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High Level of Feeding in Addititon to Dam Milk does not Improve Pre-weaning Growth Performance and Kleiber Ratio of Boer × Central Highland Kids

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ABSTRACT

In order to evaluate pre-weaning growth performance and kleiber ratio of Boer crossbred goats under different levels of supplementation an experiment based on A 2×2 ×3 factorial (2 levels of sex, 2 levels of birth type and 3 levels of feed) arrangement of treatments in completely randomized block design was conducted. Thirty six one- month old kids with an average initial body weight of 7.33±0.19 kg were randomly distributed into three dietary treatment groups. The feeding groups were: Dam milk + grazing/browsing only (T_1), dam milk+grazing/browsing+supplementary concnetrates at 1.26% of body weight (T_2), dam milk+ grazing/ browsing+ supplementary concnetrates at 2.10% of body weight (T_3). In addition, birth type (single and twin) and sex (female and male) were also considered. The average milk yield of does was 282, 332 and 394 g/day for groups T_1, T_2, and T_3, respectively. Weaning weight of kids had a positive relationship (r=0.68) with milk yield of their dams. The pre-weaning average daily gain of kids was 85±9.01 g/day, 120.45±9.19 and 113.06±9.0 g/day for groups T_1, T_2, and T_3, respectively. Sex had not a considerable influence on pre-weaning growth performance and kleiber ratio of kids. However, Single born kids exhibited higher weaning weight and average daily gain (ADG) (119.52 g/day vs 92.82 g/day) than twin born kids. Weaning weight, ADG and Kleiber ratio were significantly higher ($P<0.05$) in concnetrtae supplemented group, however, the differences between T_1 and T_2 were non-significant. Thus it can be concluded that conncetrtae supplementation at 1.26% of body weight in addition to dam's milk would improve weaning weight and pre-weaning growth rate of kids. Feeding of supplementary concentrates higher level (2.1% of BW) during pre-weaning period yielded no futher benefits.

Key words: Birth type, Correlation, Growth rate, Kleiber ratio, Milk yield, Sex

INTRODUCTION

The pre-weaning growth of kids is an economically important trait in goat production and it is essential for the post-weaning growth rate and for the successful weaning (Adenaike and Bemji, 2011). The objective of any goat production enterprise is to produce kids that are in good body condition at weaning and subsequent marketing. Rapid growth during the early period can minimize the cost of rearing and thus provide more benefit to the farmer. The birth weight and early growth rate of animals are determined not only by genetic potential but also by maternal and environmental factors (Mandal *et al.,* 2006). Among these environmental factors climate and seasonal differences among different years affect the production of the whole flock, while sex, type of birth, age and weight affect the individual performance (Kuthu *et al.,* 2013). Successful weaning is contingent upon factors including the age and weight of the goat, the modality of weaning, and nutrition prior to weaning (Mor- and-Fehr *et al.,* 1982).

In developing countries, because of the low productivity of indigenous breeds and inadequate environmental circumstances in traditional farming systems in rural areas, solutions must be aimed at genetic improvement (genetic selection and crossbreeding), development of new feeding strategies and improvement of farming systems (Gökdal, 2013). Thus, successful livestock production requires the application of strategies that optimize the use of the

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environment and available nutrient sources so as to capitalize on the production potential of livestock. For the effective use of native pasture, supplementation is needed in order to meet the nutritional requirements of goats, especially for the small producer (Silva *et al.,* 2010).

The Boer goat is a meat purpose breed famous for its rapid growth, excellent meat quality and high fertility (Malan, 2000).This breed originated in South Africa and was ûrst imported to Ethiopia in 2007 by the project entitled "Ethiopian Sheep and Goat Improvement Program (ESGPIP)" funded by USAID. Crossbreeding of Boer goats with indigenous Central Highland goat were aimed to improve their productivity. However, Boer crossbred kids didn't perform well at breeding and evaluation site management condition; the growth rate of kids become decreased after one month of age. Since milk production in goats peaks within 2-3 weeks after parturition and then declines rapidly to a low level by 8-10 weeks after parturition (Rankins and Pugh, 2012), higher growth performance of kids cannot only be sustained by milk supply from their dams. Hence, the aim of the present study was to evaluate pre-weaning growth performance and kleiber ratio of Boer crossbred kids under different levels of concentrate supplementation in addition to their dam milk.

MATERIALS AND METHODS

The study was conducted from April to June, 2016 at Sirinka Agricultural Research Center which is located 508 km away from Addis Abeba. The site is located at an altitude of 1850 m above msl. The rainfall pattern is bimodal, with two-rainfall season, *belg* (Feb./Mar.- April) and *meher* (July- Oct./Nov.) and the mean annual rainfall amount is on average about 950 mm. The area is a moderate warm temperature zone with mean daily temperature ranges from 16 - 21°C.

A total of 45 crossbred Boer does with 50 % blood level assigned to two crossbred Boer bucks with 50% blood level for mating. After kidding 27 does with normal teat and udder were selected with their 36 kids and identification number was given for each kid. A 2×2 ×3 factorial (2 levels of sex, 2 levels of birth type and 3 levels of feed) arrangement of treatments was followed. Thirty six one- month old kids with an average initial body weight of 7.33±0.19 kg were randomly distributed into three dietary treatment groups. The feeding groups were: Dam milk+grazing/browsing only (T_1), dam milk+grazing/browsing+ supplementary concnetrates at 1.26% of body weight (T_2), dam milk+ grazing/ browsing+ supplementary concnetrates at 2.10% of body weight (T_3). In addition, birth type (single and twin) and sex (female and male) were also considered. All groups were suckled their dams three times a day and during full night until being weaned at 3 month of age (natural weaning). All kids were allowed to graze/browse on natural pasture for 6:00 h from 8:00-11:00 in the morning and from 13:00-16:00 in the afternoon separately from their mothers during day time. Throughout the course of experiment kids were kept with their dams during the night in the semi-opened concrete barn. Dams were supplemented with 300 g/ day of concentrate in the evening in addition to 6:00 h grazing. Group feeding was practiced according to the level of feeding two times a day (half in the morning and a half in the evening) for supplemented groups after 7 days adaptation periods.

Average daily gain (g/day) was calculated as the difference between final and initial body weights divided by number of days of feeding experiment. The Kleiber

Table 1. Chemical composition (%) of concentrate mixture

DM	Ash	OM	CP	NDF	ADF	ADL
90	7.8	92.2	28.8	20	11.1	4.4

DM = dry matter; CP = crude protine, OM= organic matter, NDF = neutral detergent fiber; ADF = acid detergent fiber and ADL=acid detergent lignine

ratio (KR), defined as growth rate/(body mass)$^{0.75}$. The feed refusal collected and weighed on group bases for laboratory analysis. All kids were weighed weekly to estimate feed intake and weighted fortnightly on suspended weight balance after they forced to fast overnight.

Average daily milk yield was determined once weekly during the rearing period, by milk difference technique according to Louca *et al.* (1974). Does were kept away from their kids for 12 hours (overnight) and then one teat from the two teats was hand milked in the next morning. So, daily milk yield for 24 hours for the two teats was estimated as the amount of milk for one teat multiplied by four (Alsheikh, 2013).

The concentrate consisted of 55.7% wheat bran, 40% noug cake, 3% limestone and 1.3% salt. Feed samples were analyzed for dry matter (DM) by drying at 105°C for 24 h, ash by ignition in a muffle furnace at 600°C for 6 h, crude protein (CP) by the Kjeldahl procedure (AOAC, 2006), and neutral detergent fiber (NDF) and acid detergent fiber (ADF) according to procedures of Decruyenaere *et al.* (2009).

Data on dry matter intake, body weight, average daily gain, and kleiber ratio were analyzed using the GLM (General Linear Models) procedure implemented in the SAS package (SAS, 2002). Treatment, sex, birth type and their interaction effect were considered as fixed factors. Means were separated by least significant difference when the overall treatment effect was

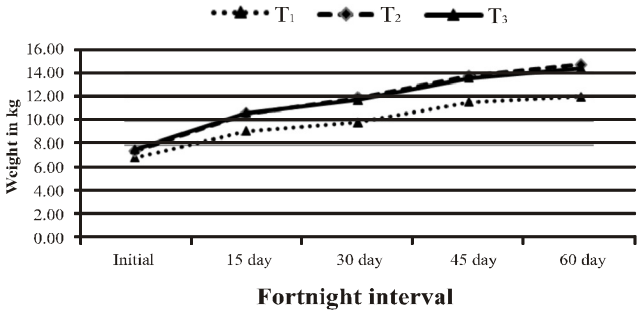

Fig. 1. Pre-weaning body weight of Boer × Central Highland kids from different treatments

significant (P<0.05). Correlations between milk yield of doe and growth performance of kids were obtained using PROC CORR by using standard package(SAS, 2002). Since the interaction between treatment, sex and birth type was non-significant, only the value of main effects were presented and the interacton effect was removed from the model.

The statistical model used was:

$Y_{ijkl} = ì + F_i + B_j + S_k + e_{ijkl}$

Where:

Y_{ijkl} = the feed intake, body weights, average daily weight gain, and kleiber ratio of Boer x Central highland kids

ì = overall mean

F_i = fixed effect of the feeding levels (i= control, 1.26 and 2.1% of their body weight)

B_j = fixed effect of birth type (j=single, twin)

S_k = fixed effect of kid sex (k=male, female)

e_{ijkl}= residual error.

Table 2. Intake, growth rate of crossbred Boer kids and milk yield (g/day) of their dam

Parameters	T_1	T_2	T_3	SEM	P-value
DMI (g/day)	-	93.6	141.3	4.120	<.0001
DMI (% of BW)	-	0.68	1.01	0.049	.0002
Dam milk yield (g/day)	282	332	394	32.58	0.378
Initial weight (kg)	6.92	7.51	7.60	0.19	0.0998
Final(weaning)weight (kg)	12.02^b	14.74^a	14.38^a	0.26	0.0192
Average daily gain (g/day)	85.00^b	120.45^a	113.06^a	5.21	0.038
KR	12.85^b	15.94^a	15.03^{ab}	0.49	0.0247

DMI= dry matter intake, BW= body weight, KR= kleiber ratio, T_1= grazing/ browsing only, T_2= grazing/browsing + supplement 1.26% of their body weight, T_3= grazing/browsing + supplement 2.1% of their body weight; $^{a\,b}$ Means in the same row followed by different letters differ between treatments (P < 0.05)

Table 3. Effect of sex and birth type on weight and average daily gain of kids (n=36)

Items	Sex		Birth type		SEM	P-value	
	Male	Female	Single	Twin		Sex	Birth type
Initial weight (kg)	7.30	7.38	7.68	7.00	0.19	0.8413	0.0948
Final weight (kg)	13.65	13.78	14.85	12.57	0.40	0.8785	0.0122
ADG (g/day)	105.73	106.60	119.52	92.82	5.21	0.9379	0.0221
KR	14.61	14.60	15.45	13.77	0.78	0.8682	0.0692

ADG= Average daily gain, SEM= Standard error of mean, KR= Kleiber ratio

RESULTS AND DISCUSSION

Data pertaing to milk yield of dams, concentrate intake and growth performance of kids are presented in Table 2. The milk yield of Boer x Central Highland goat is found within the range of milk production performance of Ethiopian indigenous goats which varies from 0.28 kg/day for Afar goat (Awigchew *et al.,* 1989) to 1.13 kg/day for Arsi Bale goat (Mestawit *et al.,* 2012). Concentrate intake of kids was increased with the supplementation levels and the highest concentrate intake was observed for kids of group T_3, followed by T_2.

Kid mortality during the period from birth to puberty induces one of the most critical stress periods (Otuma and Osakwe, 2008). Pre-weaning growth performances of kids in different treatment are presented in Table 2. Weaning weight, ADG and Kleiber ratio were significantly higher ($P<0.05$) in concnetrtae supplemented group, however, the differences between T_1 and T_2 were non-significant. The weaning weight as observed in the current study was higher than the value of 12.84 kg (pure Boer), 10.77 kg (Boer x Baladi) and 8.54 kg (Baladi) goat kids fed supplementary concnetrtaes at 1% of their body weight (Salama *et al.,* 2015). Values were also higher than those earlier reported by Belay *et al.* (2015) for the crossbreed Boer goat. This was probably because of strategic supplementation of dams in this experiment during late pregnancy and early lactation.

Results of this experiment demonstrate that conncetrtae supplementation at 1.26% of body weight in addition to dam's milk would improve weaning weight and pre-weaning growth rate of kids. Htoo *et al.* (2015) observed that the ADG of kids from creep feed with alfalfa group was greater than ADG of kids from creep feed without alfalfa and dam milk groups. The current study revealed that kids from T_1 gained least as they relied on their dam milk only. Bhatt *et al.* (2009) reported that pre-weaning parameters such as body weight, ADG and feed conversion ratio were higher in lambs fed creep feeding and milk replacer supplementation. This concurs with our findings and also with other studies (Yiakoulaki *et al.,* 2009; Yiakoulaki *et al.,* 2014), which showed that supplementation of

Table 5. Correlation coefficient (r) of average daily milk yield of does (g/day) and pre weaning weight of kids

	2MWT	WWT	2MADMY	3MADMY	CADMY
2MWT	1.00				
WWT	0.93***	1.00			
2MADMY	0.74***	0.61***	1.00		
3MADMY	0.57**	0.66***	0.68***	1.00	
CMADMY	0.73***	0.68***	0.94***	0.88***	1.00

***= significant at P<0.001, **= significant at P<0.01, 2MWT=2 Month weight, WWT=Weaning weight (3 month weight), CADMY=Cumulative average daily milk yield, 2MADMY=2 month average daily milk yield and 3MADMY=3 month average daily milk yield

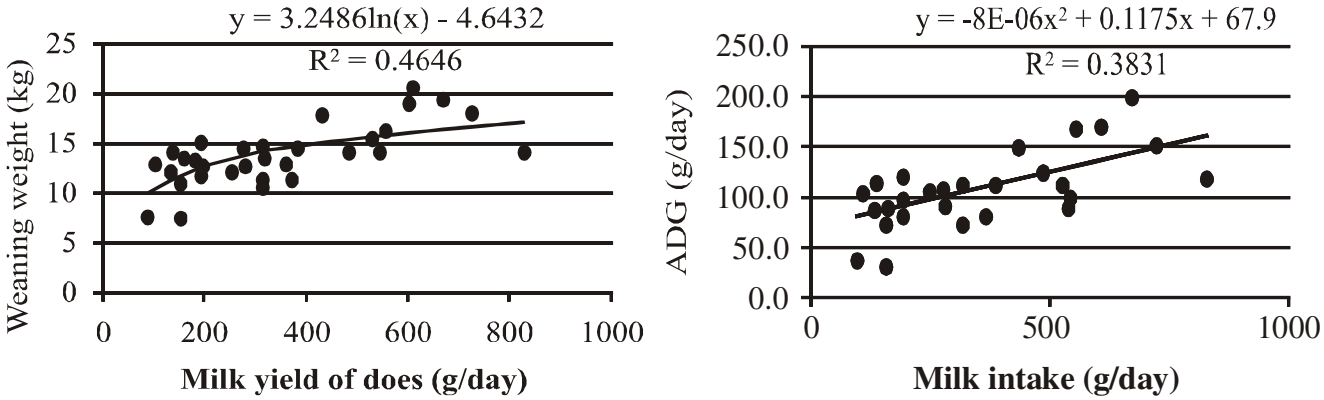

Fig. 2. Regression of milk intake on body weight (left) and weight gain (right) of experimental kids

different pastures during weaning increase ADG of kids and lambs.

The kleiber ratio is the useful indicator of efficiency of feed conversion independent of body size and an important selection criterion for efficiency of growth (Kleiber, 1961; Köster *et al.* 1994). In this study, kids in T_2 had higher kleiber ratio and thus considered efficient users of feed than kids in the other feeding groups. However, KR was not influenced by sex and birth type of kids (Table 3).

Data pertaining to average weaning weight and weight gain of kids for different sex and birth type are presented in Table 3. Weaning weight and pre-weaning average daily gain were not not influenced (P>0.05) by sex of kids. Similar observation had been made by several scholars (Zahraddeen *et al.,* 2008; Belay *et al.,* 2015). However, the weaning weight of single born kids was 2.28 kg heavier than twin kids. Likewise, Belay *et al.* (2015) reported that single born kids were relatively heavier at birth and weaning than twins. Single born kids had greater (P<0.05) pre-weaning average daily gain than twin (119.52±7.45 g/day vs 92.82±7.72 g/day). These results are consistent with other scholars (Madibela *et al.,* 2002; Zeleke, 2007; Belay and Mengistie, 2013). The daily weight gain advantage of kids born single may be linked to pre-and-early post-natal nutrient competition and the less inter-uterine space the twin kids experienced (Zeleke, 2007; Belay and Mengistie, 2013). It is quite clear that multiple born kids need to compete for milk consumption from their dam while single born kids are sole users of milk from their dam.

The relationship between pre-weaning live weight of kids and milk of dams is shown in Table 5. Higher and positive correlation (r=0.68) among weaning weight of kids and average daily milk yield of their dams was observed in this study. Similar strong and positive association was observed by other scholars (Nurfeta *et al.,* 2012; Andualem *et al.,* 2016) for Arsi-Bale goat. This suggests that the live weights and growth rate of kids could be improved by enhancing milk yield of their respective mothers. The regression of milk intake on body weight and weight gain of experimental crossbred kids is presented in Figure 2.

CONCLUSIONS

The study exhibited that supplemention of concnetrtaes at 1.26% of their body weight during pre-weaning period beside dam milk and good pasture could improve the productivity of kids and provide a better profit. Feeding of supplementary concentrates at higher level (2.1% of BW) during pre-weaning period yielded no futher benefits and thus may not be necessary.

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