

# THE PRODUCTION AND BODY COMPOSITION OF KACANG GOAT FED DIFFERENT QUALITY OF DIETS

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## ABSTRAK

Sebuah studi eksperimental dilakukan untuk menilai pengaruh kualitas pakan pada produktivitas dan komposisi tubuh dari kambing Kacang. Lima belas ekor kambing Kacang jantan dengan bobot badan  $14,28 \pm 3,36$  kg (CV = 23,55%) dibagi menjadi 5 kelompok berdasarkan bobot badan. Desain eksperimen yang digunakan dalam penelitian ini adalah Rancangan Acak Kelompok (RAK) dengan 3 perlakuan kandungan protein dan total nutrisi tercerna (total digestible nutrients, TDN) yaitu T1 = pakan dengan protein 9,20% dan 54,67% TDN, T2 = ransum dengan protein 11,6% dan 58,61% TDN, T3 = ransum dengan protein 18,33% dan 65,23% TDN). Parameter yang diamati dalam penelitian ini adalah konsumsi bahan kering pakan, konsumsi protein kasar, konsumsi TDN, pertambahan bobot badan dan komposisi tubuh dari kambing Kacang. Hasil penelitian menunjukkan bahwa kualitas pakan perlakuan tidak berpengaruh nyata ( $P > 0,05$ ) pada konsumsi bahan kering dan komposisi tubuh, tetapi berpengaruh nyata ( $P < 0,05$ ) pada konsumsi protein, konsumsi TDN dan pertambahan bobot badan. Dari penelitian ini dapat disimpulkan bahwa kualitas pakan yang lebih tinggi menghasilkan produktivitas yang lebih tinggi, tetapi kualitas pakan yang lebih tinggi pada penelitian ini tidak mempengaruhi komposisi tubuh dari kambing Kacang, kecuali pertambahan lemak tubuh (%).

*Kata kunci : kambing Kacang, kualitas pakan, komposisi tubuh, produktivitas*

## ABSTRACT

An experimental study was carried out to assess the effect of diet quality on productivity and body composition of Kacang goat. Fifteen male Kacang goats weighing  $14.28 \pm 3.36$  kg (CV = 23.55%) were divided into 5 groups based on body weight. The experimental design used in this study was Randomized Block Design (RBD) with 3 treatments of dietary protein and total digestible (TDN) contents (T1= diet with 9.20% protein and 54.67% TDN; T2= diet with 11.6% protein and 58.61% TDN; T3= diet with 18.33% protein and 65.23% TDN). Parameters observed were feed intake, dry matter intake, crude protein intake, TDN intake, live weight gain (LWG) and body composition of Kacang goat. The results showed that feed quality did not significantly affect ( $P > 0.05$ ) dry matter intake and body composition, but significantly affect ( $P < 0.05$ ) protein intake, TDN intake and LWG. It can be concluded that the higher quality diet resulted in higher productivity, but the higher quality diet was not affect body composition of Kacang goat, except body fat gain (%).

*Keywords: Kacang goat, feed quality, body composition, productivity*

## INTRODUCTION

Kacang goat is one of the local breeds of goat which is potential to be developed in Indonesia. The population of this goat was 7,325,977 in 2011 or equal to 41.9% of the total goat population in Indonesia (Direktorat Jenderal Peternakan and Kesehatan Hewan, 2012). Kacang goat has strong adaptability to coarse environment such as heat stress and low quality feed. Some

previous studies reported that the carcass percentage of Kacang goat reach ranged between 41.8 and 46.7% (Triantini *et al.*, 2002; Usmiati, 2008; Karami *et al.*, 2013). Kacang goat is prolific and 26% kid mortality (Sumardianto *et al.*, 2013; Gatenby, 1988; Dinas Peternakan Brebes and Balai Pengkajian Teknologi Pertanian Jawa Tengah, 2005).

Feed quality is one of important factors that need to be considered for the development of

animal farming system. High quality feed is needed to increase animal productivity, since it affects feed intake, growth rate and growth efficiency of animal (Mahgoub *et al.*, 2000). Feed intake affects the body composition of animal (fat) (Owen *et al.*, 1993, Manso *et al.*, 1998). Abdullah *et al.* (2007) reported that male black goats fed different levels of energy i.e. 10.44, 11.60, and 12.90 MJ ME/ kg DM, resulted in 133, 92 and 100 g/d body weight gain, respectively. Similar results were reported by Aregheore (2006) that crossbred of Anglo-Nubian x Fiji local goats fed diet containing energy 17.0, 18.1, 19.1 and 20.0 MJ/kg DM and obtained body weight gain 67, 81, 86 and 109 g/d, respectively.

Animal productivity is not only evaluated through body weight gain, but also body composition, because the real value of animal productivity is meat or body protein. Animal body consists of water, protein and fat (Soeparno, 1992). The proportion of these components varies with the quality of diet, growth rate and body weight. Sahlu *et al.* (1999) reported that carcass of Angora goat fed 14.7% dietary protein contained 13.5% protein, 26.5% fat and 52.8% water. Other results were reported by Atti *et al.* (2004) that Tunisian local goats fed different level protein diet (10, 13 and 16%) gave 74.3% to 76% body water, 22.4% to 23.4% body protein and 2.0% to 4.5% body fat. Ngwa *et al.* (2007) observed Boer x Spanish goat treated with different level feed intake resulted in 14.3% to 14.7% body protein, 54% to 56% body water, 25% to 29% body fat.

The explanation above showed that feed quality was considered related to the body weight gain and body composition of animal. Therefore, the objective this study was to investigate the effect of feed quality on body weight gain and body composition of Kacang goat.

## MATERIALS AND METHODS

### Experimental Animal and Diet

Fifteen male Kacang goats with body weight ranging from 8.77 to 19.87 kg (average  $14.28 \pm 3.36$  kg; CV = 23.55%) were divided into 5 groups of body weight. Each group contained 3 goats. The goats were fed 3 diets of different quality as treatments. The proportion of feedstuffs and the nutritional content of the diets are shown in Table 1.

### Experimental Design

The goats were assigned to a Randomized

Block Design, with 5 groups of body weight (BW1 = 17.13 to 19.87 kg; BW2 = 14.98 to 16.71 kg; BW3 = 14.62 to 14.94 kg; BW4 = 11.71 to 14.33 kg; BW5 = 8.77 to 9.55 kg) and 3 treatments (T1= feeding with 9.20% protein and 54.67% TDN; T2= feeding with 11.6% protein and 58.61% TDN; T3= feeding with 18.33% protein and 65.23% TDN). Each treatment consisted of 5 goats as replicates.

### Procedures

The experiment was conducted in three stages, i.e. adaptation period (6 weeks), preliminary period (1 week) and treatment period (10 weeks). The goats were placed in individual cages and fed with three different quality diets. Feed was given based on DM requirement, i.e. 4.5% of body weight. The feed was offered 4 times a day at 08.00, 13.00, 18.00 and 21.00. The residuals feed were collected and weighed every morning of the following day. Fresh water was provided *ad libitum*. The goats were weighed every week to determine the amount of feed given in the next week. In the week 0, 4 and 8, and 2 days before goats were slaughtered at the end of experiment, the goats' body composition was measured by urea space technique.

### Parameters Measurement

Parameters observed in this study were dry matter intake (DMI), crude protein (CP) intake, total digestible nutrients (TDN) intake, live weight gain (LWG), feed efficiency and body composition of the goats. Feed intake was determined by subtracting the residual feed to the feed given. TDN was determined by sum up digestible protein, digestible extract ether (multiplying to 2.25), digestible crude fiber and digestible NFE. The feed digestibility was determined by total collection method, which was conducted in the 7<sup>th</sup> week of experiment. Feces collected were sprayed with 20% H<sub>2</sub>SO<sub>4</sub>, placed into the plastic bag and stored in 16°C cooled room. Feces from 7 days collection was blended, homogenized and sampled for 20 g. The samples feces were then analyzed to determine the chemical composition. Live weight gain was calculated by subtracting the initial body weight to final body weight, divided the duration of observation (day). Feed efficiency was obtained by dividing body weight gain with dry matter intake and multiplied by 100 percent.

Dry matter, CP and TDN intakes were obtained by subtracting residual feed to feed

Table 1. Proportion of Feedstuff and Nutritional Content of the Experimental Diet

Feed Ingredients/Nutrients	T1	T2	T3
Feed Composition	-----%-----		
Napier grass	7.0	8.0	9.0
Rice Bran	10.0	9.0	8.0
Cassava	73.0	67.0	61.4
Soybean meal	10.0	16.0	22.0
Nutrient Composition (100% DM)			
Dry Matter (DM)	87.38	87.48	87.14
Crude Protein (CP)	9.20	11.67	18.33
Crude Fiber (CF)	29.89	27.69	26.23
Extract Ether (EE)	0.34	0.57	0.57
Nitrogen Free Extract (NFE)	48.73	48.98	45.00
Total Digestible Nutrients* (TDN)	54.67	58.61	65.23
Ratio CP/TDN	1:5.94	1: 5.02	1: 3.56

given to, multiplied by the nutrient content of feed (DM, CP and TDN). Live weight gain was calculated by subtracting the initial body weight to the final body weight divided by the length of time of observation. The methods for predicting body composition was urea space technique. One day before urea injection, the goats were weighed to measure their body weight and calculate the metabolic body weight ( $BW^{0.75}$ ) to determine the dose of urea injection (0.65 ml/kg metabolic body weight). Urea was injected using catheter and flushed with 10 ml NaCl to ensure all dose of urea entered into the blood. The actual quantity of urea injected was determined by weighing syringes before and after injection. An amount of 10 ml blood sample was collected before and 12 minute after urea injection through jugular vein. The blood sample was centrifuged at 3000 rpm for ten minute to obtain blood plasma for further analysis of urea concentration. Body composition of the goat calculated following the recommendation of Bartle *et al.* (1983), Panaretto and Till (1963), Rule *et al.* (1986) and Astuti and Sastradipradja (1999) as the following formulas.

$$\bullet \text{ Urea Space} = [(V \times C) / (DBUN \times 10 \times LW)]$$

where:

V = volume of urea solution that was injected (ml); C = concentration of urea solution (mg/dl); Δ BUN = change of blood urea nitrogen (0 and 12

minutes) (mg/100ml); US = urea space; BW= body weight (kg); EBW = empty body weight.

- Body water (%) =  $59.1 + 0.22 \times US$  (%) – 0.04 BW
- Body water (kg) = {body water (%) x EBW (kg)/100% }
- Body protein (kg) =  $0.265 \times \text{body water (kg)} - 0.47$
- Body protein (%) =  $100 \times (\text{body protein (kg)} / \text{EBW})$
- Body fat (%) =  $98.0 - 1.32 \times \text{body water (%)}$
- Body fat (kg) = {body fat (%) x EBW (kg)}/100%

The changes of body composition were obtained by subtracting the data of 4th week with prior data of 0 week, or 8th week to 4th week, as well as 8th week to 0, respectively.

### Statistical Analyses

The data observed were analyzed by ANOVA. When there was a significant difference ( $P < 0.05$ ) among the treatments, the further test by Duncan multiple range test was carried out.

## RESULTS AND DISCUSSION

### Feed Intake and Daily Gain

Data of the effects of different feed quality

Table 2. The effect of Different Feed Quality on Dry Matter Intake, Protein Intake, TDN Intake and Live Weight Gain

Parameters	T1	T2	T3
DMI (g)	517.21	610.89	604.35
Protein intake (g/day)	48.00 <sup>A</sup>	71.00 <sup>B</sup>	111.00 <sup>C</sup>
TDN intake (g/day)	281.62 <sup>a</sup>	360.08 <sup>b</sup>	393.81 <sup>b</sup>
DM digestibility (%)	57.66 <sup>A</sup>	61.13 <sup>A</sup>	68.36 <sup>B</sup>
Feed Efficiency (%)	4.24 <sup>a</sup>	10.63 <sup>b</sup>	11.73 <sup>b</sup>
LWG (g/day)	23.46 <sup>A</sup>	61.86 <sup>B</sup>	69.41 <sup>B</sup>
VFA (mMol)	36.11	39.41	38.33

Superscripts with different small letters in the same row indicate significant difference ( $P < 0.05$ ), superscripts with different capital letters in the same row indicate highly significant differences ( $P < 0.01$ )

on dry matter intake, protein intake, TDN intake and live weight gain are presented in Table 2. The feed given (4.5% body weight) was consumed by all the goats in all treatments. Differences were found in TDN intake, feed efficiency ( $P < 0.05$ ), protein intake, DM digestibility and LWG ( $P < 0.01$ ). Protein intake on T2 was highly significantly ( $P < 0.01$ ) higher than T1, and protein intake on T3 highly significantly ( $P < 0.01$ ) higher than T2. While TDN intake on T2 was significantly higher ( $P < 0.05$ ) than T1, and TDN intake on T3 was not significantly different ( $P > 0.05$ ) with T2 (Table 2). The observed differences in TDN and protein intakes were attributed to the content of CP and TDN in diets. This is in accordance with the opinion of Boorman (1980), Martawidjaja *et al.* (1999) and Atti *et al.* (2004), that the amount of nutrients consumed by the animal is influenced by the nutrient content of feed given.

Table 2 also shows that an increase in dietary CP and TDN content increased the DM digestibility, feed efficiency and LWG. This was caused by protein and TDN affected rumen conditions. Most of the nutrients consumed by goat will be utilized by rumen microbes for growth. Rumen microbial growth will increase the microbial population in the rumen, and support increasing the process of fermentation in the rumen. Chanthakhoun *et al.* (2012) and Kang *et al.* (2012) stated that increasing dietary crude protein will increase rumen fermentation. Increased fermentation in the rumen was shown from the rumen VFA concentration, i.e. T1, T2

and T3 being 36.11, 39.41, 38.33 mMol, respectively. This was in agreement with the results of Wang (2012), Chanthakhoun *et al.* (2012) and Abubakr (2013b), that increasing fermentation increased VFA concentration, feed digestibility and feed efficiency, which in turn increase the amount of nutrients that can be utilized by animal for production. This was also coincide with the statement of Jia *et al.* (1995) that increment of DM digestibility increases LWG and feed efficiency. Therefore, increasing CP and TDN content in the diet increases LWG.

The experiment of Dutta *et al.* (2009) on 32 Barbari goats, fed different levels protein and level TDN, showed that CP 12% and TDN 60% was the optimum balance of protein and TDN for goats and feed efficiency (7.55%). A similar result was reported by Agnihotri *et al.* (2006), that the appropriate CP and TDN to Barbari goats was 12 and 60%. Similar study by Prieto *et al.* (2000) showed that the best CP and TDN for Boer x Spanish goats was 14.2 and 71.5%, feed efficiency was 10.38-13.51%. In the present experiment, the best CP and TDN ratio of feed was 11.67 and 58.61%. As it is described above, increasing CP and TDN content in the diet affects feed efficiency. In this research feed efficiency was significantly different ( $P < 0.05$ ). Increasing CP and TDN content in the diet affect rumen fermentation, increasing rumen fermentation, increasing feed digestibility and increasing feed that can be utilized by goat. Increasing feed utilization, increased feed efficiency (Wang, 2012; Chanthakhoun *et al.*, 2012; Abubakr, 2013a).

### Body Composition on Kacang Goat

The changes of body protein and fat of Kacang goats are presented at Table 3. The body protein, body fat gain increased with dietary CP and TDN content. This was so due to the increased in feed efficiency (see Table 2). Improved feed efficiency indicates that more nutrients can be utilized for animal productivity and growth. Increased productivity and growth are shown at final BW (Table 3). Refer to Fox and Black (1984), Owens *et al.* (1993), Sanon *et al.* (2008) that goats with high growth rate tend to have higher BW, increasing BW increased body protein and body fat.

There was no significant difference ( $P>0.05$ ) in body protein gain (% and kg) and body fat gain (kg) among the treatments. Body protein gain on percentage and kg in average were 1.13% and 0.27 kg respectively, body fat gain (kg) was 0.29 kg. However, the percentage of body fat gain was significantly different ( $P<0.05$ ) among the treatments. Body fat gain (%) in T2 and were T3 higher than T1 ( $P<0.05$ ), but T2 and T3 were not significantly different ( $P>0.05$ ). Fox and Black (1984), Schmidely *et al.* (1992) claimed that the growth of body protein on animals are relatively

constant, and the growth of body fat inversely related to body water. In addition, body weight of goats in this research was not significantly different ( $P>0.05$ ) so that body protein in this research was not different. This was in accordance with the results of Owens *et al.* (1993) that body weight affects body composition on animals. Changes in body fat in this study was different in percentage, but was not different in weight (g). This was due to the body weight of goats among treatments. This was in accordance with the opinion of Owens *et al.* (1993), and Schmidely *et al.* (1992) that body weight affects the proportion of body fat.

The growth of body protein (% , kg) and body fat growth (kg) was not significantly different ( $P>0.05$ ) among the treatments, because the animals used in this study had similar age, so they was at the same growth phase. This is in accordance with Purnomoadi *et al.* (2008) and D'Alessandro *et al.* (2013), that the growth of body protein in animal at various ages was relatively constant. In addition, the protein intake used by the animal to form the body weight was the same relatively, so that the body protein gain in this research was not significant differences.

Table 3. The change of Body Composition of Kacang goat during 8 Weeks Experiment

Parameter	T1	T2	T3
Body Weight (BW) (kg)			
Preliminary	15.57	15.30	15.6
Final	16.98	18.52	18.95
Intake (g/d)			
Protein 0-8 weeks	48.16 <sup>A</sup>	71.82 <sup>B</sup>	113.11 <sup>C</sup>
TDN 0-8 weeks	286.17 <sup>a</sup>	360.72 <sup>b</sup>	402.53 <sup>b</sup>
Nutrient Efficiency (%)			
Body protein gain	43.00	35.61	33.46
Body fat gain	10.36	10.67	13.61
Body Composition Gain 0 – 8 <sup>th</sup> weeks			
Body protein gain (%/d)	0.66	0.70	1.12
Body protein gain (kg/d)	0.14	0.19	0.26
Body fat gain (%/d)	0.12 <sup>a</sup>	0.25 <sup>b</sup>	0.24 <sup>b</sup>
Body fat gain (kg/d)	0.20	0.28	0.37

BW (Body Weight), ns = Non Significant ( $P>0.05$ ), Superscript with different small letters in the same row indicate significant differences ( $P<0.05$ )

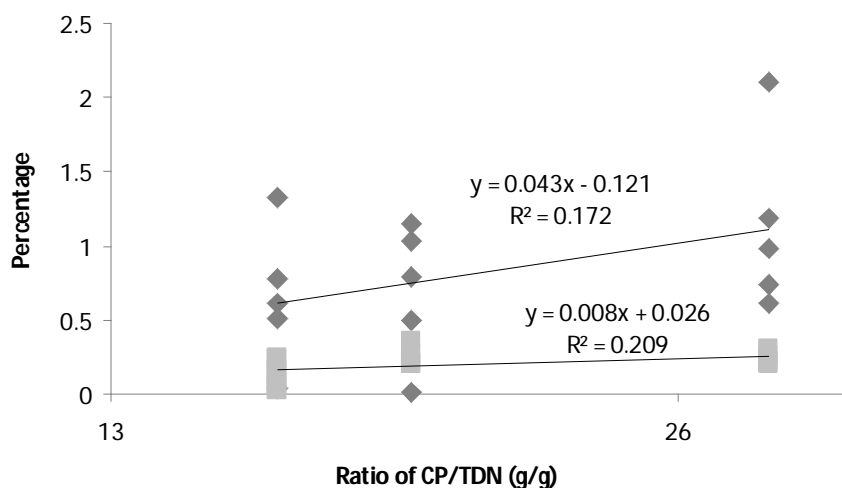


Figure 1. Relationship between CP/TDN Ratio of the Diets and Percentage of Body Protein (◆) and Body Fat Gain (■)

Moreover, the efficiency of body protein and body fat in each treatment was not significantly different ( $P>0.05$ ). This showed that the animals have the same ability to utilize the feed to form body protein and body fat.

#### Relationship between increasing CP and TDN to Body Protein and Body Fat Gain

Figure 1 shows that increasing CP and TDN was not significantly affect body protein gain and body fat gain. The results (Figure 2.) It was caused the animals used in this study have similar age, so it was the same growth phase. This was accordance with Owens *et al.* (1993), Purnomoadi *et al.* (2008), Alessandro *et al.* (2013), and Hassan and El-Feel (1991) that growth phase grouped by age and age affect the growth phase. In addition, weak correlation was also caused by nutritional efficiency of goat that were not significantly different, this case illustrated that the goat feed that can be utilized for growth was not significantly different. This was in accordance with Lancaster *et al.* (2009) who stated that feed efficiency used for productivity and for growth. Correlation between the CP and TDN to body fat gain was greater than the correlation between CP and TDN to body protein gain. This was caused the body protein gain in goat is relatively constant, while the body fat will continue to rise (Fox and Black, 1984; Schmidely *et al.*, 1992; Purnomoadi *et al.*, 2008).

The relationship between increasing CP and

TDN to body protein and body fat gain is shown at Illustration 1. Increasing CP and TDN was not significantly correlated with body protein gain ( $r = 1.81$ ,  $P>0.05$ ), and body fat gain ( $r = 2.09$ ,  $P>0.05$ ), which means that the increase in the CP and TDN was not lead to increase body protein and body fat gain. This is because the nutrients were used in equal amounts by animals. So that the resulting growth was in the same value. It was also shown from nutrient efficiency of each diets were not significantly different.

#### CONCLUSION

Based on the result of this study, it can be concluded that the higher quality diet results in higher productivity, but did not affect body composition of Kacang goat, except body fat gain.

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