The study of creatinine as an indicator of body protein in small ruminant

K F Setyawan, F R Paulina, S Sutaryo, W S Dilaga, V Restitrisnani and A Purnomoadi

Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang 50275, Indonesia

E-mail: agung194@yahoo.com

Abstract. This study was aimed to determine the relationship between body weight, body protein and urinary creatinine in local male sheep. The materials used in this study were 12 heads of local male sheep aged one year old with an average body weight of 25.04 ± 0.44 kg (CV = 6.24%). All sheep were fed concentrate at 2.3% of body weight and rice straw ad libitum. Parameters measured were body weight, body protein, and the amount of creatinine excreted through urine. The data obtained were analyzed by correlation and regression. The results showed a medium relationship between urinary creatine, body weight, and body protein composition, being \( r = 0.600 \) and \( 0.605 \), respectively.

1. Introduction

Feed for livestock needs to be considered because it is very important to fulfill basic living needs, growth, production and reproduction. If the feed requirements are not met, then those will have an impact on the nutrient status of the livestock. Nutritional status of sheep is a measure of success in the fulfillment of nutrients indicated by the body weight of sheep [1]. Body weight, nutrient status, growth rate, and age are factors which are related to each other and influence body composition [2].

The body composition studied was measured at the composition of body protein through the urea space method [3]. One of the factors that influences body composition of sheep is body weight. The higher body weight of sheep resulted in higher energy utilized [2]. In term of energy utilization, the sheep in high metabolism activities will produce creatinine, a metabolites end product of metabolism excreted through the urine [4]. Therefore, it is important to study the the influence of body weight and body protein on creatinine output.

2. Materials and methods

The materials used in this study were 12 local male sheep aged one year old with the average body weight of 25.04 ± 0.44 kg (CV = 6.24%). The sheep were fed concentrate at 2.3% of body weight and rice straw as ad libitum basal diet. The concentrate was formulated to provide at least 17.3% CP and 61.8% TDN, while rice straw was varied at the range of 6.1 - 7.5% CP and 37.5 – 39.5% TDN. The feed was calculated to fulfill the requirement of sheep for the maintenace body weight and production. The sheep were adapted to the experimental condition for 2 months.

Body protein was measured by urea space method [3] at week 0-6, while urinary creatinine was collected using a bucket filled with 20% H\(_2\)SO\(_4\) to adjust urine pH less than 3. Urine samples were taken and were then stored in a freezer prior to analysis. The data obtained (the body weight, body
protein, and creatinine excretion) were analyzed by correlation regression to find the relationship between them.

3. Results and discussion
The data of body weight, body protein, and the amount of creatinine are presented in Table 1.

| Parameter               | Range     | Mean   | Sd   |
|-------------------------|-----------|--------|------|
| Body Weight (kg)        | 24.82 – 33.17 | 28.58  | 2.23 |
| Body Protein (kg)       | 1.24 – 1.64   | 1.43   | 0.10 |
| Creatinine Excretion (mg/day) | 109.77-334.01 | 207.09  | 71.68 |

The correlations between creatinine excretion, body weight, and body protein are shown in figure 1.

Figure 1 showed that there were moderate correlations between both body weight and body protein with creatinine excretion. The relationship of urinary creatinine, body weight and body protein were moderate being 0.600 and 0.605, respectively. The higher the body weight and the body protein of the sheep, the greater the energy requirements for their metabolism processes. According to McDonald et al.[5], sheep need an energy for metabolic processes, one of the metabolic processes that occurs in body tissues of sheep that produce creatinine which excreted in the urine.

Figure 1 showed that the body protein and body weight affect the urinary creatinine. This occurred presumably because an increase in the body's metabolism also increase of protein metabolism in the body resulting in increase creatinine output. Meanwhile, body protein influences the output of creatinine [6]. In addition, Dawn et al. [7] stated that ATP can be formed from 2 molecules of ADP. In order to release energy, one molecule of phosphate from ATP was released to obtain 7-12 kcal, or equal to 35 cal per 1 mg creatinine. For example, based on equation of body protein and creatinine excretion as shown in figure 1., 

\[ y = -0.0005x + 1.5684 \]

\[ r = 0.605 \]

\[ y = -0.0112x + 31.481 \]

\[ r = 0.600 \]

Using data in Table 1. that average body protein is 1.43 kg, therefore it
can be calculated that creatinine excreted predicted to be 276.8 mg per day, equal to 9.688 kcal or 40.53 kJ.

4. Conclusion
Based on the results of this study, it could be concluded that the body weight and body protein have a positive moderate correlation with creatinine output.

References
[1] Yan T, CS Mayne, D C Patterson, and RE Agne 2009 Prediction of body weight and body composition using body size measurement in lactating diary cows Livest Sci. 124: 233-241
[2] Soeprono 2009 Ilmu dan teknologi daging. Cetakan kelima. (Yogyakarta: UGM Press)
[3] Astuti D A, and D Sastradipradja 1999 Evaluation of body composition using urea dilution and slaughter technique of growing priangan sheep Med. Vet. 6 5-9
[4] Chen XB, A T Mejia, D J Kyle and E R Orskov 1995 Evaluation of the use of the purine derivative: Creatinine ratio in spot urine and plasma samples as an index of microbial protein supply in ruminants: Studies in sheep. J. Agric. Sci. Camb. 125 137–143
[5] McDonald P, R A Edwards, J F D Greenhalgh, and C A Morgan 1995 Animal Nutrition 5th Ed. (Singapore: Longman Singapore Publishers)
[6] Kertz A F, L R Prewitt, A G Lane and J R Campbell 2008 Effect of dietary protein intake on creatinine excretion and the creatinine nitrogen ratio in bovine urine J. Anim. Sci. 30 278 – 282
[7] Dawn B M, M D Allan, S M Colleen 2000 Biokimia Kedokteran Dasar: Sebuah Pendekatan Klinis. (Jakarta: EGC)