Pertanika J. Trop. Agric. Sci. 41 (2): 729 – 740 (2018)

TROPICAL AGRICULTURAL SCIENCE

Journal homepage: http://www.pertanika.upm.edu.my/

Effects of Non-Medicated and Medicated Urea Molasses Multi-nutrient Blocks on Dry Matter Intake, Growth Performance, Body Condition Score and Feed Conversion Ratio of Saanen Lactating Does Fed Conventional Diets

Mira, P.[1], Wan Zahari, M.[2]*, Rusli, N. D.[1] and Mat, K.[1]

[1]*Faculty of Agro Based Industry, Universiti Malaysia Kelantan, 17600 UMK, Jeli, Kelantan, Malaysia*
[2]*Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, 16100 UMK, Kota Bharu, Kelantan, Malaysia*

ABSTRACT

In this study, 24 Saanen lactating does raised by a smallholder in Kemahang, Tanah Merah, Kelantan were randomly assigned to four groups with six goats in each group. The trial included evaluation of four dietary treatments, that is, T1: control group fed on basal diet only, which consisted of 3 kg Napier grass (*Pennisetum purpureum*) and 1 kg commercial goat pellet. Animals in T2, T3 and T4 received equal amounts of basal diet with supplementation of urea molasses multi-nutrient block (UMMB), medicated urea molasses multi-nutrient block (MUMB) and commercial mineral block (CMB) respectively. The total dry matter intake (DMI) (kg/d) in T2 (1.28) and T3 (1.24) were significantly higher ($p<0.05$) than in T1 (1.14) and T4 (1.15). However, there were no significant differences ($p>0.05$) between treatments on average daily gain (ADG) and body measurements. Highest ADG (g/d) were recorded in T2 (53.57) followed by T3 (45.63), T4 (39.68) and T1 (37.70). Similar trend was also recorded in body condition score (BCS) but there were no significant differences ($p>0.05$) between treatments. At the end of the 90 days of feeding trial, both T2 and T3 showed acceptable BCS, that is, at 3.25 and 3.08 respectively, while low BCS were recorded in T1 (2.63) and T4 (2.71). There was significant difference ($p<0.05$) between treatments on feed conversion ratio (FCR) which were at 0.84, 0.95, 1.20 and 1.46 for T2, T3, T4 and T1 respectively. Both UMMB and MUMB were effective in enhancing appetite, DMI and ADG of the dairy goats, apart from minimising weight loss during lactation.

Keywords: Commercial mineral block, feed conversion ratio, lactating goats, MUMB, UMMB

ARTICLE INFO

Article history:
Received: 20 September 2017
Accepted: 8 December 2017

E-mail addresses:
mirapanadi@gmail.com (Mira, P.)
wanzahari@umk.edu.my (Wan Zahari, M.)
nordini@umk.edu.my (Rusli, N. D.)
khairiyah@umk.edu.my (Mat, K.)
* Corresponding author

ISSN: 1511-3701

INTRODUCTION

Small ruminant farming plays an important part in smallholder communities, and contributes substantially to the economic development in Malaysia (Melissa, Norsida, & Nolila, 2016). The demands for mutton and milk are increasing every year and the self-sufficiency levels for both items cannot be met if goats and sheep farming are not fast expanding. The interest in dairy goat farming in particular, has been observed in Peninsular Malaysia, especially in the eastern regions. Saanen is one of the most common breeds of goats raised by local smallholders owing to its high milk yield and its resistance to tropical diseases. However, the high cost of feed is one of the main constraints faced by local smallholders (Shanmugavelu & Quaza Nizamuddin, 2014; Wan Zahari, Chandrawathani, Sani, Nor Ismail, & Oshibe, 2007). In lactating dairy goats, poor nutritive values in daily feeds usually result in low milk yield and poor milk quality. Daily milk yield of 1.5 to 2.0 liters is commonly observed in Saanen dairy goats raised by smallholders in Kelantan.

Most smallholders utilise mineral or salt block as supplement to their lactating goats. This practice is usually aimed at increasing appetite of the animals, and not for rectifying mineral deficiencies or imbalances. Mineral blocks or salt blocks are imported and specifically produced to overcome mineral deficiencies only. Deficiencies of protein and energy are the main problems in local ruminants which can be solved by supplementing mineral block or salt block. Hence, supplementation of urea-molasses multi-nutrient blocks (UMMB) is more appropriate as it is enriched with molasses and urea, as source of energy and protein respectively (Akter, Akbar, Shahjalal, & Ahmed, 2004; Manta, Aduba, Dada, & Onyemize, 2013). Besides, UMMB is also highly efficient as a vehicle of anthelminthic carrier and for this reason, it is known as 'medicated UMMB' or MUMB (Akbar, Ahmed, & Mondal, 2006). This study was aimed at comparing the effect of UMMB, MUMB and imported commercial mineral block (CMB) on dry matter intake (DMI), average daily gain (ADG), feed conversion ratio (FCR) and body condition score (BCS) of Saanen lactating does raised by a smallholder in Kemahang, Tanah Merah, Kelantan, Malaysia.

MATERIALS AND METHODS

Experimental Animals and Management

A total of 24 Saanen lactating does with different parity (primiparous and multiparous) were used in this trial. The animals were housed in separate pens and were fed individually over 90 days' trial period.

Experimental Design and Treatments

The animals were allocated into four treatment groups based on randomised complete block design, with six goats per group based on their initial body weight (Mean±SE) of 40.58±1.50 kg and parity.

All animals in the treatment groups received equal amounts of basal diet - 3 kg fresh Napier grass and 1 kg commercial goat pellet for the control group, T1, and supplemented with either UMMB (group 2), MUMB (group 3) or commercial mineral block (group 4). The goats were fed routine diets two times per day, that is, goat pellet at 9.00 am and Napier grass *(Pennisetum purpureum)* at 12.00 noon. The supplements were provided in each pen for the animals to lick. Each UMMB, MUMB and CMB was provided in the form of 2 kg block. MUMB contained 0.05% of fenbendazole for each 1 kg of blocks. Intake of the supplement by each group was monitored daily, and when the blocks were fully consumed by the animals, new blocks were replaced.

Chemical Analysis

Samples of UMMB, MUMB, CMB and basal diet were subjected to chemical analysis to determine dry matter (DM), ash, crude protein (CP), crude fiber (CF), ether extract (EE), acid detergent fiber (ADF) and neutral detergent fiber (NDF). DM was determined by drying the sample in forced air oven at 110°C for 24 hours. Ash was determined by ashing the sample in carbolite furnace at 600°C for six hours. CP was analysed by digestion, distillation and titration processes while CF determination was conducted by washing and boiling the sample in acid and alkali. EE was determined by extraction with petroleum ether. ADF and NDF were analysed by washing and boiling the sample in ADF and NDF solution respectively (AOAC, 1990). OM was determined by the equation of 100-ash (%) (Zaklovta, Hilali, Nefzaoui, & Haylani, 2011). All sample were analysed in triplicate and the results were expressed in % mean.

Data Collection and Analysis

Fresh feed intake and dry matter intake (DMI) of basal feed and supplements were taken daily by the difference of offer and refuse. Body weight of the goats and body measurements were measured on Day One of feeding trial, and every two weeks thereafter. The body measurements taken included heart girth (HG), body length (BL), height at wither (HW) and height at rumps (HR). HG was the circumference of the chest while BL was measured from the point of shoulder to the pin bone. HW and HR were measured as the distance from the floor to withers and rump respectively (Babale, Kibon, & Yahaya, 2015). BCS were evaluated before the feeding trial and every month thereafter based on 5-point scale. FCR was determined by dividing the total DMI to milk output over 90 days feeding period. All data were analysed by Analysis of Variance (ANOVA) using SPSS 2015 version 23.

RESULTS AND DISCUSSION

Chemical Composition of Basal Diet and Multi-nutrient Block

The composition of UMMB, MUMB and basal diet are presented in Table 1. UMMB contained 90.06% DM, 17.48% ash,

82.52% OM, 33.84% CP, 4.49% CF, 0.55% EE, 5.47% ADF and 10.51% NDF. The respective values for MUMB are 90.13%, 17.36%, 82.64%, 32.84%, 4.07%, 0.82%, 5.45% and 9.27% respectively.

Moisture content in UMMB and MUMB was found to be less than 10% and this is sufficient to prevent mould growth (Suharyono, Sutanto, Purwati, Martanti, Agus, & Utomo, 2014). Ash in this present study was lower than the value of 25.8% as reported by Abid, Khan, Bhatti, Shah, Zahoor & Ahmad (2016), but in agreement to the value of 17.5% as reported by Singh, Verma, Dass and Mehra (1999). High concentration of ash is attributed to addition of premix and salt in UMMB, MUMB and CMB.

CP content of the UMMB and MUMB in the present study (33.84% and 32.84% respectively) was higher than the range of 11.1% - 29.4% as formulated by Faftine & Zanetti (2010), Mubi, Mohammed, & Kibon (2013) and Suharyono et al., (2014). However, higher CP of 42.6% was reported by Khadda, Lata, Kumar, Jadav, & Rai (2014), and mostly attributed to urea supplementation (Liu, Long, & Zhang, 2007). The variations in the nutritional content between studies were due to differences in dietary formulation and were mainly influenced by the type of protein sources and their protein content.

Table 1
Chemical composition (%) of basal feed and supplements

Nutrients (%)	Napier grass	Goat Pellet	UMMB	MUMB	CMB
DM	16.09	91.19	90.06	90.13	92.26
Ash	5.33	7.19	17.48	17.36	95.05
OM	94.67	92.81	82.52	82.64	4.95
CP	15.54	17.13	33.84	32.84	ND
CF	33.26	20.07	4.49	4.07	ND
EE	2.44	3.33	0.55	0.82	ND
ADF	41.41	35.24	5.47	5.45	ND
NDF	65.77	61.21	10.51	9.27	ND
Ca(g/kg)	0.40	3.86	36.54	34.95	21.23
Cu(mg/kg)	4.46	0.97	0.70	0.58	8.23
Fe(mg/kg)	10.69	45.18	11.27	3.87	259.07
Zn(mg/kg)	1.83	0.25	1.84	2.61	21.27

UMMB: Urea molasses multi-nutrient block, MUMB-Medicated urea molasses multi-nutrient block, CMB-Commercial mineral block, DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fiber, EE: Ether extract, ADF: Acid detergent fiber, NDF: Neutral detergent fiber, Ca: Calcium, Fe: Ferum, Cu: Copper, Zn: Zinc, ND- Not determined

Feed Intake

Total DMI in T2 and T3 were significantly higher ($p<0.05$) than those in T1 and T4. The order of DMI was in the sequence of T2>T3>T4>T1. UMMB and MUMB supplementation had improved DMI of basal diet with the values of 1.21 kg/d and 1.20 kg/d respectively compared to the control group (1.14 kg/d) and CMB group (1.13 kg/d) (Table 2). Addition of UMMB and MUMB had regulated DMI and this improvement was attributed to catalytic effect, that is, optimisation of ammonia concentration in rumen that contributed from the presence of supplementary nitrogen that led to effective microbial activity (Perera, Perera, & Abeygunawardane, 2007).

The consumption of supplements was found to be higher in T2 (86.8g/d) followed by T3 (50.4 g/d), while goats in T4 only consumed 36.6 g/d (Table 2). Highest UMMB consumption led to better DMI as compared to other treatments. Likewise, less consumption of MUMB, as in the case of T4, resulted in reduced overall performance. The use of molasses in both UMMB and MUMB had increased the appetite of the animals. Slight depression of intake in T3 as compared to T2, could be associated with the addition of anthelminthic in MUMB, which could affect their palatability. UMMB and MUMB supplementations had established favourable rumen environment that enhanced fermentation of basal diet, resulting in increased rate of digestion and subsequently, improvement of DMI, as has been previously reported by Migwi, Godwin, Nolan, & Kahn (2011). In the study on Saanen goats, higher DMI in supplemented group (520 g/d), compared to the control group (279 g/d) was also reported (Faftine & Zanetti, 2010). It is evident that no improvement of DMI was observed in animals supplemented with commercial mineral block (T4). Moreover, there was no significant difference ($p>0.05$) in DMI between T1 and T4 with the values of 1.14 kg/d and 1.13 kg/d respectively. In a separate study, supplementation of mineral blocks did not significantly affect ($p>0.05$) DMI of basal diet and this could be linked to feed quality. Inadequate protein and energy content in the basal feed are insufficient to meet nutritional requirement of the animals, resulting in animals maximising feed intake to meet the demand (Jayawickrama, Weerasinghe, Jayasena, & Mudannayake, 2013).

Table 2
Dry matter intake (dmi) of basal feed and supplement between treatments

Parameters	T1	T2	T3	T4
Basal DMI (kg/d)	1.14^{a}	1.21^{b}	1.20^{b}	1.13^{a}
Supplement intake (g/d)	-	86.78^{b}	50.37^{a}	36.55^{a}
Supplement DMI (kg/d)	-	0.08^{b}	0.05^{a}	0.02^{a}
Total DMI	1.14^{a}	1.28^{b}	1.24^{b}	1.15^{a}

^{ab} means in the same row with different superscript are significantly different ($p<0.05$), T1-Control group, T2-Basal diet+UMMB, T3-Basal diet+MUMB, T4-Basal diet+CMB, DMI- Dry matter intake.

Growth Performance and Milk Production

The rate of growth is less important in dairy goats, particularly at the lactating stage. Energy reserved in dairy animals will be used mainly for milk production and only the extra energy is transported to body tissue (Tekeba, Wurzinger, Baldinger, & Zollitsch, 2013). This proves the sigificant effect of different treatments on milk production in the present study. However, information on body weight changes will provide better picture on DMI, BCS and health of the animals in general.

There were no significant differences ($p>0.05$) between the treatments on body weight changes. However, T2 (53.57 g/d) showed highest ADG followed by T3 (45.63 g/d), T4 (39.68 g/d) and T1 (37.70 g/d). In separate studies, lambs supplemented with UMMB showed significant effect ($p<0.05$) on body weight changes (Hatungimana & Ndolisha, 2015; Mubi, Mohammed & Kibon, 2013). The findings from the present study are in agreement with the study on dairy cows whereby block supplementation was reported to achieve highest body weight gain at 174 g/d as compared to weight loss of 10 g/day in the control group (Akter et al., 2004). Increased ADG in T2 and T3 could be due to the effect of UMMB and MUMB supplementation that had increased digestibility of basal diet as has been reported previously (Ben Salem & Nefzaoui, 2003; Hossain, Hasnath, & Kabir, 2011). This issue will be reported separately.

There were significant effects ($p<0.05$) of different treatments on FCR. FCR in T2 (0.84) and T3 (0.95) were significantly lower ($p<0.05$) compared to T1 (1.46) and T4 (1.20). Lower FCR in goats supplemented with UMMB and MUMB indicated that the goats had efficiently convert the feed to milk. Hence, significant effect ($p<0.05$) of different treatment on milk yield was observed. Milk yield in goats supplementd with UMMB (1.52 l/d) was significantly higher ($p<0.05$) compared to other treatments. Additionally, MUMB group (1.31 l/d) also showed significantly higher ($p<0.05$) milk yield compared to the control group (0.78 l/d) and CMB group (0.96 l/d). Better results which were observed in UMMB group indicates better dry matter utilisation which led to improved milk yield while highest FCR in T1 shows poor utilisation of feed (Muralidharan, Jayachandran, Thiruvenkadan, Singh, & Sivakumar, 2016). The nutritive values of the supplements and availability of effective rumen microbes in increasing nutrient digestibilities are some of the factors that can improve FCR and ultimately increase of milk yield. High FCR value can be caused by lack of nitrogen, minerals, vitamins and high level of lignin in the basal diet. Besides, multinutrient blocks can be used to rectify nutrient deficiencies by improving FCR and at the same time reducing the weight loss of the animals (Faftine & Zanetti, 2010).

No significant differences ($p>0.05$) in BCS at the end of the experiment were also observed between treatments but T2 (3.25) and T3 (3.08) showed higher BCS compared to T1 (2.63) and T4 (2.71). Additionally, at the end of the feeding trial, goats supplemented with UMMB and MUMB showed better BCS than those in the control group (T1) and CMB supplemented group (T4) (Figure 1). Hence, higher DMI in T2 and T3 could be linked to enhanced BCS in these animals, as has been reported by Weiss (2015). Besides, factors such as lactatation stage also affects BCS in dairy goats. Mishra, Kumari and Dubey (2016) established that BCS was decreased during early lactation due to the negative energy balance but increased during mid and late lactation. Besides, improvement of BCS was also attributed by the availability of nutrients through UMMB and MUMB supplementation (Darwesh, Merkhan, & Buti, 2013). In this study, the effect of lactation stage on BCS was not studied due to data inavailability.

Table 3
Growth performance, milk yield, feed conversion ratio and body condition score between treatments

Parameters	T1	T2	T3	T4	LS
Initial body weight (kg)	40.00	41.50	41.00	39.83	NS
Final body weight (kg)	43.17	46.00	44.83	43.17	NS
Total weight gain (kg)	3.17	4.50	3.83	3.33	NS
ADG (g/d)	37.70	53.57	45.63	39.68	NS
Initial milk yield (l/d)	0.79	0.67	0.80	0.85	NS
Final milk yield (l/d)	0.78^{a}	1.52^{c}	1.31^{b}	0.96^{a}	*
FCR (DMI/milk yield)	1.46^{c}	0.84^{a}	0.95^{a}	1.20^{b}	*
Initial BCS	2.38	2.38	2.17	2.32	NS
Final BCS	2.63	3.25	3.08	2.71	NS

LS-Level of significance, NS- Non-significance ($p>0.05$), *-Significance at $p<0.05$, T1- Basal diet only, T2-Basal diet with UMMB, T3-Basal diet with MUMB, T4-Basal diet with CMB, ADG-Average daily gain, DMI-Dry matter intake, FCR-Feed conversion ratio, BCS-Body condition score

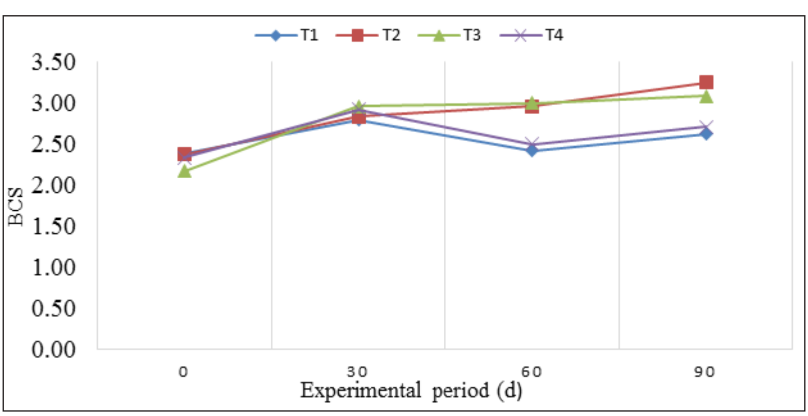

Figure 1: Changes of BCS throughout the experimental period between treatments

Body Measurements

Table 4 shows the effect of different treatments on body measurements. There were no significant differences (p>0.05) on body measurements between treatments. Increase in HG, BL, HW and HR at the completion of the trial is parallel to the increase in the body weight. Feed adequacy and feed quality are two main factors that affect body measurements. Geleta, Negesse, Abebe and Goetsch (2013) reported that higher HG was observed in wet season, which was due to the presence of excessive supply of feeds, apart from the positive response of animals to the supplement given.

Table 4
Body measurements between treatments

	Parameters (cm)	*T1*	*T2*	*T3*	*T4*	*LS*
Before	HG	79.77	79.30	79.78	78.37	NS
	BL	70.95	68.27	68.02	66.65	NS
	HW	69.93	67.87	69.05	70.57	NS
	HR	70.97	68.90	70.33	70.42	NS
After	HG	83.83	82.93	84.70	82.28	NS
	BL	68.00	66.55	69.17	66.58	NS
	HW	72.52	67.82	72.00	71.57	NS
	HR	76.37	74.55	75.67	76.68	NS

LS- Level of significance, NS-Non significant (p>0.05), T1- Basal diet only, T2- Basal diet with UMMB, T3- Basal diet with MUMB, T4-Basal diet with CMB, HG-Heart girth, BL-Body length, HW-Height at wither, HR-Height at rump

CONCLUSIONS

The present findings clearly show that supplementation of UMMB and MUMB had improved appetite, DMI, milk production, body weight gain, feed conversion ratio and BCS of Saanen dairy goats. UMMB or MUMB supplementation is sufficient to improve the performance of lactating does owing to the input of protein, energy and minerals. Supplementation of CMB did not increase DMI and its benefit of feeding is therefore questionable under the condition of the current trial. Hence, UMMB or MUMB supplementation is recommended to replace the use of mineral or salt blocks by local smallholders. UMMB or MUMB supplementation is not only cost-effective, but it can improve intakes of protein, energy and minerals by the animals.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Ministry of Higher Education for fully funding this project under the FRGS grant scheme (R/FRGS/

A07.0/01083A/001/2015/000287) and to Mr. Mohd Nasaruddin bin Mohd Yusoff, the Managing Director of Yusof Eco Farm, Tanah Merah, Kelantan for providing the research facilities. Heartfelt gratitude is also extended to the Dean, Faculty of Agro Based Industry and Faculty of Veterinary Medicine, Universiti Malaysia Kelantan for granting use of the laboratories.

REFERENCES

Abid, R., Khan, I., Bhatti, J. A., Shah, Z., Zahoor, A., & Ahmad, S. (2016). Effect of medicated urea molasses blocks on sub-clinical parasitic infestations in goats. *Online Journal of Animal and Feed Research, 6*(2), 57-71.

Akbar, M. A., Ahmed, T. U., & Mondal, M. M. H. (2006). Improving animal productivity and reproductive efficiency: Development and testing medicated urea-molasses multi-nutrient blocks in rural farms of Bangladesh. In H. P. S., Makkar, & T. Smith (Eds.), *Improving animal productivity by supplementary feeding of multi-nutrient blocks, controlling internal parasite and enhancing utilization of alternate feed resource* (pp. 13-27). Austria: International Atomic Energy Agency.

Akter, Y., Akbar, M. A., Shahjalal, M., & Ahmed, T. U. (2004). Effect of urea molasses multi-nutrients block supplementation of dairy cows fed rice straw and green grasses on milk yield, composition, live weight gain of cows and calves and feed intake. *Pakistan Journal of Biological Sciences, 7*(9), 1523-1525.

AOAC. (1990). *Official methods of analysis* (15th Ed.). USA: Association of Official Analytical Chemists.

Babale, D. M., Kibon, A., & Yahaya, M. S. (2015). Performance and linear body measurements of Red Sokoto male goats on replacement levels of corn cobs for maize bran with cowpea husk basal diet. *Net Journal of Agricultural Science, 3*(2), 35-40.

Ben Salem, H., & Nefzaoui, A. (2003). Feed blocks as alternative supplements for sheep and goat. *Small Ruminant Research, 49*(3), 275-288.

Darwesh, K. A., Merkhan, K. Y., & Buti, E. T. S. (2013). Impact of lactation stage on the body condition score and milk quality of Black goat. *International Journal of Agricultural and Food Research, 2*(2), 48-52.

Faftine, O. L. J., & Zanetti, A. M. (2010). Effect of multinutrient block on feed digestibility and performance of goats fed maize stover during the dry season in south of Mozambique. *Livestock Research for Rural Development, 9*(22). Retrived April 1, 2014, from http://www.lrrd.org/lrrd22/9/faft22162.htm

Geleta, T., Negesse, T., Abebe, G., & Goetsch, A. L. (2013). Effect of supplementing grazing Arsi-Bale sheep with molasses-urea feed block on weight gain and economic return under farmers' management condition. *Journal of Cell and Animal Biology, 7*(10), 125-131.

Hatungimana, E., & Ndolisha, P. (2015). Effect of urea molasses block supplementation on growth performance of sheep. *International Journal of Novel Research in Life Science, 2*(3), 38-43.

Hossain, F. M. A., Hasnath, M. R., & Kabir, M. S. (2011). Hematobiochemical dynamics and body weight gain of Black Bengal goat following urea molasses block (UMB) supplementation. *Online Journal of Animal and Feed Research, 1*(5), 182-185.

Jayawickrama, D. R., Weerasinghe, P., Jayasena, D., & Mudannayake, D. C. (2013). Effects of supplementation of urea-molasses multi-nutrient block (UMMB) on the performance of dairy cows fed good quality forage based diets with rice straw as a night feeding. *Journal of Agricultural Science, 40*(2), 123-129.

Khadda, B. S., Lata, K., Kumar, R., Jadav, J. K., & Rai, A. K. (2014). Effect of urea molasses mineral block on nutrient utilization, milk production and reproductive performance of crossbred cattle under semi-arid ecosystem. *Indian Journal of Animal Science, 84*(3), 302-305.

Liu, J. X., Long, B., & Zhang, D. (2007). Feed supplementation blocks experience in China. In H. P. S. Makkar, M. Sanchez, & A. W. Speedy (Eds), *Feed supplementation blocks. Urea molasses multi-nutrient blocks: Simple and effective feed supplement technology for ruminant agriculture* (pp. 89-109). Rome, Italy: Food and Agriculture Organization.

Melissa, A. Y., Norsida, M., & Nolila, M. N. (2016). Socio-economic factors in relation to small ruminant farming potential in Malaysia: Ranchers' perspective. *International Journal of Agriculture, Forestry and Plantation, 2,* 72-76.

Mishra, S., Kumari, K., & Dubey, A. (2016). Body condition scoring of dairy cattle: A review. *Journal of Veterinary Science, 2*(1), 58-65.

Muralidharan, J., Jayachandran, S., Thiruvenkadan, A. K., Singh, A. P. D., & Sivakumar, K. (2015). Effect of concentrate and urea molasses mineral block supplementation on the blood biochemistry of off season Mecheri lambs. *Indian Journal of Animal Research, 49*(3), 409-412.

Manta, I. H., Aduba, J. J., Dada, J. T., & Onyemize, C. U. (2013). Development of urea molasses multi-nutrient block (UMMB) for ruminant animals as a supplementary feed to cushion the effect of draught in Northern Nigeria. *International Journal of Environmental Science, 2*(3), 106-109.

Mubi, A. A., Mohammed, I. D., & Kibon, A. (2013). Effects of multinutrient blocks supplementation on the performance of Yankasa sheep fed with basal diet of rice straw in the dry season of Guinea Savanna Region of Nigeria. *Achives of Applied Science Research, 5*(4), 172-178.

Migwi, P. K., Godwin, I., Nolan, J. V., & Kahn, P. (2011). The effect of energy supplementation on intake and utilization efficiency or urea-treated low-quality roughage in sheep I. Rumen digestion and feed intake. *Asian Australasian Journal of Animal Science, 24*(5), 623-635.

Perera, A. N. F., Perera, E. R. K., & Abeygunawardane, H. (2007).Development, use and impact of feed supplementation blocks: Experience in Sri Lanka. In H.P.S. Makkar, M. Sanchez, & A. W. Speedy (Eds.)*, Feed supplementation blocks. Urea-molasses multi-nutrient blocks: Simple and effective feed supplementation technology for ruminant agriculture* (pp.119-129). Rome, Italy: Food and Agriculture Organization.

Singh, P., Verma, A. K., Dass, R. S., & Mehra, U. R. (1999). Performance of Pashmina kid goats fed oak (qercus semecarpifolia) leaves supplemented with a urea molasses mineral block. *Small Ruminant Research, 31,* 239-244.

Shanmugavelu, S., & Quaza Nizamuddin, H. N. (2014). Country report - Malaysia*. Asian Australasian Dairy Goat Network, 57*. Retrieved January 23, 2017, from http://www.aadgn.upm.edu.my/aadgn/file/7_Malaysia.pdf

Suharyono, Sutanto, H., Purwanti, Y., Martanti, Agus, A., & Utomo, R. (2014). The effect of urea molasses multi-nutrient and medicated block for beef cattle, beef and dairy cow. *Atomic Indonesia, 40*(2), 77-87.

Tekeba, E., Wurzinger, M., Baldinger, L., & Zollitsch, W. J. (2013). Effects of dietary supplementation with urea molasses multi-nutrient block on performance of mid lactating local Ethiopina and crossbred dairy cows. *Livestock Research for Rural Development, 25*(6). Retrieved April 23, 2017, from http://lrrd.cipav.org.co/lrrd25/6/teke25096.htm

Wan Zahari, M., Chandrawathani, P., Sani, R. A., Nor Ismail, M. S., & Oshibe, A. (2007). Production and evaluation of medicated urea-molasses mineral blocks for small ruminants in Malaysia. In H. P. S.Makkar, M. Sanchez, & A. W. Speedy (Eds), *Feed supplementation blocks. Urea molasses multinutrient blocks: Simple and effective feed supplement technology for ruminant agriculture* (pp. 213-231). Rome, Italy: Food and Agriculture Organization.

Weiss, B. (2015). Optimizing and evaluating dry matter intake of dairy cows. *Advances in Dairy Technology, 27,* 189-200.

Zaklovta, M., Hilali, M., Nefzaoui, A., & Haylani, M. (2011). *Animal nutrition and product quality laboratory manual*. Syria: International Center for Agricultural Research in the Dry Areas.