

EVALUATION OF BODY COMPOSITION USING UREA DILUTION AND SLAUGHTER TECHNIQUE OF GROWING PRIANGAN SHEEP

EVALUASI KOMPOSISI TUBUH DENGAN MENGGUNAKAN TEKNIK RUANG UREA DAN PEMOTONGAN PADA DOMBA PRIANGAN TUMBUH

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ABSTRACT

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This study aimed to evaluate the *in vivo* measurement of body composition using urea space (US) to be compared with the slaughter technique (ST) method. Correlations were found between urea space, total body water, fat and protein in growing Priangan sheep and results from US and ST were evaluated. Six growing Priangan sheep were fed commercial concentrate and grazed on pasture for half a day. Prior to and on the last day of the experiment, body composition was measured by urea space technique. Subsequently the animals were slaughtered and analyzed for water, fat and protein contents. Results show that there were no significant difference of body water, fat and protein as percentage of empty body weight (EBW) from both US and ST determination. The data of US and ST were 68.64 and 65.87 for body water; 9.78 and 9.85 for body fat; 16.87 and 16.53 for body protein, respectively. Body fat using US was under-estimated by 0.7%, while body water and protein were over-estimated by 4.02 and 2.01%, respectively. The correlation between US and body compositions as percentage of EBW were developed and follow the equations :

$$\text{Water} = 16.519 + 1.047 \text{ US}(\%); r = 0.95$$

$$\text{Fat} = 23.837 - 0.297 \text{ US}(\%); r = -0.98$$

$$\text{Protein} = 6.714 + 0.208 \text{ US}(\%); r = 0.96$$

The correlation between body water and body fat and protein using ST method, as percentage of EBW were :

$$\text{Fat} = 27.68 - 0.270 \text{ body water}(\%); r = -0.96$$

$$\text{Protein} = 4.42 + 0.184 \text{ body water}(\%); r = 0.91$$

Key words: urea space, slaughter technique, body composition, Priangan sheep

ABSTRAK

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Penelitian ini bertujuan untuk mengevaluasi cara pengukuran komposisi tubuh (air, protein dan lemak) dengan menggunakan metode ruang urea dan pemotongan secara *in*

vivo. Setelah dilakukan pengukuran dengan kedua metode tersebut di atas kemudian dicari hubungan secara persamaan liniernya dari kedua metode tersebut. Sejumlah enam ekor domba Priangan yang sedang tumbuh digunakan dalam penelitian ini dengan diberi pakan berupa konsentrat dan merumput di padang pangan selama kurang lebih setengah hari. Pada awal dan akhir percobaan dilakukan pengukuran komposisi tubuh dengan menggunakan metode ruang urea, dan diakhir penelitian dilakukan pemotongan hewan. Dari hasil pemotongan, diambil contoh untuk digerus dan dicampur, kemudian dilakukan analisa kandungan air, lemak dan protein tubuh. Hasil penelitian menunjukkan bahwa tidak ada perbedaan dari air, lemak dan protein tubuh (persen dari bobot badan kosong) baik yang diukur secara metode ruang urea maupun secara pemotongan. Air tubuh sebesar 68,64 (metode ruang urea) dan 65,87 (metode pemotongan), sedangkan untuk lemak dan protein tubuh masing-masing untuk kedua metode tersebut adalah 9,78; 9,85 dan 16,87; 16,53. Data lemak tubuh dengan menggunakan metode ruang urea 0,7% lebih rendah dibanding dengan metode pemotongan, sedangkan air dan protein tubuh yang diukur dengan metode ruang urea lebih tinggi 4,02 dan 2,01% dibandingkan dengan metode pemotongan. Hubungan antara persentase ruang urea (RU) dengan komposisi tubuh (persentase bobot badan kosong) mengikuti persamaan :

$$\text{Air tubuh} = 16,519 + 1,047 \text{ RU}(\%); r = 0,95$$

$$\text{Lemak tubuh} = 23,837 - 0,2965 \text{ RU}(\%); r = -0,98$$

$$\text{Protein tubuh} = 6,714 + 0,2082 \text{ RU}(\%); r = 0,96$$

Sedangkan hubungan antara air tubuh dengan lemak dan protein tubuh (persentase bobot badan kosong) menggunakan metode pemotongan adalah :

$$\text{Lemak tubuh} = 27,68 - 0,270 \text{ air tubuh}(\%); r = -0,96$$

$$\text{Protein tubuh} = 4,42 + 0,184 \text{ air tubuh}(\%); r = 0,91$$

Kata-kata kunci: ruang urea, metode pemotongan, komposisi tubuh, domba Priangan

INTRODUCTION

The relationships between total body water, fat and protein have been previously examined in living sheep and

goats (Pana-retto, 1963). Tritiated water space, antipyrine and N-acetyl-4-aminoantipyrine space techniques are methods used to estimate body composition in ruminants (Panaretto and Till, 1963), and subsequently the urea dilution technique was developed for beef steers *in vivo* (Rule *et al.*, 1986). Urea was shown to be a suitable chemical to be used as a tracer for estimating body composition because it is inexpensive and the technical requirements of plasma urea N analysis are minimal. Urea space was found to be similar with deuterium oxide as a tracer for body water determination in humans (San Pietro and Rittenberg, 1953). Accurate calculation of the quantities of water, fat and protein in the bodies of living domestic animals by the *in vivo* technique is a non destructive procedure to assess changes in body composition in experimental animals.

Information on body compositions in living indigenous animals in Indonesia is very limited. This study was conducted to compare results of *in vivo* body composition determination of growing Priangan sheep by the urea space method of Rule *et al.* (1986) with results of the slaughter technique and to make the necessary correction of the prediction equations.

MATERIAL AND METHODS

Six male growing Priangan sheep (av. 20 kg LW) were used in this experiment. Animals were fed 500 g commercial concentrate (GR-1, PT Indo feed, Bogor) daily, and grazing on native grass pasture, whereas water was available at all times. Concentrate contained (87.5% DM) 17.40 MJ/kg Gross Energy and 18% crude protein on a DM basis, while native grass (54.80% DM) contained 14 MJ/kg GE and 12.60% crude protein.

Prior to and the last week of the experimental period, each sheep was injected with 130 mg urea/kg metabolic body size (MBS) dissolved in sterile saline (200 g.L⁻¹) through the jugular vein within one minute, and time was recorded at the beginning and the end of injection. The jugular vein was flushed with 3 ml of heparinized saline after urea injection. The actual quantity of urea injected was determined gravimetrically by weighing syringes before and after injection. Blood samples were obtained before injection and 12 minutes after the mean injection time. Plasma was separated by centrifugation of blood at 5000 x g for 10 minutes and analyzed for urea-N by Indophenol urease-N method. Urea space was calculated by dividing the dose of urea N injected with the change in plasma urea-N before and after 12 minutes injection, following the equation as described by Bartle *et al.* (1983), while body protein and fat (BP and BF) were calculated after Panaretto and Till (1963), and body water (BW) according to Rule *et al.*, (1986). All parameters (except BP in kg) were expressed as percentage of empty body weight (%EBW) :

$$US (\%) = \frac{[\text{dose of urea-N(mg injected)}]}{\text{change in plasma urea-N(mg/100ml)} \times 10 \times \text{Life Weight}}$$

$$BW (\%) = 59.1 + 0.22 \times US (\%) - 0.04 \text{ LW}$$

$$BP (\text{kg}) = 0.265 \times BW (\text{Liter}) - 0.47$$

$$BF (\%) = 98.0 - 1.32 \times BW (\%)$$

Empty body weight (EWB) was defined as body weight minus the contents of the alimentary tract (after fasting for 24 hours). For slaughter animals, EWB was obtained immediately after slaughter without gastrointestinal contents. All slaughtered sheep were sampled carcass and non carcass components for chemical compositions determination. Samples from each group (carcass and non carcass) were mixed in order to have a homogenized subsamples. Five grams subsample were dried at 60 °C for 24 h for DM determination. Fat content was determined by extraction for 48 h with petroleum ether in a soxhlet apparatus, while protein was determined by the Kjeldahl method (AOAC, 1975).

Validation of the equations was carried out in a separate experiment using 6 animals by comparing *in vivo* results with ST analysis data on the same sheep. Data from US were related to body water, fat and protein data from the slaughter technique, in order to make linear regression for each parameter. Additional equations were also developed relating body water with body fat and protein using the slaughter method.

The significant differences between mean parameters were analyzed using *t*-test (Steel and Torrie, 1986) and the computer program Minitab/SPSS release 6.1 (1988) was used for linear regression procedures.

RESULTS AND DISCUSSION

The data on body composition of growing Priangan sheep, both using US and ST, are presented in Table 1. There was no significant difference in body water using US [calculated according to the equation of Rule *et al.*, (1986)] and ST methods. The same situation holds for BF and BP calculated according to the equations of Panaretto and Till (1963). In predicting body water, 95% of the result found with the US technique [$\pm 0.04 \times US (\% \text{ EBW})$] included body water measured by desiccation in these sheep. Similarly, 95% of values for body protein calculated from US [$\pm 0.02 \times US$] and 95% of values calculated for body fat [$\pm 0.007 \times US (\% \text{ EBW})$] included protein and fat measured by chemical technique, respectively. The US technique overestimated body water and protein around 4 and 2%, respectively, but underestimated body fat around 0.7%. After correction, the US technique yielded an accurate and unbiased estimate of total body water, fat and protein of

growing Priangan sheep. Empty body water estimated according to Rule *et al.* (1986), resulted in an underestimation by 4.2% on Etawah crossbred goats (Arta *et al.*, 1998). The results of this study are similar to those reported previously on merino crossbred sheep for body water and protein, which values were 64.16 and 17.54% EBW, respectively, (Panaretto, 1963). However, results of body fat was quite different (14.21%) from growing Priangan sheep (9.78%). The wide range and low body fat in growing Priangan sheep suggested that this breed of sheep tended to have low fat content. Such might be the results of rearing male Priangan sheep were reared for fighting.

Table 1. Body compositions of growing Priangan sheep (% EBW)

Parameter	Value (% EBW)
Urea space technique:	
- US	47.16±5.26
- BW	68.64±1.28
- BF	9.78±1.50
- BP	16.87±1.30
Slaughter technique:	
- BW	65.87±5.67
- BF	9.85±1.59
- BP	16.53±1.14

Figure 1. The regression coefficients were different for all relationships illustrated ($P < 0.01$). The US were related to body water, fat and protein (%EBW) with the coefficient correlation (r) of 0,95; -0,98 and 0,96, respectively. The negative value of correlation coefficient of US with BF means that the higher the US, the lower is the BF (% EBW). The relationship between US and BW, both expressed as %EBW, showed that prediction of BW will lie in the interval $Y_1 \pm 2.96\%$ ($2 \times \text{SE}$) for 99% of US measurements, where Y_1 was the BW content, predicted from regression. The standard error of a predicted BW content was $\pm 1.48\%$ EBW. Similarly, the relationship between the US to BF and BP were calculated to get the prediction of BF and BP. Body fat will lie in the interval $Y_2 \pm 0.68\%$ for 99% of US measurements, with the standard error of predicted BF content being $\pm 0.34\%$ EBW. Body protein will lie in the interval $Y_3 \pm 0.07\%$ for 99% of US measurements, with the standard error of predicted BP content being $\pm 0.35\%$ EBW.

From the slaughter technique data in this experiment, body fat and protein of growing Priangan sheep could be calculated from body water (% EBW) using equations which are depicted in Figures 2. The correlations coefficient from the developed linear regression, were -0,96 and 0,91 for fat and protein, respectively.

The relationship between BW and BF, shows that the prediction of BF would lie in the interval $Y_4 \pm 0.94\%$ for 99% of BW measurements, where Y_4 was the BF content as

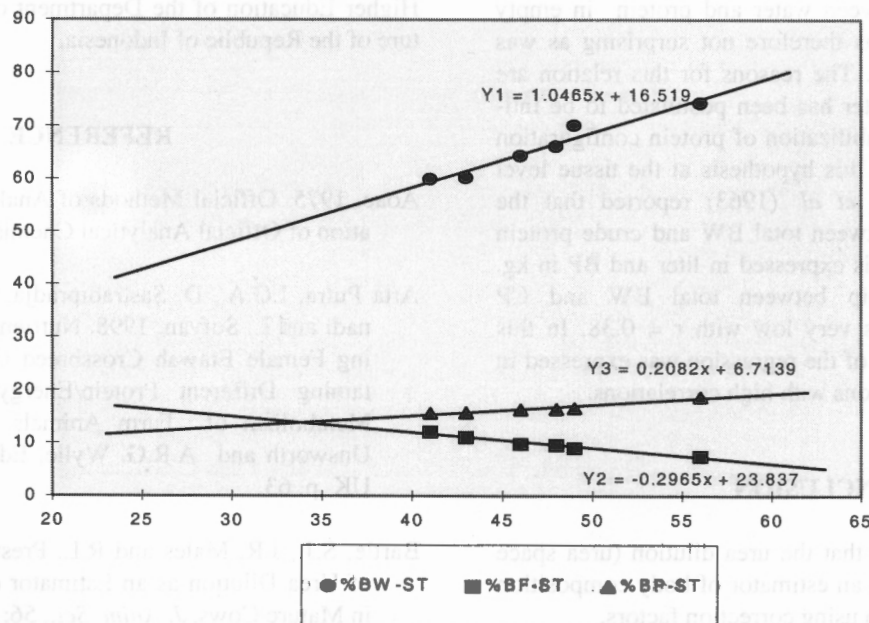


Fig.1. The regression between US (X) and BW (Y_1), BF (Y_2) and BP (Y_3) as % EBW in growing Priangan sheep

The relations between US and body water, fat and protein in six growing Priangan sheep are illustrated in

predicted from regression with a standard error of the predicted BF content being $\pm 0.47\%$ EBW. The relationship

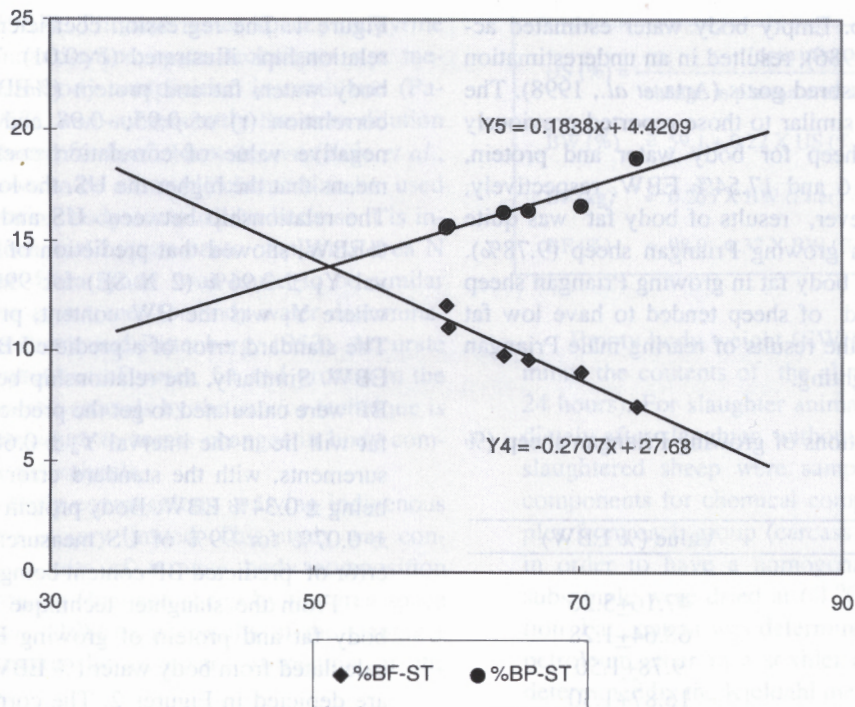


Fig. 2. The regression between BW (X) and BF (Y₄), BP (Y₅) using ST method in growing Priangan sheep.

between BW and BP shows that the prediction of BP would lie in the interval $Y_5 \pm 1.02\%$ for 99% of BW measurements, with a standard error of the predicted BP content being $\pm 0.51\%$ EBW.

The relationship between water and protein in empty bodies of these sheep was therefore not surprising as was demonstrated in Figure 2. The reasons for this relation are beginning to emerge. Water has been postulated to be intimately involved in the stabilization of protein configuration and the results supported this hypothesis at the tissue level (Klotz, 1962). Panaretto *et al.* (1963) reported that the closest of relationship between total BW and crude protein was presented when BW is expressed in liter and BP in kg. However, the relationship between total BW and CP expressed as % LW, was very low with $r = 0.38$. In this experiment, all parameter of the regression was expressed in % EBW, leading to equations with high correlations.

CONCLUSION

The results indicated that the urea dilution (urea space technique) can be used as an estimator of body composition of growing Priangan sheep using correction factors.

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