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Research Article

Effect of Feeding High Proportion Concentrates Containing Tofu Waste on Nutrient Consumption, Milk Production, Body Condition Score and Postpartum Mating Period of Dairy Goats in Yogyakarta, Indonesia

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Abstract

Objective: This study was conducted to investigate the effect of feeding a high proportion concentrate containing tofu waste on nutrient consumption, milk production, body condition (BC) score and length of postpartum mating (PPM) period of dairy goats. **Methodology:** Data were collected from 30 lactating goats on small farms in the Sleman region of the Yogyakarta province in Indonesia. The goats were fed diets consisting of *Calliandra calothyrsus* and wheat pollard with (Farm B, Diet B) or without (Farm A, Diet A) tofu waste. The proportion of concentrates in the diets on a dry matter (DM) basis was 20 and 55% for Diet A and Diet B, respectively. Data for feed and nutrient consumption, milk production, BC score and length of PPM period were collected. All data were statistically analyzed by t-test. **Results:** Feeding a high proportion concentrate containing tofu waste significantly ($p<0.05$) decreased DM and crude protein (CP) intake but did not affect the consumption of crude fiber and total digestible nutrients. High proportion concentrate significantly ($p<0.05$) lengthened PPM period but no effect on milk production. Long PPM period presumably associated with the presence of tofu waste in high concentrate diet. **Conclusion:** Diets containing high proportion concentrate with tofu waste did not affect milk production or BC score but lengthened the PPM period. Thus, the proportion of tofu waste can be reduced to avoid negative effects of phytoestrogens contained in the tofu waste on reproductive performance.

Key words: Nutrient consumption, high proportion concentrates, tofu waste, milk production, body condition

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The contribution of dairy goats to meet the demand for milk in Indonesia has recently increased. In particular, small farms producing goat milk play a significant role in milk production on Java Island. One constraint dairy goat farmers face is limited forage, which can be affected by several factors, including farm size and labor availability. In response to such limitations, farmers often seek alternative feeds to substitute for forage. On small farms, leguminous leaves are mainly used for goat feed. In the Yogyakarta province, goat farmers typically use *Calliandra calothyrsus* due to its rapid growth and palatability[1], which exceeds that of other forages such as *Leucaena* and *Albizia*[2]. *Calliandra calothyrsus* grows in many soil types, including acidic soils (pH 4.5)[3] and this plant is adapted to a wide range of habitats, including those having various elevations (from sea level to 1850 m above sea level) and annual rainfall (between 700-4,000 mm year^{-1})[4]. The optimal cutting time for Calliandra is 6 months before the middle of the dry season[5] and plants cut at 16 week of age produce the highest quantity of fresh forage, dry matter (DM), organic matter and crude protein (CP)[6]. A high proportion of forage in dairy goat feed increases milk production, milk fat and decreases ruminal acidity[7]. However, as with other forages, the availability of Calliandra decreases during the dry season[8]. Thus, alternative, supplementary feed is needed to sustain milk production throughout the year.

Several food by-products are available in rural areas, including tofu waste, which farmers commonly purchase from tofu processing plants. Tofu waste has economic benefit due to its low price and continuous availability. With an average protein and fiber content of 23.39 and 19.44%, respectively, tofu waste is a good source of protein and fiber[9] and thus is used as a concentrate in feed for pigs[10] and dairy cows[11], Muscovy ducks[12] and steers[13].

Although, there is currently limited information about the use of tofu waste in feed for dairy goats and particularly its safety and effect on milk production, tofu waste is commonly used as a supplement for fattening goats[14]. Tofu waste also serves as a substitute for grass in goat production in Banjarnegara, Central Java during the dry season[15]. Another study conducted in the village of Sukorejo, Turi, Indonesia, examined the effects of a combination of tofu and Calliandra in goat feed, although how the diet impacted goat productivity was not assessed[16]. According to Wina *et al.*[9] the high solubility and digestibility of protein in tofu waste is beneficial but *in vitro* assays showed decreases in tofu waste protein digestibility with increasing amounts of *Calliandra calothyrsus* in feed.

To attain optimal milk production from goats, assessment of the utilization of high proportion concentrates in goat feed from the perspective of nutritional adequacy and milk production is needed, particularly for small farms. The nutritive status of goats can be determined by evaluating body condition (BC) score[17]. Low body energy reserves associated with low BC score can reduce milk yield[18] and negatively impact reproduction by reducing levels of plasma follicle stimulating hormone (FSH)[19].

In this study we assessed the effect of feeding a high proportion concentrate containing tofu waste on nutrient consumption, milk production, BC score and the length of the postpartum mating (PPM) period of goats. Results from this study will provide useful information about food by-products as sources of protein and fiber to provide adequate nutrition and maintain milk production by dairy goats, as well as demonstrate the usefulness of tofu waste as a substitute for forage.

MATERIALS AND METHODS

This study involved small dairy goat farms in the Sleman region of Yogyakarta province in Indonesia, which is located on the latitude between 110°33′ 00″ and 110°13′ 00″ and 7°34′ 51″ and 7°47′ 30″ east and south, respectively, at 1,000 m above sea level[20] (Fig. 1).

Data were collected from 30 lactating Etawah Crossbred goats (Fig. 2) on Farms A and B. The goats were fed two types of diet consisting of leguminous tree leaves (*Calliandra calothyrsus*) and wheat pollard that lacked (Farm A, Diet A) or included (Farm B, Diet B) tofu waste substituted for 35% of forage DM (Table 1). Diets A and B had 20 and 55% concentrates, respectively, on a dry matter (DM) basis. Farm A represented common feeding of dairy goats in smallholder farm in Sleman, whereas Farm B was an example of feeding high proportion concentrate.

Goats were in the mid-lactation phase (3-4 months after kidding) of their second or third lactation period. The initial body weight of the goats was between 44.0-50.0 kg. Milk production in previous lactation phase(s) was approximately 1.0-2.0 L d^{-1} and the litter size was 1-2 kids/doe. All goats were managed in a confined system in individual pens that had feed troughs and water containers. *Calliandra calothyrsus* (Fig. 3a) was harvested from the farmers' land. Tofu waste (Fig. 3b) was purchased from local processing plants near the farms. Chemical analysis of samples was conducted at the Laboratory of Animal Nutrition and Laboratory of Dairy Science and Milk Industry, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia.

Fig. 1: Map of the Sleman region in the Yogyakarta province of Indonesia

Fig. 2: Etawah crossbred goat

Table 1: Diet compositions

	Proportion (percentage of total feed dry matter)	
Ingredients	Farm A diet	Farm B diet
Wheat pollard	20	20
Calliandra calothyrsus	80	45
Tofu waste	0	35
Total	100	100

Data for feed and nutrient consumption were collected for 14 consecutive days from the beginning of the study. Feed intake was determined as the difference between weights of offered and refused feed after 24 h. Tofu waste was mixed with wheat pollard and given prior to feeding forage. Chemical composition of feed expressed as DM, crude protein (CP), fat, crude fiber and total digestible nutrients (TDN) was determined according to AOAC guidelines[21]. Nutrient intake was calculated by multiplying the weight of feed consumed by nutrient content. Milk production was measured across 30 days in the middle of the study period.

Fig. 3(a-b): (a) *Calliandra calothyrsus* (b) Tofu waste

Body condition (BC) score was measured at the beginning and end of the experimental period. Body condition scoring was performed by palpating muscle and fat deposits over and around the vertebrae and in the loin region of the goat.

BC score ranged from 1-5 points[22] and represented the average results for examinations by three evaluators. BC scores were: 1: Very thin, highly visible back bone having no visible fat cover, 2: Thin (bony), visible backbone having a continuous ridge, 3: Good, in which the backbone was not prominent and a thick tissue layer covered the vertebrae, 4: Back bone and ribs could not be seen and 5: Presence of excessive fat and a back bone buried in fat[18,23]. Reproductive performance was determined by assessing the length of the postpartum mating (PPM) period, based on the reproduction records available at the farm and interviews. PPM data were obtained used questionnaires pertaining to kidding time, first estrus after kidding and service/conception. All data were statistically analyzed by t-test at 5% level of significance.

RESULTS

The chemical composition of Diets A and B fed on Farms A and B, respectively, showed a lower DM and crude protein (CP) for Diet B (high proportion concentrate) compared to that of Diet A (low proportion concentrate) (Table 2). Meanwhile, Diet B was higher in crude fiber, fat and total digestible nutrient (TDN) content than Diet A. The ratio of TDN : Crude protein for Diet B was 2.5:1, whereas that for Diet A was 2.2:1. Thus, the results indicated that inclusion of tofu waste increased the energy content of Diet B and in turn the available energy for rumen fermentation was higher for Diet B than Diet A.

Goats fed Diet A, which has a high proportion concentrate, had significantly ($p<0.05$) decreased DM and CP intake (Table 3). The average DM intake of the goats on Farm A and Farm B was 117.78±7.85 and 105.83±17.57 g kg^{-1} $BW^{0.75}$, equivalent to 4.38 and 3.90 g kg^{-1} body weight (BW), respectively. No significant differences were seen between the diets for crude fiber, fat and TDN intake. Together these results indicate that high proportion concentrate containing tofu waste (Diet B) provides adequate fiber and energy but is a less useful protein source.

There were no differences between average milk yield of goats on Farms A and B during the mid-lactation stage (the period after peak production) (Table 4). The average milk yield ranged between 1.0-1.2 L d^{-1}, which was consistent with the milk capacity of Etawah Crossbred goats under smallholder conditions. At the beginning of the experimental period the two diets had no effect on BC score and by the end of the period (around 7 months after kidding) the BC score increased for both groups. The average initial BC score values were 2.7 and 2.9, for Farm A and B goats, respectively, which increased to 3.0 and 3.1 by the end of the experimental period (Table 4), indicating that goats on both farms consumed adequate nutrients.

The period between PPM for goats on Farm B was longer than that for Farm A, with an average of 6.2 and 3.4 months, respectively (Table 4), suggesting that feeding high proportion concentrates containing tofu waste decreased the reproductive activity of the goats and that inclusion of tofu waste in feed could be used to lengthen the PPM period.

Table 2: Chemical composition of the diets

	Chemical composition (%)				
Feed components	DM	CP	CF	EE	TDN
Calliandra calothyrsus	32.2	23.4	15.1	3.0	45.0
Wheat pollard	89.0	17.4	16.0	3.1	65.0
Tofu waste	14.4	24.0	22.1	7.8	65.0
Diet A (farm A)	43.4	22.2	15.3	3.0	49.0
Diet B (farm B)	36.5	20.9	16.6	4.3	52.8

DM: Dry matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, TDN: Total digestible nutrient

Table 3: Feed and nutrient consumption of the diets

	Groups	
Nutrient composition	Diet A (Farm A)	Diet B (Farm B)
Dry matter (g day^{-1})	2,420.68±51.82[a]	2,118.86±168.08[b]
Dry matter (g kg^{-1} $BW^{0.75}$)	117.78±7.85[a]	105.83±17.57[b]
Dry matter (g kg^{-1} BW)	4.38±7.85[a]	3.90±17.57[b]
Crude protein (g kg^{-1} $BW^{0.75}$)	25.27±1.66[a]	23.18±3.64[b]
Crude fiber (g kg^{-1} $BW^{0.75}$)	17.96±1.20[ns]	18.07±2.77[ns]
Crude fat (g kg^{-1} $BW^{0.75}$)	3.56±0.23[ns]	5.55±4.33[ns]
Total digestible nutrient (g kg^{-1} $BW^{0.75}$)	59.05±4.02[ns]	61.69±9.41[ns]

[a,b]Mean values in the same row with different superscripts showed significant differences ($p<0.05$), [ns]Non significant ($p>0.05$)

Table 4: Milk production, body condition score and postpartum mating period of goats

	Groups	
Parameters	Farm A	Farm B
Milk production (L/day)	1.09±0.38^{ns}	1.14±0.44^{ns}
Initial body condition score	2.7±0.8^{ns}	2.9±0.4^{ns}
Final body condition score	3.0±0.3^{ns}	3.1±0.6^{ns}
Postpartum mating (months)	3.4±0.5^{a}	6.2±1.8^{b}

^{a,b}mean values in the same row with different superscripts showed significant differences ($p<0.05$), ^{ns}Non significant ($p>0.05$)

DISCUSSION

In this study, the proportion of concentrate was as high as 55% of total feed DM for Diet B. No significant differences were observed in milk production or BC score for high and low proportion concentrates. This result is consistent with the findings of Rapetti and Bava[24] and Goetsch *et al.*[25], who reported that 60-70% DM in concentrates did not alter the productive capacity of goats. However, a significant decrease was observed in DM and CP intake for the high concentrate diet containing tofu waste (Farm B, $p<0.05$). Decreases in DM intake could be related to the physical properties of tofu waste, which is wet, such that upon consumption the water volume in the rumen would increase and in turn depress subsequent consumption of leguminous leaves to reduce DM intake. According to Shittu *et al.*[26] goats can adapt to a broad range of feeding conditions, whereas Silanicove[27] and Carlson[28] described diets in which goats were given feed having an intermediate DM level, which lowers the risk of acidosis and tends to move toward concentrate selectors. Thus, use of feed having high proportion concentrates should be acceptable for goats given their high adaptability. The level of DM intake by goats on both farms was similar (4.1-5.3% of BW)[29]. The value for DM intake (112 g kg^{-1} BW), was also in the range of that reported in a previous study[30]. Therefore, both diets provided sufficient DM for lactating goats.

The goat feed used in this study had a CP content ranging from 20.9-22.2% and is thus protein rich. These values are higher than the range (14.0-20.3%) previously cited as being the optimal protein level for goat feed[31]. Results of the present study indicate that tofu waste and *Calliandra calothyrsus* were good protein sources for goats. However, digestibility must also be considered. Wina *et al.*[9] reported that feed digestibility decreased from 74-70% upon inclusion of tofu waste with *Calliandra calothyrsus.* According to a study by Umiyasih and Anggraeny[32] although feeding wet concentrate could increase by-pass protein, it negatively affected nutrient absorption due to the high flow rate of passage. Here, the physical form of the high proportion concentrate containing tofu waste in Diet B could protect proteins in the tofu waste from rumen degradation. Therefore, despite the low protein consumption of goats fed Diet B, these animals could in fact absorb more protein from the tofu waste. In addition, we found that tofu waste could serve as a crude fiber source to replace the 35% of DM provided by *Calliandra calothyrsus* in Diet A.

Milk production by goats in this study was not affected by the proportion of concentrate in the diet. The average milk production (0.7-1.6 L d^{-1}) was in the normal range for Etawah Crossbred goats under smallholder conditions[33]. These results indicate that tofu waste can be included in high proportion concentrate diets to maintain milk production.

Goats fed tofu waste in the high proportion concentrate diet had good BC score that exceeded previously reported values of 2.06[34] and 2.25[35]. This result is consistent with earlier common use of tofu as a supplement in fattening rations for goats[13]. Here, the high BC score was likely indicative of available energy reserves and could be associated with a high energy density expressed as TDN content (Table 1). Together the high BC score and milk yield of goats in this study was consistent with the findings of Rapetti and Bava[24] and Goetsch *et al.*[25], who showed that diets rich in concentrate could negatively influence milk production during the mid-lactation phase and cause excessive fattening.

The effect of feeding high proportion of concentrate containing tofu waste lengthened the PPM period. According to Jalilian and Moeini[19], decreases in reproductive performance were associated with low BC score, which could influence plasma FSH concentrations. Here we saw no association between PPM and BC score, which, at 2-3, was within the range that is ideal for breeding[18]. Therefore, other factors, such as lactation period and the presence of phytoestrogens in tofu waste, were presumably responsible for the long PPM period of these goats. According to Koyuncu and Altincekic[18] and Hussain *et al.*[36] adequate amounts of milk could be produced if animals consume sufficient nutrients and maintain optimal body conditions during the lactation period. Similar results were found in this study by the end of the lactation period the BC score had increased. Lactating goats that are continuously milked likely call on reserve nutrients to maintain milk production. High energy reserves associated with BC score in goats could be directed to milk production rather than to support reproductive activity, which in turn lengthens the PPM period. This possibility is supported by the high blood glucose levels seen in this study (between 26 and 28 mg dL^{-1}) (Table 5), which were higher than normal levels[37]. These high glucose levels could be needed to supply sufficient glucose for lactose biosynthesis during milk production.

As mentioned above, the PPM in goats fed high proportion concentrate containing tofu waste might be affected by the presence of phytoestrogen-isoflavones in soy

Table 5: Blood metabolite profiles of goats

	Groups	
Parameters	Farm A	Farm B
Glucose (g dL^{-1})	44.08±5.90^{ns}	45.34±8.12^{ns}
Total protein plasma (mg dL^{-1})	8.22±0.78^{a}	7.64±10.41^{b}
Urea (mg dL^{-1})	43.33±4.55^{ns}	44.19±2.39^{ns}
Cholesterol (mg dL^{-1})	64.67±12.12^{a}	95.55±21.33^{b}
Albumin (g dL^{-1})	3.62±0.17^{ns}	3.51±0.21^{ns}

^{a,b}Mean values in the same row with different superscripts showed significant differences ($p<0.05$), ^{ns}Non significant ($p>0.05$)

beans[38]. The effects of phytoestrogens vary from an estrogenic over-response, thus increasing secretions in the reproductive tract, to infertility and disruption of animal behavior[39]. Typically, phytoestrogens exert their estrogenic effect on the central nervous system and the reproductive system to induce estrus and stimulate growth of genital tract and mammary gland tissues in females[40]. The longer PPM period seen for goats fed tofu waste might be caused by repeated estrus. Thus, the possible negative effect of phytoestrogen-isoflavones on reproductive performance should be considered and weighed against the benefits provided by tofu waste in terms of price and palatability.

CONCLUSION

Feeding high proportion concentrates containing tofu waste in the diet significantly ($p<0.05$) decreased DM and CP intake of lactating goats but did not affect crude fiber and TDN consumption. Tofu waste could be used as a substitute for leguminous material as a source of protein and crude fiber. Feeding high proportion concentrates containing tofu waste did not affect milk production or BC score but did prolong the PPM period. Thus, the proportion of tofu waste can be reduced to avoid negative effects of phytoestrogens contained in the tofu waste on reproductive performance.

SIGNIFICANCE STATEMENT

This study described tofu waste as an alternate source of protein and fiber for goat feed. Lactating dairy goats fed diets containing tofu waste maintained milk production and good BC score. The proportion of tofu waste in diets can be managed to avoid negative effect of phytoestrogens contained in the waste on reproductive performance of goats and to maintain optimal length of PPM periods. This study provides critical information for strategies to maintain optimal nutritional value of goat feeds in tropical regions that experience decreases in forage availability during the dry season.

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REFERENCES

1. Boukila, B., E.T. Pamo, F.A. Fonteh, F. Tendonkeng, J.R. Kana and A.S. Nanda, 2005. Effects of supplementation with leaves of *Calliandra calothyrsus* and *Leucaena leucocephala* on goat production performance during dry and rainy seasons in the Western highlands of Cameroon. Cameroon J. Exp. Biol., 1: 8-14.
2. Satjapradja, O. and T. Sukandi, 1981. Agroforestry with red calliandra (*Calliandra calothyrsus*). Indones. Agric. Res. Dev., 3: 85-88.
3. Stewart, J., Mulawarman, J.M. Roshetko and M.H. Powell, 2001. Produksi dan Pemanfaatan Kaliandra (*Calliandra calothyrsus*). Winrock International and International Center for Research in Agroforestry, Bogor, Indonesia.
4. Chamberlain, J.R., 2001. *Calliandra callothyrsus*: An Agroforestry Tree for the Humid Tropics. Oxfort Institute Press, Oxford.
5. Hendrati, R.L. and N. Hidayati, 2014. Budidaya kaliandra (*Calliandra calothyrsus*) untuk bahan baku sumber energi. Kerjasama Badan Penelitian dan Pengembangan Kehutanan-Balai Besar Penelitian Bioteknologi dan Pemuliaan Tanaman Hutan dengan Direktorat Jendral Bina Usaha Kehutanan, Jakarta. IPB Press.
6. Akyeampong, E. and K. Muzinga, 1994. Cutting management of *Calliandra calothyrsus* in the wet season to maximize dry season fodder production in the central highlands of Burundi. Agrofor. Syst., 27: 101-105.
7. Abqoriyah, R. Utomo and B. Suwignyo, 2015. Productivity of Calliandra (*Calliandra calothyrsus*) as a forage in the different defoliation time. Buletin Peternakan, 39: 103-108.
8. Abijaoude, J.A., P. Morand-Fehr, J. Tessier, P. Schmidely and D. Sauvant, 2000. Influence of forage: Concentrate ratio and type of starch in the diet on feeding behaviour, dietary preferences, digestion, metabolism and performance of dairy goats in mid lactation. Anim. Sci., 71: 359-368.
9. Wina, E., D. Yulistiani, I.W.R. Susana and B. Tangendjaja, 2012. Improving microbial protein synthesis in the rumen of sheep fed fresh tofu waste by crude tannin extract of acacia mangium. Indones. J. Anim. Vet. Sci., 17: 207-214.
10. Puger, A.W., I.M. Suasta, P.A. Astawa and K. Budaarsa, 2015. The effect of commercial feed replacement with tofu waste on the race pig organ component. Majalah Ilmiah Peternakan, 18: 52-54.
11. Asminaya, N.S., B.P. Purwanto, Nahrowi, W.A. Ridwan and A. Atabany, 2017. Milk yield and nutrient adequacy of lactating dairy cow fed based on tofu waste, soybean hulls and straw. Int. J. Sci. Res., 6: 951-956.

12. Tanwiriah, W., D. Garnida and I.Y. Asmara, 2007. Effect of tofu waste in the diet on the performance of Muscovy duck in the growing period. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner, August 21-22, 2007, Badan Litbang Pertanian, Bogor, pp: 615.
13. Kim, K.H., S.J. Kim, B.T. Jeon, D.H. Kim and M.R. Oh *et al*., 2012. Effects of dietary soybean curd residue on the growth performance and carcass characteristics in Hanwoo (*Bos taurus coreanae*) steer. Afr. J. Agric. Res., 7: 4331-4336.
14. Tarmidi, A.R., 2010. Penggunaan ampas tahu dan pengaruhnya pada pakan ruminansia. http://www.kambingindonesia.com/2010/07/penggunaan-ampas-tahu-dan-pengaruhnya.html
15. Novit, E., 2017. Dampak kekeringan, harga rumput pakan kambing dan sapi naik 100%. https://daerah.sindonews.com/read/1232290/22/dampak-kekeringan-harga-rumput-pakan-kambing-dan-sapi-naik-100-1503288196
16. Husada, S., 2012. The effect of different maintenance on pre weaning growth of Etawah Crossbred kids. Faculty of Animal Science, Universitas Gadjah Mada. Yogyakarta.
17. Samardzija, M., S. Vince and D. Djuricic, 2013. Association of parity, fecundity and body condition score with blood serum concentration of some metabolites during pre and post parturient period in German improved fawn goats. Vet. Arhiv, 83: 469-477.
18. Koyuncu, M. and S.O. Altincekic, 2013. Importance of body condition score in dairy goats. Macedonian J. Anim. Sci., 3: 167-173.
19. Jalilian, M.T. and M.M. Moeini, 2013. The effect of body condition score and body weight of Sanjabi ewes on immune system, productive and reproductive performance. Acta Agric. Slovenica, 102: 99-106.
20. Anonymus, 2018. Profil Kabupaten Sleman. http://www.bpkp.go.id/diy/konten/830/Profil-Kabupaten-Sleman
21. AOAC., 2005. Official Method of Analysis. 18th Edn., Association Official Analitycal Chemistry, Maryland, USA.
22. Atasever, S., U. Sen and H. Onder, 2015. A study on the determination of body condition score and somatic cell count in Turkish Saanen goats. J. Applied Anim. Res., 43: 445-449.
23. Cimen, M. and H. Topcu, 2013. Effect of body condition score on biochemical milk parameters having economic importance in dairy goat during the first month of postpartum period. Int. J. Agric. Biol., 15: 395-397.
24. Rapetti, L. and L. Bava, 2008. Feeding Management Dairy Goats Intensive System. In: Dairy Goats Feeding and Nutrition, Cannas, A. and G. Pulina (Eds.)., CAB International, The Wallingford Oxfordshire, pp: 221-292.
25. Goetsch, A.L., G. Detweiler, T. Sahlu, R. Puchala and L.J. Dawson, 2001. Dairy goat performance with different dietary concentrate levels in late lactation. Small Rumin. Res., 41: 117-125.
26. Shittu, O.O., O.F. Smith and O.A. Osinowo, 2011. Roughage to concentrate ratio on milk secretion rate in goats. Afr. J. Agric. Res., 6: 2466-2471.
27. Silanikove, N., 2000. The physiological basis of adaptation in goats to harsh environments. Small Rumin. Res., 35: 181-193.
28. Carlson, J., 2018. Dairy goat body condition scoring. American Dairy Goat Association. https://adga.org/wp-content/uploads/2017/11/adga-dairy-goat-body-condition-scoring.pdf
29. Tarr, B., 2018. Guidelines to feeding and management of dairy goats. Nutrifax Nutrition New and Information. https://epa-prgs.ornl.gov/radionuclides/Goat_Guidelines.pdf
30. Chowdhury, S.A., H. Rexroth, C. Kijora and K.J. Peters, 2002. Lactation performance of German fawn goat in relation to feeding level and dietary protein protection. Asian Aust. J. Anim. Sci., 15: 222-237.
31. Hwangbo, S., S.H. Choi, S.W. Kim, D.S. Son, H.S. Park, S.H. Lee and I.K. Hwan-Jo, 2009. Effects of crude protein levels in total mixed rations on growth performance and meat quality in growing Korean black goats. Asian-Aust. J. Anim. Sci., 22: 1133-1139.
32. Umiyasih, U. and Y.N. Anggraeny, 2004. Evaluation of feeding and residues utilization as basal ration and its effect on beef cattle production in East Java. Prosiding Seminar Nasional Sistem Integrasi Tanaman-Ternak, Juli 20-22, 2004, Denpasar, pp: 319-328.
33. Astuti, D.A., E.B. Laconi and D. Sastradipradja, 2003. Studies milk production of Etawah Crossedbred goat fed with Tempe waste. Eur. Assoc. Anim. Prod. Public., 109: 117-120.
34. Casamassima, D., M. Palazzo and R. Pizzo, 2007. Evaluation of milk production and some blood parameters in lactating autochthonous goat extensively reared in Molise region. Ital. J. Anim. Sci., 6: 615-617.
35. Merkhan, K.Y., K.A. Darwesh and E.T. Buti, 2013. Impact of lactation stage on the body condition and milk quality of Black goat. Int. J. Agric. Food Res., 2: 48-52.
36. Hussain, Q., H. Waldeland, O. Havrevoll, L.O. Eik, O. Andresen and I.V. England, 1996. Effect of type of roughage and energy level on reproductive performance of pregnant goats. Small Rumin. Res., 21: 97-103.
37. Antunovic, Z., M. Speranda, J. Novoselec, M. Didara, B. Mioc, Z. Klir and D. Samac, 2017. Blood metabolic profile and acid-base balance of dairy goats and their kids during lactation. Vet. Arhiv, 87: 43-55.
38. Watzkova, J., L. Krizova, A. Pavlik, V. Schulzova, J. Hajslova and J. Lojza, 2011. The effect of soybean-derived phytoestrogens on concentrations of plasma isoflavones, 15-keto-13, 14-dihydroprostaglandin $F_{2\alpha}$ and progesterone in dairy cows. Acta Vet. Brno, 79: 525-532.
39. Retana-Marquez, S., H. Hernandez, J.A. Flores, M. Munoz-Gutierrez and G. Duarte *et al*., 2012. Effects of phytoestrogens on mammalian reproductive physiology. Trop. Subtrop. Agroecosyst., 15: S129-S145.
40. Mostrom, M. and T.J. Evans, 2011. Phytoestrogens. In: Reproductive and Developmental Toxicology, Gupta, R.C. (Ed.)., Academic Press, USA., pp: 707-722.