Advances in Biological Research 10 (3): 191-199, 2016
ISSN 1992-0067

DOI: 10.5829/idosi.abr.2016.10.3.102187

Milk Yield and Composition of Grazing Arsi-Bale Does Supplemented with Dried Stinging Nettle (*Urtica simensis*) Leaf Meal and Growth Rate of Their Suckling Kids

[1,2]*Dereje Andualem,* [1]*Tegene Negesse and* [1]*Adugna Tolera*

[1]Hawassa University, School of Animal and Range Sciences, Hawassa, Ethiopia
[2]Dilla University, Department of Animal and Range Sciences, P.O. Box: 419, Dilla Ethiopia

Abstract: The study was conducted to determine the effect replacing dried stinging nettle leaf meal (SNLM) for concentrate mix on milk yield and composition of lactating does and growth performance of their kids. A control and three dietary treatments using a concentrate mixture (maize, linseed cake and wheat bran) and SNLM, in the ratio of 1:0 (control), 2:1(SN33), 1:2(SN66) and 0:1(SN100) were fed to local Arsi-Bale does. Animals were managed semi-intensively and were allowed to graze on natural pasture for 6h/day; water was provided twice a day and mineral lick *ad libitum*. The control group received 300g of concentrate mixture /day/doe. In SN33, SN66 and SN100, 100g, 200g and 300g (whole) of the concentrate supplement was replaced by SNLM respectively. Daily milk yield (MY), milk fat, protein, TS, SNF and growth rate of kids' were measured every two weeks during 91days of experiment. Compared to control, MY increased ($P < 0.05$) by 33% at SN66 (1.08kg). However, MY dropped by 30% when concentrate feed was totally replaced by the SNLM, due to significantly low supplement dry matter intake in this group. The least MY (0.72kg/day) was for control. MY showed a gradual increase at early, reach peak at mid and declined at late lactation period. Highest MY (1.34kg/day) was recorded at mid stage (7-9 weeks) of lactation in SN66. On the other hand, no marked differences were observed in milk fat, TS and SNF contents among experimental diets. But highest (4.27%) milk protein was recorded ($P<0.05$) in SN33 indicating that there was no clear relationship between rate of substitution of concentrate with SNLM and milk composition. Milk fat, milk protein and TS were lower at early and late lactations but were higher at the mid lactation. Highest weaning weight and growth rate ($P<0.05$) were recorded for suckling kids in which their mothers grouped in SN66 and the least were for control. There was a positive correlation ($r = 0.82$) between weaning weight of kids and average MY of their respective mothers. These results indicated that, SNLM can partly replace concentrate mixture in dairy goat ration without undesirable effect on lactation performance.

Key words: Stinging Nettle Leaf · Milk Yield · Milk Composition · Growth Rate

INTRODUCTION

In the smallholder farming system of Ethiopia, goats are mainly kept for generating cash income and home consumption. Milk production from goats is important in some mixed crop–livestock and pastoral areas to improve kids' growth, which increases income from sale of animals. Development interventions so far were mainly focused on crossbreeding to improve milk production and growth rates [1]. Despite better performance of crossbreds over the indigenous breeds under on-station conditions, such superiority was not replicated under village conditions. Hence, selection within local breeds combined with improved management might be a better strategy for increased productivity in goats [2].

By improving feeding regime, mainly through supplementation of concentrate mixture, productivity of indigenous goats could be improved [1, 3]. However concentrate feeds of good quality are sold by a few feed mills, are expensive and thus are rarely used by small-scale farmers. Moreover in developing countries, such as Ethiopia, grain is in short supply and expensive

Corresponding Author: Dereje Andualem, Dilla University, Department of Animal and Range Sciences, P.O. Box: 419, Dilla Ethiopia. Tel: +251911919777.

and there is direct competition for grain with human beings. Thus alternate feeds should be assessed which could partly fill the gap in the feed supply, decrease competition for food between humans and animals, reduce feed cost and contribute to self-sufficiency in nutrients from locally available feed sources. Hence using locally available forage legumes and browses as supplements could be an alternative [2].

Stinging nettle hay is rich in protein (about 25% dry weight) and has high (more than 75%) IVOMD and it can be utilized as protein supplement in animal feed [4, 5]. For obvious reasons fresh nettle stings animals, but the dried plant loses its sting and is valuable animal feed. Stinging nettle is also believed to support lactation by providing essential nutrients. Stinging nettle haylage replaced grass silage in the diet of lactating cows and production level in terms of milk output were maintained [6] and stinging nettle also reduces the incidence of rumen acidosis [7].

However limited research works are available concerning the utilization of stinging nettle as animal feed and the replacement value for concentrate feeds. Therefore, this study was designed to evaluate the replacement value of stinging nettle for concentrate feed in the diet of grazing Arsi-Bale lactating goats.

MATERIALS AND METHODS

The Study Area: This study was conducted at Sheep and Goat Research Site of Hawassa University, southern Ethiopia, located at 7°02' to 7°03'N and 38°30' to 38°31'E with an altitude of 1650 meter above sea level. Rainfall is bi-modal and ranges between 700 and 1200 mm annually. The mean minimum and maximum temperature in the area was between 13.5°C and 27.6°C, respectively during the year 2013.

Experimental Animals and Their Management: The initial stock constituted 30 local Arsi-Bale does with initial average body weight of 21.75 + 3.8kg and two active breeding bucks (2 years old). Animals were purchased from a local market in southern Ethiopia. During purchase, animals were examined for any observable health problem and external abnormality with special emphasis on possible deformities on udder and teats. Upon arrival at the research site, animals were individually identified with plastic ear tags and injected intramuscular with antibiotics (Oxytetracyline 10%) to prevent any possible infection before purchase and/or during transportation. After a week, all animals were treated with Albendazole against internal parasites and Diazinon against external parasites (prescribed doze by the manufacturers). Goats were adapted to environment for two weeks and each doe was treated with 2ml PGF2α /doe intramuscular to synchronize estrous before natural mating.

Feed and Feeding: A concentrate mix composed of 25% linseed cake, 35 % maize grain and 40% wheat bran was prepared at the feed processing unit of at Hawassa University. Naturally grown fresh stinging nettle leaves were collected manually using glove and scissors and dried under a shade. The dried leaves were packed, transported and stored at the experimental site until needed for feeding. Leaves were hand crushed and mixed with concentrate at 33.3%, 66.7% and 100 % inclusion rate on dry matter basis. Chemical composition of feed ingredients used in this study is presented in Table 1. Animals were allowed to free browse for about 6 hours a day (from 8:00 AM to 11:00 AM in the morning and 2:00 PM to 5:00 PM in the afternoon) and had access to water twice a day at mid day and in the evening and were provided with mineral lick ad libitum.

Chemical Analysis: Feed samples were ground in a hammer mill (Arthur H. Thomas Company, Philadelphia PA., U.S.A.) with a 1mm screen. Dry matter (DM) and ash content of supplement feed samples were determined using methods [8]. Nitrogen (N) content was determined using Kjeldahl method and crude protein (CP) was calculated as N × 6.25. Neutral detergent fibre (NDFom) was analyzed according to [9]. Sulfite and α-amylase were not used as reagents in the determination of NDF. Both NDFom and ADFom were reported exclusive of residual ash. Acid detergent fiber (ADFom) and acid detergent lignin (ADL) were analyzed using the procedures described by [10].

Experimental Design: Thirty days after estrus synchronization a total of 24 pregnant does were selected and were divided in to four groups of six animals and randomly assigned to four experimental diets. The experimental diets were formulated to have dried stinging nettle leaves meal (SNLM) as a replacement for concentrate supplement as follows:

- Control = Grazing +300g concentrate
- Treatment 1 (SN33) = Grazing+ 200g concentrate+ 100g SNLM
- Treatment 2 (SN66) = Grazing + 100g concentrate+ 200g SNLM
- Treatment 3 (SN100) = Grazing + 300g SNLM

Table 1: Chemical composition of feed ingredients used for the formulation of the experimental diets

	Linseed cake	Maize grain	Wheat bran	Stinging nettle leaf
DM (%)	89.6	89.3	87.0	88.6
CP (%DM)	32.1	8.4	13.3	26.7
NDFom (%DM)	23.4	9.2	40.8	31.5
ADFom (%DM)	13.2	3.1	12.4	13.3
ADL (%DM)	6.4	0.6	4.1	3.6
Ash (%DM)	5.8	1.6	4.6	22.5

DM= Dry matter, CP= Crude protein, NDFom= Neutral detergent fiber, ADFom= Acid detergent fiber, ADL= Acid detergent lignin

Goats with the same experimental diets were housed in a pen but provided with individual feeders. Experimental diets were offered twice at midday and in the evening.

Milk Yield and Composition: Milk yield was measured once per 14 days, between 3 and 13 weeks postpartum. Does and kids were kept together day and night. However, on a day prior to milk sampling the kids were penned separately overnight for about 12 hours. The next morning one half of the udder was hand milked while the other half-udder was suckled by the kid [11]. The weigh-suckling-weigh method was used to estimate milk suckled by kids. Milk yield per day was taken to be the sum of hand milked and that consumed by the kid multiplied by two. Milk samples were collected six times on day 21, 35, 49, 63, 77 and 91, during the course of lactation.

Milk composition was determined every two weeks from milk samples collected during each milking time. Approximately 100ml milk sample was collected from each doe in glass sample bottles and transported to laboratory for analysis. Milk total solid was determined by direct forced air oven drying method [12]. Milk protein was determined by Kjeldahl method, while milk fat was determined by the Gerber method [13]. Solid-not-fat was calculated by subtracting fat from total solid values.

Growth Rate of Goat Kids: Goat kids were allowed to run with their does throughout the experiment period and no additional feed was provided to the kids. Birth weight of each kid was recorded immediately after delivery. On a day prior to sampling day kids were separated from their does overnight and body weight was measured on the next day before they were allowed to suckle their mothers. Body weights of kids was recorded from 3 weeks to weaning (91 days postpartum) at the interval of 14 days. Statistical Analysis: Statistical analyses were performed using the general linear model (GLM) procedure of the Statistical Analysis System [14] based on the following liner model:

$$Y_{ij} = \mu + T_i + \varepsilon_{ij}$$

where:

Y_{ij} = Individual record on actual daily milk yield, milk composition, birth weight and weaning weight

μ = The overall mean

T_i = The effect of the i^{th} level of stinging nettle leaf meal supplement (i=1, 2, 3, 4)

ε_{ij} = The residual.

Data on milk yield, milk composition, feed intakes and growth rate were analyzed according to a completely randomized design with the repeated measures (weeks) using PROC MIXED procedure of SAS [14]. Significance between individual means was identified using Fishers Least Significant Difference (LSD) and significance was declared at ($P < 0.05$).

RESULTS AND DISCUSSION

Chemical Composition of Experimental Diets: Chemical compositions of the experimental diets are presented in Table 2. The dry matter (DM) content was higher ($p<0.05$) in treatment 3 (SN100) but lowest in control diet. Similar trend was observed for ash content. Highest ($p<0.05$) protein and fiber content (NDFom, ADFom and ADL) were shown in SN100 but the lowest was for the control diet. The CP, NDFom and ADFom contents of the experimental diets increased with increasing level of stinging nettle leaf replacement for concentrate. This is a reflection of higher CP and fiber content in the SNLM as compared to the concentrate mixture.

Milk Yield and Supplement Dry Matter Intake: Daily milk yield and supplement dry matter intake (DMI) of lactating Arsi-Bale goats supplemented with various proportion of SNLM is presented in Table 3. Daily milk yield obtained in the current study is comparable with the previous work reported by [3] in which 1.13 kg of milk per day was obtained from Arsi-Bale goats supplemented with concentrate feeds. However the result in the current study

Table 2: Chemical composition of experimental diets

	Control	SN33	SN66	SN100	SEM	Prob.
DM (%)	87.5[d]	89.7[c]	91.7[b]	94.6[a]	0.158	<0.0001
CP (%DM)	16.2[d]	20.4[c]	23.4[b]	26.7[a]	0.389	<0.0001
NDFom (%DM)	25.2[d]	28.2[c]	30.5[b]	31.5[a]	0.220	<0.0001
ADFom (%DM)	9.4[d]	10.7[c]	12.5[b]	13.3[a]	0.230	<0.0001
ADL (%DM)	3.4[b]	3.3[b]	3.5[b]	3.6[a]	0.038	<0.0001
Ash (%DM)	3.8[d]	10.5[c]	16.6[b]	22.5[a]	0.150	<0.0001

* Means within a row with different superscript letters differ significantly ($p < 0.05$).

DM= Dry matter, CP= Crude protein, NDFom= Neutral detergent fiber, ADFom= Acid detergent fiber, ADL= Acid detergent lignin. Control=grazing +concentrate, SN33= Grazing+ 66.7%concentrate+ 33.3%SNLM, SN66= Grazing + 33.3% concentrate+ 67.7% SNLM, SN100= Grazing + SNLM, SEM= Standard error of means

Table 3: Supplement dry matter intake, milk yield and milk compositions

	Control	SN33	SN66	SN100	SEM	P Value
Supplement DMI (g/d/animal)	300.0[a]	300.0[a]	300.0[a]	208.3[b]	0.850	<0.0001*
Milk yield (kg/Dam/d)	0.7[c]	0.9[b]	1.1[a]	0.9[b]	0.179	<0.0001*
Fat (%)	5.3	5.2	5.2	5.1	0.6015	0.6979
Protein (%)	3.9[b]	4.3[a]	4.1[ab]	3.9[b]	0.3427	0.0002*
TS (%)	14.7	14.8	14.6	14.9	1.210	0.8511
SNF (%)	9.4	9.5	9.1	9.7	1.048	0.1959

*Means within a row with different superscripts differ significantly ($p < 0.05$)

DMI = Dry Matter Intake, TS= Total Solid, SNF= Solid Not Fat

Control=grazing +concentrate, SN33= Grazing + 66.7% concentrate+33.3%SNLM, SN66= Grazing + 33.3% concentrate+67.7% SNLM, SN100= Grazing + SNLM

was higher than that reported by Nurfeta, Bino and Abebe [15] in which 0.59 litter of milk per day was obtained from the same breed of goats supplemented with *Enset (Enset ventricosum)* leaf. FARM Africa [16] reported a daily milk off-take between 0.25 and 0.5 litters of non-supplemented goats of the same breed, which is lower than the current result. Bedhane *et al.* [17] Also reported average daily milk yield of 0.2 kg for the same breed. These differences could be attributed to the type of supplement and management used. The highest ($p<0.05$) milk yield was obtained in SN66. Lowest daily milk yield was recorded in goats where SNLM not included in supplemented diet (control). The daily milk yield increased as the level of inclusion of SNLM increased. This could be attributed to higher CP content available in the experimental diet containing SNLM than the control [2, 15]. Furthermore SNLM could promote rumen health in animals consuming high levels of readily fermentable carbohydrate [18].

Supplement DMI was higher ($p<0.05$) for goat groups in control, SN33 and SN66. Lower ($p<0.05$) supplement DMI was recorded for SN100, in which concentrate totally replaced by SNLM. Milk yield decreased when concentrate was totally replaced by the SNLM although it was higher than the control group. This might be due to the decrease in supplement DMI when SNLM was offered as a sole supplement. This result is supported by a study reported by Humphries and Reynolds [6] in which supplementation of dairy cows. The same authors also reported that production level in terms of milk output were maintained when stinging nettles replaced grass silage in the diet of lactating cows, in spite of a reduction in feed intake. Similarly a study by Richards *et al.* [21] on lactating goats indicated that the replacement of concentrates with *Leucaena luucocephala* and *Gliricidia sepium* forages decreased daily milk yield due to low organic matter intake (OMI).

As two-third of the concentrate was replaced by SNLM, the daily milk yield increased by 33 percent. A similar study on Begait and Abergelle goats by Berhane and Eik [2] indicated that a high level of vetch hay supplementation increased daily milk yield. However, in the current study when the whole concentrate was replaced by SNLM, the magnitude of milk yield increments was dropped to 21 percent due to low supplement DMI.

Milk Composition: The composition of milk fat, protein, total solid (TS) and solid not fat (SNF) is presented in Table 3. Regardless of the difference in the dietary supplementation, milk protein percentage was not different among control, SN66 and SN100. However content of protein in SN33 was higher ($p<0.05$) than that of control and SN100. SN66 showed intermediate value between the two boundaries. The protein percentage obtained in the current study was higher than those reported by Nurfeta, Bino and Abebe [15] and lower than those reported by Mestawet *et al.* [3].

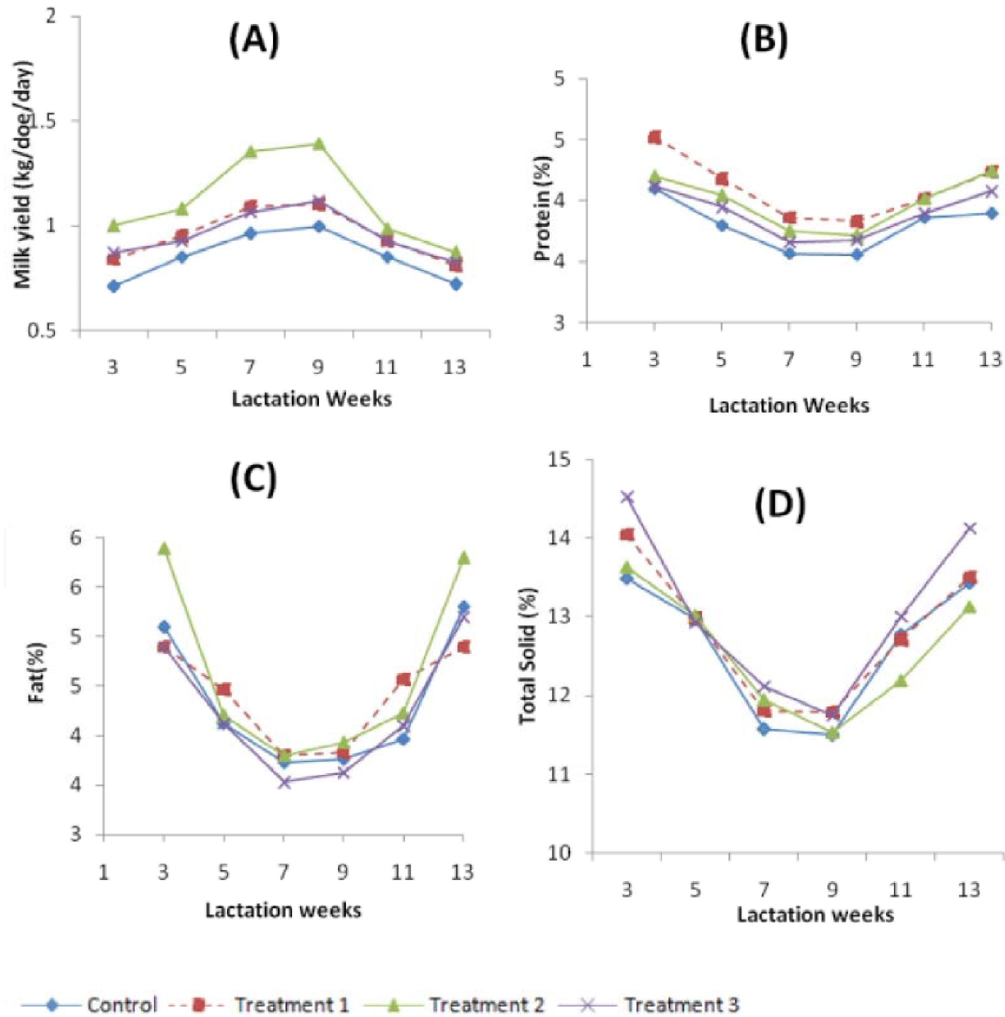

Fig. 1: Effect of lactation stages and supplementation on milk yield (A), milk protein (B) milk fat (C) and TS (D). Control=grazing +concentrate, SN33= Grazing+ 66.7%concentrate+ 33.3%SNLM, SN66= Grazing + 33.3% concentrate+ 67.7% SNLM, SN100= Grazing + SNLM

No marked differences were observed in milk fat, TS and SNF percentages among experimental goat groups. The current results are in agreement with previous studies carried out by Berhane and Eik [2] Min *et al.* [22]; Khalili and Varvikko [20] and Richards *et al.* [21]. However, Nurfeta, Bino and Abebe [15] reported contrary to the current study.

There was no clear trend observed between rate of substitution of concentrate supplementation and milk composition. This result is in agreement with a previous study reported by Khalili and Varvikko [20]. Previous reports of [2, 15, 22, 23 and 24] also noticed that there were no clear relationship between rate of supplementation and milk composition. Humphries and Reynolds [6] also reported that milk fat and protein corrected milk yield were not affected when nettles replaced ryegrass silage in the diet of lactating dairy cows, despite a numerical reduction in feed intake.

Effect of Lactation Stage on Milk Yield and Compositions: Effect of lactation stage on milk yield and composition is presented in Figure 1. Milk yield was highest ($p<0.05$) at mid stage of lactation compared with early and late stages. But percent protein, fat and TS were lowest ($p<0.05$) at mid stage of lactation and the vice-versa at early and late stage of lactations. This trend is consistent with the studies reported by [3, 25, 26, 27 and 28].

Table 5: Correlation coefficient matrix of milk yield and composition

	Milk yield	Protein	Fat	Total solid
Milk yield	1.00			
Protein	-0.30*	1.00		
Fat	-0.40*	0.58*	1.00	0.51*
Total solid	-0.26*	0.60*	0.51*	1.00

*Significant ($p<0.05$)

Table 6: Effect of supplementation of lactating Arsi-Bale does on live weight and growth rates of kids

	Control	SN33	SN66	SN100	SEM	P value
Birth weight	2.1	2.5	2.6	2.4	0.40	0.1942
Weaning weight	9.1^{c}	10.7^{b}	13.0^{a}	10.9^{b}	0.83	0.0007*
Growth rate(g/d)	77.7^{c}	90.9^{bc}	115.5^{a}	93.8^{b}	9.05	<0.0001*

*Means within a row with different superscripts differ significantly ($p < 0.05$).

Control=grazing+ concentrate, SN33= Grazing+66.7% concentrate+33.3%SNLM, SN66= Grazing + 33.3% concentrate+67.7% SNLM, SN100= Grazing + SNLM

Mahmoud, El Zubeir and Fadlelmoula [29] also reported that milk fat, protein and TS of Damascus does were higher at early and late lactations and were dropped in mid lactation period. On the contrary [30] reported that fat content and TS of Borana goat milk showed slight increase at early lactation followed by a significant increase at mid lactation and a slight decline at late lactation. Zahraddeen, Butswat and Mbap and Addass *et al.* [31, 32] also found that protein and fat content of goats milk decreased as the stage of lactation increased, however TS was in an increasing trend.

Relationship among Milk Yield and Milk Components: The relationship between milk yield and major milk components is presented in Table 5. Milk yield was negatively correlated ($p<0.05$) with milk protein, fat and TS. Milk protein, fat and TS were positively correlated among each other. The current result is in agreement with [3, 25, 26, 27, 28]. However, contrary to the current result [31, 32] found that among milk components fat and protein had negative relationship with TS.

Birth Weight, Weaning Weight and Growth Rate of Goat Kids: Effect of level of supplementation of SNLM on birth weight, weaning weight and growth rates of Arsi-Bale goats is presented in Table 6. There was no observed difference among treatment groups in birth weight. This result is contrary to previous work reported by Abebe [1] who reported prepartum supplement of Somali and their Anglo-Nubian cross does had effect on birth weight of kids. Similarly [33] reported that vetch hay supplementation to Abergelle and Begait does during pregnancy had positive effect on birth weight of kids. The same study stated that pregnant does supplemented with high level vetch hay had heavier weight kids at birth than those supplemented with low level of vetch hay. The difference with the current study could be attributed to the differences in goat breeds and type of animal management used in each study.

Growth performance of Arsi-Bale goat kids was affected by post partum supplementation of lactating does with different level of SNLM. Higher ($P<0.05$) weaning weight and growth rates observed in SN66 followed by SN100 and the lowest were for control. SN33 exhibited intermediate value between control and SN33. Weaning weight and growth rates increased with increasing level of substitution of concentrate with SNLM, but slightly decreased in kids which suckled does that supplemented with sole SNLM (SN100). Similar effects were reported by Abebe and Nurfeta, Bino and Abebe and Berhane and Eik [1, 15, 33].

Relationship Between Weaning Weight of Kids and Milk Yield of Does: Relationship between weaning weight of kids and milk yield of does is showed in Figure 2. Heavier weights and better growth rate of kids observed were attributed to higher milk yield of their respective mothers. As it is depicted in Figure 2 there was a positive relationship ($r = 0.82$) between weaning weight of kids and average daily milk yield of their respective mothers. Weaning weight of kids increased with the level of crude protein content of the experimental diets fed to the does, but decreased when the SNLM completely replaced the concentrate. Supplementary feed increased milk yield and thereby enhancing growth performance of kids. Hence growth rate of kids was influenced by the milk yield produced by their respective does. The current result is in agreement with the results of Olufunke [34] who reported kids growth performance of West African Dwarf goats was influenced by extent of milk produced

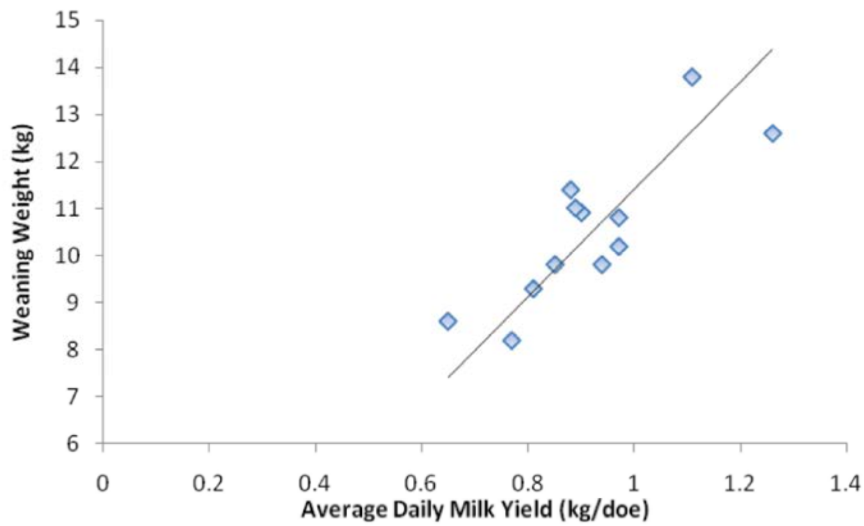

Fig. 2: Relationship between weaning weight of kids and milk yield of does

by their respective does. Similarly [15] also reported that pre-weaning growth performance of Arsi-Bale goat kids was related to milk yield of their mother which were supplemented with Enset (Ensete ventricosum) leave meal.

CONCLUSION

The current study showed that replacement of concentrate supplement with different levels stinging nettle leaf meal (SNLM) in the ration of grazing Arsi-Bale lactating goats could increase milk production without affecting milk protein, fat, SNF and TS. Moreover supplementing lactating does with SNLM can increase milk yield and thereby enhancing growth performance of kids. On the other hand, a complete replacement of concentrate mixture with SNLM decreases intake and affects thereby milk yield negatively. Meanwhile the level of milk production was sustained and was comparable with the yield resulting from concentrate supplement. Therefore, due to high cost of concentrate feeds and are not readily available in developing countries like Ethiopia, locally available forages such as stinging nettle can partly replace concentrates feed in the dairy goat ration.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the financial support of Development Partnerships in Higher Education (DelPHE) of British Council. The authors also appreciate the technical contribution of Eyob Misganaw (DVM) during estrus synchronization of experimental animals.

REFERENCES

1. Abebe, G., 1996. Studies on performance potential of Somali goats and their crosses with Anglo-Nubian: A contribution to breed documentation and evaluation. Landwirtschaftlich-Gärtnerischen Fakultät der Humboldt, Universität zu Berlin, pp: 151.
2. Berhane, G. and L.O. Eik, 2006a. Effect of vetch (Vicia sativa) hay supplementation on performance of Begait and Abergelle goats in northern Ethiopia. I. Milk yield and composition. Small Ruminant Research, 64: 225-232.
3. Mestawet, T.A., A. Girma, T. Ådnøy, T.G. Devold, J.A. Narvhus and G.E Vegarud, 2012. Milk production, composition and variation at different lactation stages of four goat breeds in Ethiopia. Small Ruminant Research, 105: 176-181.
4. Zhang X., Y. Jin, Y. Wang, F. Goa and J. Qi, 2014. Effect of inoculants and molasses on silage quality of nettle (*Urtica cannabina*). Journal of Animal and Veterinary Advance, 13: 564-569.
5. Andualem, D., T. Negesse and A. Tolera, 2015. Biomass yield, chemical composition and in vitro organic matter digestibility of stinging nettle (Urtica simensis) from four locations at three stages of maturity. Livestock Research for Rural Development, http://www.lrrd.org/lrrd27/8/andu27159.html.
6. Humphries, D.J. and C.K. Reynolds, 2014. The effect of adding stinging nettle (Urtica dioica) haylage to a total mixed ration on performance and rumen function of lactating dairy cows. Animal Feed Science and Technology, 189: 72-81.

7. Kleim, K.E., R. Morgan and F.L. Mould, 2005a. Persistency of effect of Lactuca sativa and Urtica dioica on in vitro acidosis. In: British Society of Animal Science Annual Conference, pp: 256.
8. AOAC, 1990. Official methods of analysis. Vol. I, 15th ed. Association of Official Analytical Chemists, Washington, DC, pp: 69-88.
9. Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and non-starch carbohydrates in relation to animal nutrition. Journal of Dairy Science, 74: 3583-3597.
10. Van Soest, P.J. and J.B. Robertson, 1985. Analysis of forages and fibrous foods. A Laboratory Manual for Animal Science 613, Cornell University, USA.
11. Ruvuna, F., T.C. Cartwright, H. Blackburn, M. Okeyo and S. Chema, 1988. Lactation performance of goats and growth rates of kids under different milking and rearing methods in Kenya. Animal Sci., 46: 237-242.
12. IDF-ISO-AOAC, 2005. Solids (Total) in milk by direct forced air oven drying. In: AOAC Official Method 990.20. Association of Official Analytical Chemists, Washington, DC.
13. AOAC, 2005. Fat content of raw and pasteurized whole milk Gerber method by weight. In: AOAC International Methods 2000.18. Association of Official Analytical Chemists, Washington, DC.
14. SAS, 2005. SAS Release 9.1. ed. Statistical Analysis Systems Institute Inc., Cary, NC, USA.
15. Nurfeta, A., G. Bino and G. Abebe, 2012. On-farm evaluation of Enset (*Ensete ventricosum*) leaf supplementation on does' milk yield and composition and growth rates of their kids. Ethiopian Journal of Applied Science and Technology, 1: 1-8.
16. FARM Africa, 1996. Goat types of Ethiopia and Ertirea: Physical description and management systems. Published by FARM Africa, London, UK and ILRI (international livestock research institute), Nairobi, Kenya, pp: 76.
17. Bedhane, M., A. Haile, H. Dadi and T. Alemu, 2012. Estimates of genetic and phenotypic parameters for milk traits in Arsi-Bale goat in Ethiopia. Livestock Research for Rural Development, 24(6).
18. Kleim, K.E., R. Morgan and F.L. Mould, 2005b. The effect of Lactuca sativa and Urtica dioica on in vitro acidosis. In: British Society of Animal Science Annual Conference, pp: 25.
19. Mishra, U.K., J.S. Kanesh, A.K. Mandal, R.K. Das, K. Rayaguru and S.C. Parija, 2006. Potentials of herbal galactogogues in milk production in ruminants. The Indian Cow, 9: 44-52.
20. Khalili, H. and T. Varvikko, 1992. Effect of replacement of concentrate mix by wilted sesbania (*Sesbania sesban*) forage on diet digestibility, rumen fermentation and milk production in Friesian X Zebu (Boran) crossbred cows fed low quality native hay. Animal Feed Science and Technology, 36: 275-286.
21. Richards, D.E., W.F. Brown, G. Ruegsegger and D.B. Bates, 1994. Replacement value of tree legumes for concentrates in forage-based diets. II. Replacement value of Leucaena leucocephala and Gliricidia sepium for lactating goats. Animal Feed Science and Technology, 46: 53-65.
22. Min, B.R., S.P. Hart, T. Sahlu and L.D Satter, 2005. The effect of diets on milk production, composition and on lactation curves in pastured dairy goats. Journal of Dairy Science, 88: 2604-2615.
23. Dønnem, I., Å.T. Randby and M. Eknæs, 2011. Effect of grass silage harvesting time and level of concentrate supplementation on goat milk quality. Animal Feed Science and Technology, 163: 118-129.
24. Hassan, G.Z.A., I.Y. Turki and M.E. Khogali, 2011. Effect of level of concentrate supplementation on milk yield and composition of grazing dairy cows in Southern Kordofan state, Sudan. Research Opinions in Animal and Veterinary Science, 8: 495-498.
25. Agnihotri, M.K. and V. Rajkumar, 2007. Effect of parity and stage of lactation on milk composition of western region goats in India. International Journal of Dairy Science, 2: 172-177.
26. Ciappesoni, G., J. Pribyl, M. Milerski and V. Mares, 2004. Factor affecting goat milk yield and its composition. Czech Journal Animal Science, 11: 465-473.
27. Ketto, I.A., I. Massawe and G.C. Kifaro, 2014. Effects of supplementation, birth type, age and stage of lactation on milk yield and composition of Norwegian x Small East African goats in Morogoro, Tanzania. Livestock Research for Rural Development, 26(12).
28. Darwesh, K.A., K.Y. Merkhan and E.T.S. Buti, 2013. Impact of lactation stage on the body condition and milk quality of Black Goat. International Journal of Agriculture and Food Research, 2: 48-52.
29. Mahmoud, N.M.A., I.E.M. El Zubeir and A.A. Fadlelmoula, 2014. Effect of stage of lactation on milk yield and composition of first kidder Damascus does in the Sudan. Journal Animal Production Advance, 3: 355-362.

30. Beyene, F. and E. Seifu, 2005. Variation in quality and fermentation properties of milk from local goats. Langston University Goat Research Extension. http://www2.luresext.edu/international/MilkFermProp.htm.
31. Zahraddeen, D., I.S.R. Butswat and S.T. Mbap, 2007. Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. Livestock Research for Rural Development, http://www.lrrd.org/lrrd19/11/zahr19166.htm.
32. Addass, P.A., M.A. Tizhe, A. Midau, P.A. Alheri and M.M. Yahya, 2013. Effect of genotype, stage of lactation, season and parity on milk composition of goat, in Mubi, Adamawa State, Nigeria. Annals of Biological Research, 8: 248-252.
33. Berhane, G. and L.O. Eik, 2006b. Effect of vetch (*Vicia sativa*) hay supplementation to Begait and Abergelle goats in northern Ethiopia. II. Reproduction and growth rate. Small Ruminant Research, 64: 233-240.
34. Olufunke D.O., 2013. Correlation between milk composition and kids' growth of West African Dwarf (WAD) goat fed forage based diet in southwest Nigeria. Global Veterinaria, 2: 155-159.