African Journal of Basic & Applied Sciences 9 (6): 320-325, 2017
ISSN 2079-2034

DOI: 10.5829/idosi.ajbas.2017.320.325

Effect of Pre- and Post Partum Feeding Management on Doe Reproductive Effeciency and Subsequent Offspring Growth and Survival of Arab Goats Before and After Weaning

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Abstract: This study was conducted to evaluate the effect of pre and post-partum doe feeding on the dam reproductive performance and offspring growth and survivability. Forty yearling female Arab goats were assigned through a complete randomized design to 4 treatments and 10 replicates. The experimental treatments were, grazing + feed supplement for three weeks prior to mating (T1); Grazing + feed supplement during the last six weeks of pregnancy (T2); grazing + feed supplement during twelve weeks of suckling period (T3) and grazing only (control) (T4). The feed supplement for all treatments was 59.5% pigeon pea leaf (PPL): 40.5% wheat bran (WB) and given at 247 g DM/animal/day. Salt and water were free access. The data analysis was done with SAS (version 9.2) software. The results revealed that supplementary dry matter intake was higher for T2 than T1 and T3. Milk yield, conception rate and litter size of does were similar ($P > 0.05$) among treatments. Birth weight was heavier ($P < 0.05$) for T2 than T1, T3 and T4. Contrary to birth weight average daily gain, weaning weight, six months weight, yearling weight and kid mortality were not affected ($P > 0.05$) by pre and post-partum supplementation of doe. In conclusion, pre and post-partum feeding of doe results in similar improvement of reproductive performance of does and kid growth and survivability when compared with control group but exhibit moderate birth weight and therefore, raising of doe on improved grazing land with proper breeding strategies and health management will be efficient to bring optimum goat production and productivity.

Key words: Doe · Pre and post-partum · Reproductive efficiency · Arab goats

INTRODUCTION

Ethiopia is endowed with a large number of goats estimated to be 29.11 million heads [1]. In Ethiopia goats form important economic, social and cultural functions and represent an important component of the mixed farming systems. Their contribution for income generation, food supply and financial security for the rural population is well documented. They require small initial investments; have the ability to utilize fibrous feed materials and need much shorter recovery periods to increase flock sizes following a severe drought; have faster growth rates (potential marketability in short time), ease of integration with other crop-based farming systems and greater environmental adaptability as compared to large ruminants. They are important protein sources in the diets of the poor and help to provide extra income and support for survival of many farmers in the tropics and sub-tropics. They promote soil fertility especially in arid and semi-arid areas through production of dung and urine; are easily cared for by most family members and easily managed with low risk of production. In Ethiopia, goats contribute 16.3% of the meat, 9.7% of the milk production and 18.1% of skins production [2].

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- Geographic proximity of Ethiopia to high goat meat importing countries of the Middle East countries gives relative advantage in exploiting the organic meat demand markets. Thus, the high demand for Ethiopian goat meat in these regions could be one of the most important factors encouraging the development of goats production industry in Ethiopia. The export market obviously demands goats that weigh up to 25 to 30 kg at yearling age while most indigenous goat breeds are commonly slaughtered at around yearling age when their body weights are 18-20 kg [3]. Moreover, abattoirs' report indicated that the market has been constrained by lack of consistent and uniform supply of the required weight at younger age. The low productivity of goat is mainly attributed to inadequate nutrition, low genetic potential of indigenous breeds, prevalence of disease and parasites. Among the factors contributing to low productivity, low nutrition is considered the most important [4]. Feed is one of the major constraints limiting livestock productivity in Ethiopia [5]. One critical issue regarding kid survival is the nutrition of dams during pregnancy. Pregnant goats that are under-nourished gave birth to kids with a reduced birth weight and heightened mortality rates [6]. Furthermore, under- nutrition reduces development with decreasing production and quality of both colostrum and milk [7, 8]. Supplemental food during late pregnancy has been shown to reduce kid mortality by improving birth weight and enhancing the immune system while reducing the incidence of hypothermia [9, 10]. However, in the tropics, nitrogen nutrient deficiencies are reported to be particularly severe in lactating phase of ruminants [11]. In Benishangul-gumuz region, the problem of feed supply and quality is even more aggravated when indigenous people burn natural pasture during the dry season and the rain delays [12]. Besides, natural pastures of the region were under fair condition indicating that it's in transitional state from desirable to less desirable [13]. Low feed supply both in terms of quality and quantity results in retarded reproductive and growth performance of animals [14]. Hence, lack of clarity on feeding system of the available feed resource to goat is another pain to the goat production. These problems are hindering the goat production and productivity in Ethiopia in general and Benishangul-gumuz in particular. Therefore, generation of baseline information about the pre- and post partum feeding management of doe plays paramount role to achieve preferable yearling and export weight of offspring as well as improvement of dam reproductive performance. Therefore this study was initiated with the objective of evaluating the effect pre and post-partum feeding of does on offspring growth and dam reproductive performance, milk production in addition to their effect on offspring growth and survival (birth weight, pre- and post weaning growth and survival) performance

MATERIALS AND METHODS

Experimental Animals and Management: Forty eight yearling female kids and six yearling bucks of Arab goats were used in this experiment. The animals were quarantined for ten days to get them used to their new environment and to observe their health condition. At the end of the quarantine period, animals randomly divided into four groups of 12 animals each and assigned to one of the treatment settled.

Experimental Feeds: Pigeon pea leaf (PPL) was collected from the established on half a hectare of land for micro seed multiplication at AsARC. The PPL was harvested from 6 month to 3 years old trees in which 100 kg/ha of DAP fertilizer is applied. The supplement feed were offered at 247 g DM/animal/day. All animals had free access to drinking water and mineralized salt block. The median value of grazing hours per day was 7 hours. Before the experiment starts, samples of supplement ingredients were analyzed for chemical composition of dry matter (DM) content. Based on the chemical composition the supplement ratios were formulated.

Experimental Design and Treatments: The forty yearling female Arab goats were randomly assigned to four feeding period treatments. The experiment was a Complete Randomized Design with four treatments and ten replications. The treatments of the experiment were as follows:

Treatment 1: Grazing + 247 g/h/d feed supplement three weeks prior to mating
Treatment 2: Grazing + 247 g/h/d feed supplement last six weeks of pregnancy

Treatment 3: Grazing + 247 g/h/d feed supplement during twelve weeks suckling period
Treatment 4: Grazing only (control)

Chemical Analysis: Prior to the start of the experiment samples of each of feedstuff was taken to Holetta nutrition laboratory for the determination of DM%, CP, OM, NDF, ADF and ADL. Feed ingredients intended to be used as a feed component in the ration formulation was include pigeon pea leaf and wheat bran. The DM, organic matter (OM, CP and ash were determined according to AOAC [15]. CP content was measured by the Kjeldahl method as N*6.25. The content of NDF, ADL and ADF was determined according to Van Soest and Robertsson [16].

Feed Intake: Daily feed intake of individual animal was calculated as following:

Feed intake (g) = Amount of feed offered (g) – Amount of feed refused (g).

Milk Yield: Dam milk production was measured on one day of each week for the first 12 weeks post partum. Dams were separated from their kids in the late afternoon when they came in from grazing. Early next morning, the kids were weighted before and after they are suckling their dams. Then the milk yield was determined by the following formula:

Milk yield = Weight of kid after suckling - weight of kid before suckling

Live Weight Change and Daily Gain: Kid body weights were taken at fortnightly interval after overnight fasting. Mean daily body weight change was calculated as;

$$ADG\ (kg/d) = \frac{Final\ body\ weight\ (Kg) - Initial\ live\ weight\ (Kg)}{No.\ of\ feeding\ days}$$

RESULTS AND DISCUSSION

Results

Feed Intake: The chemical composition of supplementary feed and DM intake of Arab doe fed on free grazing and supplemented with pigeon pea (*cajanus cajan*) is indicated in Table (1). The supplementary DMI was non-significantly (P > 0.05) among treatments.

Milk Yield, Litter Size and Conception Rate: Milk yield, litter size, birth weight of kids and conception rate of Arab does fed on free grazing and supplemented with pigeon pea leaves is indicated in Table (2). The result of current study revealed that milk yield, litter size and conception rate of Arab does were not influenced by pre and post-partum supplementation. Birth weight of kids was significantly (P < 0.01) different among treatments and it was higher for T2 than T1, T3 and T4.

Effect of Supplements on Kid Performance: The effect of pre and post- partum supplementation of does on kid growth performance is indicated in Table (3). Birth weight of kids was significantly (P < 0.01) affected by pre and post-partum supplementation of does. Contrary to birth weight, pre and post-partum supplementation of does had not any significant effect (P > 0.05) on growth performance of kids rather than birth weight. Birth weight of kids was significantly higher (P < 0.01) for T2 than T1, T3 and T4. Contrary to the birth weight, kids born in T3 had numerically heavier body weight than T1, T2 and T4 at different stages of growth and this has implications on future reproductive performance of animals. The result of this study showed that average daily weight gain, weaning weight, six months weight, kid mortality and yearling weight of kids were not-significantly different among treatments. The average daily weight gain of kid ranged between 75.00-101.33, 38.21-52.16 and 27.34-31.18 g/day for the first, second and third months after birth respectively. The average daily body weight gain decreased with the increasing age of the kids. T3 recorded numerically high yearling weight as compared to other treatments.

The Effect of Sex and Litter Size on Growth Performance of Kid: The effect of sex type and litter size on birth weight and growth performance of kids for the first twelve weeks after birth is indicated in Table (4). The result of this study revealed that sex type had no significant (P > 0.05) effect on body weight change of kids. Whereas, type of birth significantly (P < 0.01) influenced the weight change of kids for first twelve weeks after birth. The body weight gain was higher (P < 0.01) for single type of birth than twin birth types. Kids born single had significantly heavier than twin kids and they maintained their superiority until weaning. The interaction effect of sex type and litter size significantly influenced birth weight while, it had no significant effect for the first twelve weeks. Kids born male x single had significantly higher (P < 0.05) birth weight compared to other sex x birth type.

Table 1: Chemical composition of supplementary feed and DMI of Arab goats supplemented with pigeon pea leaf and fed on free grazing.

	Chemical Composition						
Feed	DM (%)	OM	Ash	CP	NDF	ADF	ADL
Pigeon pea leaf	92.7	91.4	8.6	23.0	40.9	29.1	8.9
Wheat bran	91.6	93.8	6.2	18.6	61.0	17.1	3.6
DMI	T1	T2	T3	T4	SEM	SL	
Supplementary	215.63	211.20	242.86	-	7.12	Ns	

[a, b,] Means with different superscripts in rows are significantly different *** = (P < 0.001); DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; PPL = pigeon pea leaf; WB = wheat bran; T1 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) three weeks prior to mating; T2 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) last six weeks of pregnancy; T3 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) during twelve weeks suckling period; T4 = grazing only (control); ; SEM = standard error of mean; SL = significance level; DMI = dry matter intake.

Table 2: Residual effect of pigeon pea leaf supplementation of Arab dam goats on body weight change of kids and milk yield

Parameters		T1	T2	T3	T4	SEM	SL
Milk yield (mL)	Morning	241.42	252.18	249.81	225.86	7.72	NS
	Afternoon	162.02	158.82	172.72	169.57	7.53	NS
	Per day(total)	403.44	411	422.53	395.43	12.03	NS
Birth Weight (Kg)	Male Kids	1.72	2.09	1.73	1.73	0.06	NS
	Female Kids	1.69	1.90	1.74	1.57	0.05	NS
	Over all	1.70^{b}	2.07^{a}	1.73^{b}	1.63^{b}	0.05	**
Litter size (%)	37	25	42	19	0.04	NS	
Conception rate (%)	87	85	84	84	0.03	NS	

[a, b,] Means with different superscripts in rows are significantly different ** = (P < 0.01); ns = non-significant; T1 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) three weeks prior to mating; T2 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) last six weeks of pregnancy; T3 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) during twelve weeks suckling period; T4 = grazing only (control); ; SEM = standard error of mean; SL = significance level;NS means non-significant.

Table 3: Residual effect of pigeon pea leaf supplementation of Arab dam goats on body weight change of kids

	Treatments					
Live weights of kids (kg)	T1	T2	T3	T4	SEM	SL
Week 1	1.70^{b}	2.07^{a}	1.73^{b}	1.63^{b}	0.05	**
Week 2	2.72	3.09	2.93	2.57	0.10	ns
Week 4	3.59	3.70	3.92	3.64	0.14	ns
Week 6	4.11	4.32	4.67	4.37	0.17	ns
Week 8	4.74	5.05	5.30	5.21	0.18	ns
Week 10	5.45	5.43	5.88	5.67	0.18	ns
Week 12	5.65	5.75	6.22	6.14	0.19	ns
Growth rate of kids (g/day)						
Weeks 1-4	80.13	75.00	101.33	88.14	0.97	ns
Weeks 4-8	38.21	41.00	52.16	45.89	0.56	ns
Weeks 8-12	30.39	27.34	31.18	30.89	0.43	ns
Weaning Weight	5.69	6.02	6.58	6.39	0.17	ns
Six month	8.01	7.60	7.76	7.69	0.26	ns
Yearling weight	16.37	14.67	16.83	12.50	0.86	ns
Kid mortality	45.99	42.10	34.39	49.50		ns

[a, b,] Means with different superscripts in rows are significantly different ** = (P < 0.01); ns = non-significant; T1 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) three weeks prior to mating; T2 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) last six weeks of pregnancy; T3 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) during twelve weeks suckling period; T4 = grazing only (control); ; SEM = standard error of mean; SL = significance level; NS means non-significant.

Table 4: Effect of birth type and sex on growth performance (1 to 12 weeks) Arab kids

	Time (Weeks)			
Fixed effects	1	4	8	12
Sex of Kids				
Male	1.67	3.63	5.03	5.87
Female	1.85	3.86	5.11	6.10
Significance	ns	ns	ns	ns
Type of birth				
Single	1.90[a]	4.04[a]	5.40[a]	6.29[a]
Twin	1.60[b]	3.20[b]	4.51[b]	543[b]
Significance	**	**	*	*
Sex- birth type interaction				
Male x single	2.09[a]	4.15	5.50	6.32
Male x twin	1.61[b]	3.07	4.53	5.41
Female x single	1.70[b]	3.92	5.29	6.26
Female x twin	1.60[b]	3.66	4.48	5.52
Significance	*	ns	ns	ns

[a, b,] Means with different superscripts in rows are significantly different * = ($P < 0.05$); ** = ($P < 0.01$); ns = non-significant; T1 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) three weeks prior to mating; T2 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) last six weeks of pregnancy; T3 = grazing + 247 g DM/animal/d PPL and WB (59.5: 40.5) during twelve weeks suckling period; T4 = grazing only (control); ; SEM = standard error of mean; SL = significance level;

DISCUSSION

Birth weight of kids of T2 was heavier than T1, T3 and T4 and this might be due to supplementation improve weight of does during pregnancy and this can be indicated pre-natal development of the fetus as evidenced by significant correlations between birth weight of the offspring [17]. This is because the live weight of pregnant does during gestation affects the amount of available energy for fetal growth. However, size and health status of a doe may be another important factor, which may affect birth weight of kids [18]. The other reason might be due to litter size was numerically lower for T2 than the other treatments. Though the birth weight kids born in T3 had higher, body weight than T1, T2 and T4 at different stages of growth but this increase might refer to the higher milk yield of their dams results in faster pre-weaning and consistent weight gain. This consistent body weight improvement will have implications on future reproductive performance of animals [18, 19] resulting in achievement of better reproductive performance when they attain sexual maturity and thus improve efficiency of goat enterprises. The overall mean birth weight of Arab kids (1.85 kg) was slightly lower than value reported (1.91 kg) by Belay Deribe and Mengistie Taye [20] for Abergelle goats under traditional management system. However, it was higher than the value of 1.5 kg reported by Tucho, Regassa and Fita [21] for Mid Rift Valley kids. The discrepancy in kid birth weight in different studies could be attributed to the difference in breed, parity, age and management of the experimental goats.

The mean litter size (30.75%) observed in this study was lower than the value (42%) for Arsi- Bale and central highland goats reported by Tesfaye *et al.* [22], while the result higher than those reported (4%) by Belay Deribe and Mengistie Taye [20] for Abergelle goat breed under traditional management system. Kids born single weighed significantly more than twins kids at birth and all along until twelve weeks. This could be attributed to the weight advantage to competition for maternal nutrients and the less inter-uterine space in cases where does carry two or more fetuses as compared to one [23]. Moreover, single kids consume more milk with no suckling competition.

CONCLUSION

The result revealed that pre and post-partum feeding of doe did not influence pre and post-weaning growth performance of kid except birth weight. Dam reproductive performance (litter size, conception rate and milk yield) and kids mortality were also not affected by pre and post-partum supplementation of doe with pigeon pea and wheat bran. Therefore, keeping doe on improved grazing land with proper breeding strategies and health management will be efficient to bring optimum goat production and productivity.

ACKNOWLEDGEMENTS

The field research was fully financed by Ethiopian Institute of Agricultural Research (EIAR). The authors would like to thank Assosa Agricultural Research Center for facilitating the field research work.

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