Jurnal Kedokteran Hewan June 2022, 16(2):67-72
P-ISSN : 1978-225X; E-ISSN : 2502-5600 DOI: https://doi.org/10.21157/j.ked.hewan.v16i2.23464

THE INFLUENCE OF NUTRITIONAL FLUSHING ON BODY MORPHOMETRICS OF FEMALE BREEDING GOATS

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ABSTRACT

The purpose of this current study was to evaluate the influence of nutritional flushing on body morphometrics of female breeding goats. This study used 32 local female goats or does with an average age of 3.28±1.08 years and an average body weight of 42.47±8.28 kg. The goats were distributed in a completely randomized design using a 2 x 2 factorial pattern with 8 replications. The first factor was the flushing feed (FF) type, consisting of rice bran and concentrate, whereas the second factor was the level of tannin-protected arginine (TPA: 0 and 300 mg/kg). The body morphometrics observed in this study were initial body length (IBL), final body length (FBL), body length change (BLC), initial chest girth (ICG), final chest girth (FCG), chest girth change (CGC), initial wither height (IWH), final wither height (FWH), and wither height change (WHC). The IBL, FBL, BLC, ICG, FCG, IWH, FWH, and WHC of the local does were not significantly different (P>0.05) after receiving the FF type. However, FF significantly affected the CGC of the goats (P<0.001). The use of concentrate for the local female local goats resulted in a higher CGC (P<0.001) compared to the use of rice bran. On the other hand, TPA did not significantly affect all body morphometrics of the goats (P>0.05). Thus, it can be concluded that the use of concentrate leads to higher chest girth change, giving better body growth compared to the use of rice bran. The addition of tannin-protected arginine was also found to have no significant contribution to the body morphometrics of the local female goats.

Key words: concentrate, local female goats, small ruminant, productivity

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengevaluasi pengaruh flushing nutrisi terhadap morfometri tubuh induk kambing betina. Dalam penelitian ini digunakan 32 ekor kambing betina dengan umur rata-rata 3,28±1,08 tahun dan rata-rata bobot badan 42,47±8,28 kg. Kambing didistribusikan pada rancangan acak lengkap menggunakan pola faktorial 2 x 2 dengan 8 ulangan. Faktor pertama adalah jenis pakan flushing (FF) yaitu dedak padi dan konsentrat, sedangkan faktor kedua adalah level penggunaan arginin terproteksi tanin (TPA: 0 dan 300 mg/kg). Morfometri tubuh yang diamati adalah panjang tubuh awal (IBL), panjang tubuh akhir (FBL), perubahan panjang tubuh (BLC), lingkar dada awal (IWH), lingkar dada akhir (FWH), perubahan lingkar dada (WHC). Nilai IBL, FBL, BLC, ICG, FCG, IWH, FWH, dan WHC pada kambing betina tidak menunjukkan perbedaan yang signifikan (P>0.05) setelah diberikan FF. Akan tetapi, FF secara nyata berpengaruh (P<0.001) terhadap CDC kambing lokal. Penggunaan konsentrat untuk kambing lokal menghasilkan CGC yang lebih tinggi (P<0.001) dibandingkan penggunaan dedak padi. Di sisi lain, TPA tidak memberikan pengaruh yang nyata (P>0.05) terhadap seluruh morfometri tubuh kambing lokal. Disimpulkan bahwa penggunaan konsentrat memberikan perubahan lingkar dada yang lebih tinggi dibandingkan dedak padi. Penggunaan arginin terproteksi tanin tidak memberikan kontribusi yang nyata terhadap morfometri tubuh kambing lokal.

Kata kunci: konsentrat, kambing lokal, ruminansia kecil, produktivitas

INTRODUCTION

Since ancient times, goats have been a source of livelihood for many rural communities. Goats have the ability to adapt to almost all ecosystems, including harsh, frigid, and arid zones (Miller *et al*. 2012). They also have unique and valuable traits, such as better productivity responses under low input conditions, diseases and parasites resistance, as well as the capability to cope with the negative effects of heat stress (Miller *et al*. 2012; Kaumbata *et al*. 2020). More importantly, goat farming requires less feed and area for housing compared to cattle farming (Kaumbata *et al*. 2020; Scano and Caboni, 2021). Goats are mostly reared by smallholder farmers to obtain food (meat and milk), fertilizer from the manure, short-term cash when the owners need money to buy staple food, meet other daily needs, pay for their children's school fees, and for agricultural inputs (Mayberry *et al*. 2018; Kaumbata *et al*. 2020).

In Indonesia, the goat population is the highest among other ruminants, and this population continues to increase year by year, with 18.21, 18.31, 18.46, 18.69, and 19.23 million heads reported in 2017, 2018, 2019, 2020, and 2021, respectively (Directorate General of Livestock and Animal Health Services 2021). Goats are also included in the export commodities, and the export rate also increases every year. In 2017, the export of goats reached 6.24 tons, which increased to 11.26 tons in 2018 and 15.12 tons in 2019 (Directorate General of Livestock and Animal Health Services 2021) due to the increasing demand for goat products. However, this high demand certainly needs to be followed by efforts to increase the population and productivity of goats.

During the implementation of these efforts, there is an issue arising, namely poor feeding management of goats that does not meet the goats' nutritional needs for growth and reproduction. In general, smallholder farmers only feed them with grass from the surrounding environment, which only meets some of the goats' nutritional needs and results in less optimal growth (Idamokoro *et al*. 2017; Delgadillo *et al*. 2020). In goat breeding, a lack of nutrient supply can have a negative impact on goats' optimal reproductive performance (Gallego-Calvo *et al*. 2015; Idamokoro *et al*. 2017).

One way to optimize the productive and reproductive performance of goats is by using flushing

Revised 31-05-2022, Accepted 05-06-2022

feed (FF). On one hand, the provision of FF in a relatively short time before mating is expected to optimize goats' reproductive performance. On the other hand, it is expected that farmers will not be distressed by high feed costs. Since the application of FF aims to optimize reproductive hormones prior to mating, it is expected that the percentage of pregnancy will increase. FF is usually made of high energy and protein content (total digestible nutrients >70% and crude protein >17%) (Aidismen *et al*. 2018; Nurlatifah *et al*. 2020; Shaukat *et al*. 2020). Some feed supplements also need to be added to achieve the expected reproductive performance targets.

Arginine is one of the amino acids that has a vital role in the reproductive system of livestock. Arginine metabolism in the body produces nitric oxide and polyamines, which are important molecules in the process of fertilization, embryo implantation, and placental angiogenesis (Zeng *et al*. 2013; Hsu *et al*. 2019). Nitric oxide is also reported to play a role in regulating the rate of blood flow to the placenta, which will determine the transfer of nutrients from the dam to the embryo (Wu *et al*. 2018; Costa *et al*. 2019). Meanwhile, polyamines are molecules responsible for protein synthesis that will support the process of embryo proliferation, growth, and differentiation (Wu *et al*. 2013; Hussain *et al*. 2017; Palencia *et al*. 2018). Arginine supplementation has been reported to increase the secretion of reproductive hormones (Al-Dabbas *et al*. 2008; Green *et al*. 2017). Arginine and its precursors have also been reported to increase the percentage of pregnancy (de Chávez *et al*. 2015; Gilbreath 2018) and support fetal development (Zhang *et al*. 2016). However, arginine needs to be protected first before it is given to goats because of a great likelihood of arginine being fermented in the rumen and converted to ammonia (Sun *et al*. 2018; Gootwine *et al*. 2020).

Tannins are one component of water-soluble polyphenols (Seabra *et al*. 2018; Fraga-Corral *et al*. 2020). Tannins can be divided into two groups, namely hydrolyzed tannins and condensed tannins. In general, plants have a higher concentration of tannins in the condensed form than in the hydrolyzed form (Fraga-Corral *et al*. 2020). Some plants that contain condensed tannins are chestnuts, acacia, quebracho, pine, and gambier. Condensed tannins have the ability to form complex bonds with proteins; therefore, they can be utilized to protect proteins from degradation in the rumen. Protein degradation in the rumen is considered unfavorable because it will be converted to ammonia (Sun *et al*. 2018; Gootwine *et al*. 2020). The presence of protein protection in the rumen is expected to increase the amount of protein that is absorbable through the small intestine, resulting in more optimal protein utilization (Bee *et al*. 2019; Jayanegara *et al*. 2020; Nawab *et al*. 2020).

The nutritional flushing is expected to support body growth before the goats prior to mating and improve the reproductive performance of the goats. The purpose of the current study was to evaluate the influence of nutritional flushing on body morphometrics of female breeding goats.

MATERIALS AND METHODS

Animals and Management

This study used 32 local does with an average age of 3.28±1.08 years and an average body weight of 42.47±8.28 kg. The goats were adapted to a new environment for 7 days. After that, they were fed according to the treatment for 35 days. The goats were distributed in a completely randomized design using a 2 x 2 factorial pattern with 8 replications. The first factor was the FF type, consisting of rice bran and concentrate, whereas the second factor was the level of tannin-protected arginine (TPA: 0 and 300 mg/kg). The forage used to feed the goats was elephant grass as much as 10% of body weight. Flushing feed was also provided as much as 1.5% body weight. The concentrate used consisted of pollard (44%), corn (40%), soybean meal (10), molasses (5%), and minerals (1%). The nutrient content of concentrate comprised 17.35% of crude protein and 75.09% total digestible nutrients. TPA was given in the amount of 0 or 300 mg/kg of flushing feed. The provision of drinking water during the study was carried out *ad libitum*.

Measurement of Body Morphometrics

The body morphometrics observed in this study were initial body length (IBL), final body length (FBL), body length change (BLC), initial chest girth (ICG), final chest girth (FCG), chest girth change (CGC), initial wither height (IWH), final wither height (FWH), and wither height change (WHC). Body length (BL) is the distance from the point of the shoulder to the pin bone (Depison *et al*. 2020). Chest girth (CG) is the body circumference measured just behind the foreleg (Knupp *et al*. 2021). Wither height (WH) is the distance between the top of the wither to the ground (Knupp *et al*. 2021). In the study, body morphometrics was observed in the initial and final feeding treatments. The measurement was done using a measuring tape.

Statistical Analysis

Data of body morphometrics (BL, CG, and WH) of the local does were tabulated in Microsoft Excel software. The data were then analyzed using a two-way analysis of variance and reported as treatment means followed by a standard error of the mean (SEM). $P<0.05$ was considered a statistical significance. Statistical analysis was performed by using IBM SPSS Statistics 22.

RESULTS AND DISCUSSION

Body Length

The overall mean values of IBL, FBL, and BLC of the local female goats in this study were 77.78, 77.97, and 0.19 cm, respectively. Compared to other types of Indonesian local goats, these values found in the current study were relatively higher than those of Bligon, Gembrong, and Kejobong goats with BL of 59.13, 56.67,

and 57.25 cm, respectively (Kusminanto *et al*. 2020). BL of the goats in this study was also relatively higher compared to that of Saburai goats (BL= 61.16 cm) (Dakhlan *et al*. 2021), Marica goats (B= 56.25 cm) (Septiyawan *et al*. 2020), Muara goats (B= 72.82 cm), and Samosir goats (BL= 63.44 cm) (Batubara *et al*. 2011). However, in comparison with other exotic breeds, BL of the goats in the current study was relatively lower than that of Boer goats (BL= 85.35 cm) (Abd-Allah *et al*. 2019) and Saanen goats (BL= 101.55 to 109.75 cm) (Pesmen and Yardimci 2008). The current study's results were also relatively lower than that of Beetal goats, which is 84.86 cm (Waheed *et al*. 2020).

The effects of nutritional flushing on IBL, FBL, and BLC of the local goats are shown in Table 1. The IBL, FBL, and BLC of local goats were not significantly different (P>0.05) among FF. TPA also did not significantly affect (P>0.05) the IBL, FBL, and BLC of the local goats. No significant interaction between FF and TPA was observed (P>0.05) on IBL, FBL, and BLC of the local goats.

These results were probably due to the duration of nutritional flushing treatments which was only five weeks, providing insignificant effects. In a study by Tadesse *et al*. (2016), it was found that two concentrate levels (1% and 1.5% body weight) did not significantly affect the BL of goats. Nagamine *et al*. (2013) also showed that three different protein sources (soybean meal, awamori-pressed lees, and dried tofu lees) did not alter the BL of goats. Mohsan *et al*. (2019) also observed that three different dietary crude protein levels (18.00, 25.50, and 31.60 %) did not provide any significant differences in the goats' BL.

Chest Girth

The overall mean values of ICG, FCG5, and CGC of the local goats in this study were 76.50, 77.56, and 1.06 cm, respectively. In comparison with other types of Indonesian local goats, these values were relatively higher than that of Bligon goats (CG= 69.27 cm), Gembrong goats (CG = 66.59 cm), and Kejobong goats (CG = 65.00 cm) (Kusminanto *et al*., 2020). CG of the local goats in this study was also relatively higher compared to that Saburai goats (68.02 cm) (Dakhlan *et al*. 2021), Marica goats (66.60 cm) (Septiyawan *et al*., 2020), and Samosir goats (66.00 cm) (Batubara *et al*. 2011). However, in comparison with other exotic breeds, CG of the local goats in this study was relatively lower than the CG of Boer goats (80.10 cm) (Abd-Allah *et al*. 2019) and Beetal goats (93.30 cm) (Waheed *et al*. 2020). The CG value was also relatively lower than that of Alpine goats (81.79 cm) (Maksimović *et al*. 2015) and Saanen goats (82.12 cm) (Sarmin *et al*. 2021).

The effects of nutritional flushing on the ICG, FCG, and CGC of the local goats are presented in Table 1.

Table 1. The influence of flushing feed type and tannin-protected arginine on body measurement characteristics of the local goats

Items	Rice Bran		Concentrate		SEM	*p* value		
	0 TPA	300 TPA	0 TPA	300 TPA		FF	TPA	FF*TPA
IBL	77.00	78.25	78.13	77.75	0.98	> 0.05	> 0.05	> 0.05
FBL	77.13	78.38	78.38	78.00	0.98	> 0.05	> 0.05	> 0.05
BLC	0.13	0.13	0.25	0.25	0.05	> 0.05	> 0.05	> 0.05
ICG	76.38	76.63	76.38	76.63	0.92	> 0.05	> 0.05	> 0.05
FCG	77.00	77.31	77.81	78.13	0.92	> 0.05	> 0.05	> 0.05
CGC	0.63	0.69	1.44	1.50	0.10	< 0.001	> 0.05	> 0.05
IWH	72.13	73.00	73.75	73.38	0.63	> 0.05	> 0.05	> 0.05
FWH	72.25	73.13	73.94	73.63	0.63	> 0.05	> 0.05	> 0.05
WHC	0.13	0.13	0.19	0.25	0.05	> 0.05	> 0.05	> 0.05

TPA= tannin-protected arginine (ppm); IBL= initial body length (cm); FBL= final body length (cm); BLC= body length change (cm); ICG= initial chest girth (cm); FCG= final chest girth (cm); CGC= chest girth change; IWH= initial wither height (cm); FWH5= final wither height (cm); WHC= wither height change

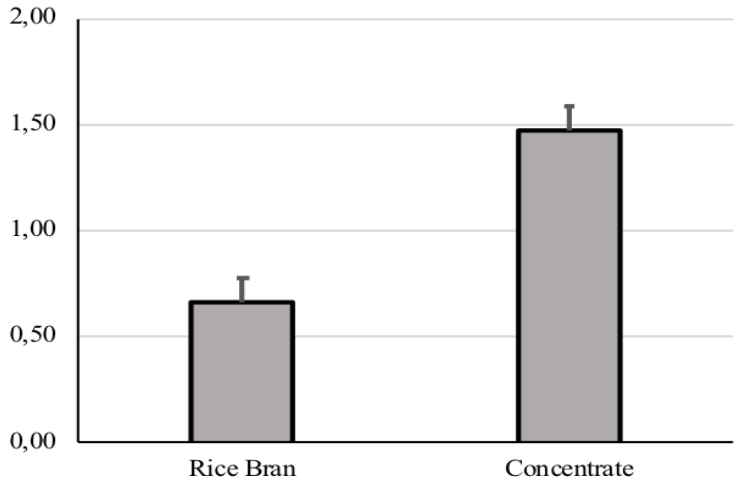

Figure 1. The influence of flushing feed on the chest girth change of the local goats. The goats fed with concentrate had a higher chest girth change compared to those fed with rice bran (1.47 vs 0.66 cm; P<0.001).

The ICG and FCG were not significantly different (P>0.05) among FF types. However, FF significantly affected the CGC of the local goats (P<0.001). The use of concentrate for the local goats resulted in a higher (P<0.001) CGC compared to the use of rice bran. Since CG is the most sensitive body morphometrics, the result was significant although the feeding treatments were given for only a short period of time. In a study by Panzuti *et al*. (2018), three levels of concentrate feeding had a significant effect on CG of the goats, in which a high level of concentrate led to a higher CG than a low level of concentrate.

In a study by Akhtar *et al*. (2021), it was reported that CG had a significant positive relationship with the body weight of goats. In addition, Knupp *et al*. (2021) also indicated that CG is a trait that is most related to the body weight of goats. Depison *et al*. (2020) also showed a positive relationship between CG and the body weight of goats. According to these previous findings, it can be stated that a higher CGC in goats treated with concentrate provides better body growth compared to CGC when treated with rice bran. Moreover, Mulyono *et al*. (2018) showed that CG is highly associated with prolificacy, in which every 1% increase in CG can improve 2.38% of litter size. Therefore, it is assumed that the use of concentrate as nutritional flushing can also improve the reproductive performance of the local female goats.

As shown in Table 1, TPA did not significantly affect (P>0.05) the ICG, FCG5, and CGC of the goats. No interaction between FF and TPA was also observed (P>0.05) on the ICG, FCG, and CGC of the goats. This finding indicates that the body development of the local female goats was most likely influenced by FF, while TPA had no substantial benefit to the body development of the goats.

Wither Height

The overall mean values of IWH, FWH, and WHC of the local goats in this study were 73.06, 73.23, and 0.17 cm, respectively. This finding was relatively higher than the WH of the other types of Indonesian local goats. Kusminanto *et al*. (2020) reported that Bligon, Gembrong, and Kejobong goats had WH of 68.36, 56.08, and 65.12 cm, respectively. Budisatria *et al*. (2021) noted that the WH of Bligon and Kejobong goats was 60.60 and 63.80 cm, respectively. In another study, Batubara *et al*. (2011) showed that the WH of Muara and Samosir goats were 65.29 and 54.50 cm, respectively. WH of the local goats in the current study was also relatively higher compared to that of Saburai goats (58.79 cm) (Dakhlan *et al*. 2021) and Marica goats (57.40 cm) (Septiyawan *et al*. 2020). However, the value was relatively lower than that of Beetal goats (92.10 cm) (Waheed *et al*. 2020) and Alpine goats (74.20 cm) (Panzuti *et al*. 2018).

The effects of nutritional flushing on the IWH, FWH, and WHC of the local female goats are shown in Table 1. The IWH, FWH, and WHC of the goats were not significantly different (P>0.05) between FF. TPA also did not significantly affect (P>0.05) the IWH, FWH, and WHC of the goats. No significant interaction between FF and TPA was also observed (P>0.05) on the IWH, FWH, and WHC of the goats.

The insignificant effect of nutritional flushing in the current study was probably due to the short time of feeding treatments. Tadesse *et al*. (2016) also found that the wither height of goats was not significantly different after two different concentrate levels were given. Nagamine *et al*. (2013) also found that the use of three different main protein sources (soybean meal, Awamori-pressed lees, and dried Tofu lees) had no significant effect on the WH of goats. Mohsan *et al*. (2019) also observed that the WH of goats were similar among three different dietary crude protein levels (18.00, 25.50, and 31.60 %).

CONCLUSION

Based on the results of the study, the flushing feed had no significant effect on the body morphometrics of the local female goats, except for chest girth change. The use of concentrate provided higher chest girth change, resulting in better body growth compared to the use of rice bran. The addition of tannin-protected arginine also had no significant contribution to the body morphometrics of the goats. It is recommended that concentrate be used as nutritional flushing for the local does.

ACKNOWLEDGMENT

This study was financially supported by Universitas Brawijaya through Hibah Penelitian Unggulan with Contract Number: 537.31.2/UN10.C10/PN/2021.

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