Total volatile fatty acids (VFA) and its partial VFA (acetic, propionic and butyric acids) were analyzed by using gas chromatography equipment (GC 8-Schmidzu). Methane emission was estimated by stoichiometry from VFA partial by following equation of Moss *et al.* (2000):

$$CH4\ (mmol) = 0.42\ C2 - 0.275\ C3 + 0.40\ C4$$

All blood metabolite were analysed by using standard procedures and Kits on spectrophotometer at specific wave length. The data were analyzed by using analysis of variance (ANOVA) and the differences among treatments were compared by using Duncan's Multiple Range Test, using IBM SPSS Statistics version 20.0 (2011).

RESULTS AND DISCUSSION

Result of the present study presented through tables 1-3 reveals that cricket meal has good palatability for lamb, as there were no significant differences in dry matter, protein and energy consumptions among three treatments. The total dry matter intake was around 2.80% of BW. This is comparable with NRC (2006) recommendation that lambs with 10-20 kg BW require dry matter intake about 2.85% of BW. There was no significant change in digestibility of dry matter and protein in CM-50 and CM-100, and also for the energy digestibility in all treatments (Table 1). It was reported that cricket meal has 8% of chitin (carbohydrate), which may affect to the nutrient digestibility. Some chitin from cricket meal will reduce the absorption due to the low digestibility. Wang *et al*. (2005) reported that 100 g of cricket meal has protein content of 58.30% and chitin around 8.70% which can disturb the nutrient absorption. The digestibility of feed is also affected by physiological status of the animal, age, rate of passage of diet and quality of the ration (Mc Donald *et al.* 2002). The result of this research was similar with Astuti *et al.* (2011) who reported that the dry matter digestibility of growing sheep fed with tropical browse plants (as protein sources) as 62-67%.

Table 1. Consumption and digestibility of nutrient at different level of cricket meal in the feed

Parameters	C	CM-50	CM-100
Consumption (g.lamb^{-1}.d^{-1}):			
Dry matter	383.53±8.64	368.90±45.55	338.53±45.45
Protein	64.98±1.80	57.99±9.05	57.27±9.92
Energy (Mkal.lamb^{-1}.d^{-1})	1.43±0.05	1.36±0.04	1.27±0.04
Digestibility (%):			
Dry matter	64.39±2.43	66.72±4.41	62.28±3.31
Protein	77.09±3.87	74.53±2.73	73.99±2.22
Energy (Mkal)	1.02±0.03	1.04±0.06	0.99±0.10

C= concentrate containing 15% of soybean meal, CM-50 = concentrate containing 7.5 per cent cricket meal and 7.5 per cent soybean meal and CM-100 = concentrate containing 15 per cent cricket meal without soybean meal.

Volatile fatty acids (VFA) are the primary energy substrate of adult ruminants. Concentration of total VFA in group II (CM-50; 116.33 mM) and group I (control 113.42 mM) was significantly (P<0.05) lower than CM-100 (135.60 mmol.L-1) (Table 2). High total VFA in CM-100 is due to the accumulation of VFA partial especially from acetic and butyric acid and lower energy intake so that the crude fiber and protein source of the ration were fermented and produced VFA predominantly acetic and butyric acids, to cover the energy requirement for the lamb. Ration with high fiber will produce higher acetic acid than propionic acid. Such VFA is a major energy source for ruminant,

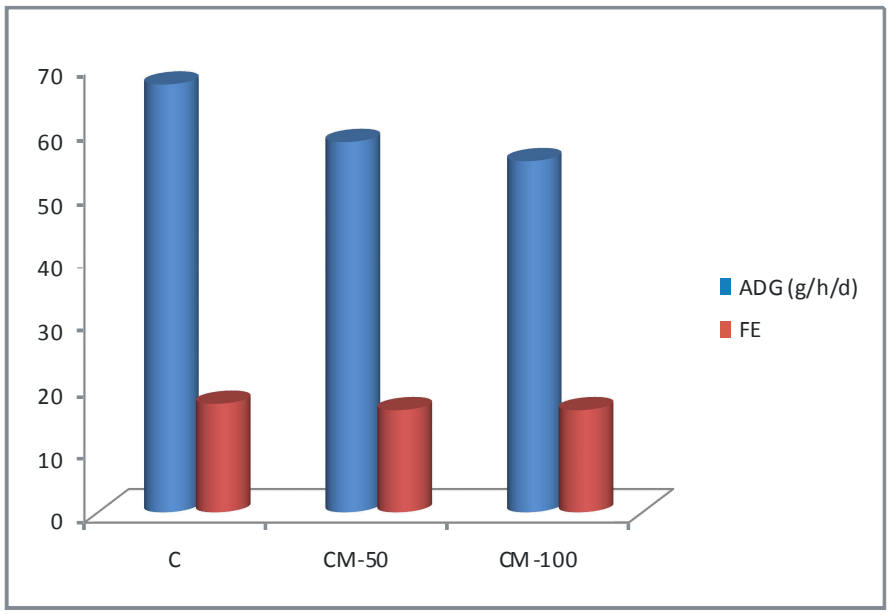

Fig. 1. ADG and FE value of lamb

maintaining the ratio of acetic, propionic and butyric acids as 60%; 30% and 10% from the rumen fermentation profiles (Jayanegara et al., 2013; Mc Donald et al., 2002). In this experiment, the ratios of acetic acid, propionic acid and butyric acid were 62.72-64.52%, 25.95-27.69% and 8.51-11.32%, respectively. The high acetic acid percentage from rumen fermentation was resulted from the high fiber content in the ration (24.79% in the concentrate and 35 % in Brachiaria humidicola).

The high acetic acid and butyric acid production will cause the high methane production (Rheidol et al. 2011). The increasing concentration of acetic acid and butyric acid at treatment CM-100 lead to methanogenesis since fermentation of glucose and protein to acetic and butyric acid yields H2, a main compound of methane (Jayanegara et al., 2013).

Tabel 2. Rumen fermentation profiles and performance of lamb fed different level of cricket meal

Parameters	C	CM-50	CM-100
Total VFA (mmol.L^{-1})	113.42± 13.93^{b}	116.33± 17.74^{b}	135.60± 15.05^{a}
- Acetic acid	71.88± 17.91^{b}	72.99± 5.75^{b}	87.47± 6.87^{a}
- Acetic acid (%)	63.44±1.64	62.72±4.64	64.52±4.83
- Propionic acid	31.45± 9.12	30.32± 9.28	36.56± 5.69
- Propionic acid (%)	27.69±2.28	25.95±2.66	26.97±3.64
- Butyric acid	10.08± 2.89	13.02± 2.70	11.53± 2.46
- Butyric acid (%)	8.87±0.45	11.32±1.15	8.51±0.55
Methane (CH4) (mmol)	27.73± 1.23^{b}	25.22±2.01^{b}	33.93±1.72^{a}
CH4/DMI	0.07±0.008^{b}	0.068± 0.01^{b}	0.10±0.009^{a}
CH4/VFA total	24.45±2.22	23.71± 3.11	25.02±3.51
CH4/kg BW	0.41±0.02	0.43±0.02	0.62±0.03
ADG (g/lamb/d)	69.96±13.56	59.59±10.85	57.36±20.98
Feed Efficiency (%)	17.45±3.51	15.75±3.07	16.18±4.92

C= concentrate containing 15% of soybean meal, CM-50 = concentrate containing 7.5 per cent cricket meal and 7.5 per cent soybean meal and CM-100 = concentrate containing 15 per cent cricket meal without soybean meal. Means in the same row with different superscript differ P<0.05

Data of daily gain and feed efficiency showed that there were no significant differences between treatments. The average daily gain (ADG) of those lambs ranged from 57.36 - 69.96 g.lamb-1.d-1, and feed efficiency (FE) values ranged from 15.75 - 17.45% (Table 2). Cricket meal as source of animal protein in this ration has not given good effect on the performance yet. The growth of animal depends on feeding management, quality of the ration, digestibility of nutrient, environment and disease (Parakassi, 1999).

The result of two months experiment from twelve lambs with three different rations showed that the feed efficiency values were not significantly different among the groups. It could be said that the substitution of soybean meal with cricket meal resulted no significant difference in feed efficiency.

Table 3. Glucose, triglyceride and total protein in blood plasma of lambs fed different level of cricket meal

Parameters	C	CM-50	CM-100
Glucose (mg/dL)	66.22 ± 3.52	58.68 ± 4.70	58.04 ± 2.98
Triglyceride (mg/dL)	57.51 ± 2.70	59.30 ± 3.09	51.30± 3.20
Total protein (mg/dL)	6.76 ± 0.24	7.32 ± 1.29	6.09 ± 0.62

C= concentrate containing 15% of soybean meal, CM-50 = concentrate containing 7.5 per cent cricket meal and 7.5 per cent soybean meal and CM-100 = concentrate containing 15 per cent cricket meal without soybean meal.

Blood metabolite status of lamb fed different level of cricket meal is presented at Table 3. The result showed that substitution soybean meal with 100% cricket meal has no effect on plasma glucose, triglyceride and total protein concentration.

CONCLUSION

It was concluded that 15% cricket meal (100% replacement of soybean meal) could be used as protein source in lamb ration without any problem with palatability, performance, feed efficiency and blood metabolites profile. Utilization of 7.5% cricket meal in the lamb ration will reduce methane production significantly. Further replacement of soybean meal by 7.5 per cent cricket meal may be better suited as it reduces methane production.

REFFERENCES :

Astuti, D.A., Baba, A.S. and Wibawan, I.W.T. (2011). J. Media Peternakan, 34(3): 201-206.

Jayanegara, A., Ikhsan and Toharmat, T. (2013). J. Indonesian Trop. Anim Agric., 38: 103-108.

Mc Donald, P., Edwards, R.A. and Greenhalgh, J.F.D. (2002). Animal Nutrition. 6th ed. Longman Scientific and Technical, New York.

Moss, A.R., Jouany, J.P. and Newbold (2000). Ann. Zootech. 49:231-253.

Novianti, J. (2003). Komposisi Jangkrik Kalung (Gryllus bimaculatus) Pada suhu pengeringan yang berbeda. Thesis IPB. Bogor Indonesia.

[NRC] National research Council (2006). Nutrient Requirement of Small Ruminant. Washington DC National Academy Press. USA.

Parakassi, A. (1999). Ilmu Nutrisi dan Makanan Ternak Ruminansia. 1st ed. University of Indonesia Press, Jakarta.

Rheidol, Parc Merlin and Aberystwyth. (2011). Reducing methane emissions through improved lamb production. Meat Promotion Wales. www.hccmpw.org.uk. Email: info@hccmpw. org.uk.

Wang, D., Zhai, S.W., Zhangm, C.X., Bai, Y.Y., An, S.H. and Xu, Y.N. (2005). J. Anim. Sci., 18(5): 667-670.

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