Effect of pre-and post-partum feed supplementation of Maraz does on the productive performance of their offspring

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Abstract

The purpose of this experiment was to investigate the impact of maternal pre-and post-partum feed supplementation, under farm conditions, on goat kid's growth, follicle traits and fiber production. The design of experiment was supplementation from 2 months pre-partum to 2 months post-partum with 3 nutritional groups (8 does each). The first does group (GI) was fed black barley at 250 g/doe/day (traditional farmer's practice), whereas does of the second (GII) and third (GIII) groups were fed concentrate diet at 500 and 750 g/doe/day, respectively. Results revealed that birth weight from GII and GIII was significantly (P<0.05) higher by 22% (2.3 vs. 1.8 kg) than that of GI. Weaning weight and marketable live weight traits, growth rates, follicle traits except primary follicles, and fiber characteristics were significantly (P<0.05) higher in (GIII) followed by (GII) and then (GI). Moreover, goat kids of the GIII attained significantly (P<0.05) 37% (16.9 vs. 10.7 kg) and 26% (16.9 vs. 12.5 kg) more marketable live weight compared with GI and GII, respectively. Also, goat kids of the GIII produced 32% (813.3 vs. 553.3 g; P<0.05) and14% (813.3 vs. 703.3 g; P>0.05) higher fleece weight than that of GI and GII, respectively. Additionally, body weight traits, growth rates, and fiber characteristics were significantly (P<0.05) affected by sex of birth. In conclusion, supplementation with an increased level of feeding concentrate pre-and post-partum of Maraz goats showed a significant (P<0.05) positive effect on productive performance of their kids in comparison to the traditional farmer's practice.

Keywords: Maternal feeding, goat kids, follicle traits, fiber production.

Introduction

Maraz/Meriz goat known as Kurdi originated in Kurdistan region of Iraq and Iran. It is found at high altitudes in the north eastern area of the country and belong to cashmere-bearing goat breeds [1]. The primary target of raising this breed is producing fine fibers beside meat and milk. This breed was subjected over an extended period of time

to the severe semi-dry conditions, drought, feed shortage and prevalent diseases. Hence, their adaptation to such circumstances was at the expense of significant economic traits [2]; for instance, kids' daily gain in weight is low as well as hair productivity [2,3].

Maternal undernourished during gestation affects birth weight, which is directly correlated with the kid's growth and survival rate [4,5]. Kid's growth from birth to marketing is of great economic importance, since rapid growth during the early period minimize the maintenance cost and provide more profit from the offspring's sale [6].

Plane of nutrition of does in late pregnancy (when the secondary follicles are initiating in the fetus), and of the kids during it's first few months of life (when the secondary follicles begin to mature and produce fiber), are crucial. If deficient food is supplied at these stages; the kid starts life with a reduced number of follicles, the lifetime of fiber production will be affected, and this will be a permanent limitation [7].

During November to February, the majority of Maraz does are in late pregnancy and early lactation, when their nutrient requirements are highest [4]. That period of a year coincides with the winter season when there is a shortage of green pasture and deciduous type brows trees. Therefore, farmers use their traditional practice, to provide a small amount of feed (barley and straw) to alleviate the shortage of feed.

Nutrition plane supplementation of does during late stage of gestation and early lactation significantly affecting productive performance of goat kids [8,11]. However, no information is available on the effect of feeding supplementation pre-and post-natal of Maraz does on the productive performance of their offspring. Therefore, the objective of the current study was to assess the impact of supplementary concentrate feed in comparison to the traditional farmers practice of Maraz does during late pregnancy and post-partum, under farm conditions during the winter season, on goat kid's growth, follicle traits and fiber production.

Materials and Methods

Ethics approval

This experiment was approved by the Department of Animal Resources, College of Agricultural Engineering Sciences (Reference No. 2823/2021) and complied with the guidelines of the Animal Research Ethics Committee (AREC) of the College of Science, Salahaddin University-Erbil (Reference No.45/94/2022).

Study location

The study was done at a private commercial farm located in Qadrawa village (Latitude 36° 16' 24"N, Longitude 45° 0' 38"E and Elevation of 602 m), Sangasar, Rania, Sulaimani, Iraq, during August 2021 to October 2022.

Animals management

A total of 24, synchronized estrus, Maraz goats (40.3± 0.63 kg body weight) at the end of the third month of pregnancy were used. In the current investigation, full detail of management and feeding was described in our previous study [12]. In brief, does were allocated to one of three separate experimental treatment groups (8 of each) based on their age and body weight. The does of the first group (GI) were fed with whole

black barley at 250 g/doe/day (traditional farmer's practice), while those of the second (GII) and third (GIII) groups were fed concentrate diet at 500 and 750 g/doe/day, respectively. The concentrate diet (13.4% CP, 12.6 Mj/kg ME) composed of 48% black barley, 30% corn, 20% wheat bran, 1% limestone, 0.5% sodium bicarbonate and 0.5% table salt. Experimental diets were supplied at 8.30 am and 8.30 pm. Wheat straw was offered *ad libitum* to all groups after eating of experimental diets. The animals had free access to mineral blocks and water. In addition, all animals were allowed to exercise and graze on available fallen tree leaves in the fields adjacent to the project area for 3-4 hours daily depending on the weather in the area. Pregnant does were separated from the herd about 4-5 days before kidding into kidding pens. The sex of the kid and type of birth were recorded. Kids were left with their mothers until weaning age (3 months). The above-mentioned levels of feeding were during the last two months of pregnancy and continued during the first two months of the suckling period with an additional 100 g against each kid born. At the third month of suckling and the first month of post-weaning periods, the feeding system was the same for all groups, where the does were allowed to graze on available natural pasture (grasses, shrubs and browse plants) during the entire day. Also, the feeding system was the same for all goat kids after weaning till the age of 9 months (end of experiment), where the kids were supplied with a limited amount of ground barley in addition to grazing on natural pasture. Goat kids were weighed at birth (within 24 hours of birth) and then at monthly intervals during the experimental period.

Histological studies

A skin specimen of 1 cm^2 from the right mid-side of each selected animals (six kids from each feeding groups) at the age of 6 months was taken and fixed in 10% neutral buffered formalin. At the Department of Anatomy/College of Veterinary Medicine/University of Mosul, specimens were processed for routine histological processing method and paraffin block preparation [13]. With rotary microtome, the sections of 5-6 μm thickness were cut and stained with Harris hematoxylin and eosin stain. At the Department of Biology/College of Education/University of Salahaddin-Erbil, the micrometrical observations on number of primary and secondary hair follicle/4x field were achieved using digital Microscopic camera (OMAX 18MP, CHINA) fit on Olympus Microscope CX21, JAPAN.

Raw hair studies

The same animals from which the skin specimens were taken, sheared at the age of 9 months. Greasy fleeces were weighed, and a patch from the left mid-side of each fleece was taken. Average staple length was determined by measuring 4 greasy staples randomly selected from each mid-side sample, by ruler. The mid-side samples were scoured in non-ionic detergent. About 200 fibers were randomly drawn from four degreased staples and used to measure fiber length, by a graduated ruler, after being removed from crimps. The diameter of 150 fibers from each sample was measured by a Projection Microscope in accordance to the ASMTT [14] at the Department of Animal Production/College of Agricultural Engineering Science/University of Duhok.

Statistical analysis

The statistical analysis of data was done using the General Linear Model; GLM procedure of the Statistical Analysis System; SAS [15] to investigate the impact of does feed supplementation, birth type and sex of birth on studied traits. Significant differences among means were detected by using Duncan Multiple Range Test using SAS.

Results and Discussion

The effect of the dams feed supplement on goat kids body weights and growth rates from birth until nine months of age appeared to be highly significant ($P<0.01$, Table 1). Kids from supplementary concentrate feed groups (GII and GIII) recorded the same value (2.3 kg) of birth weight, which was higher (by 22%) significantly ($P<0.05$) than that observed in the first group (GI; traditional farmer's practice, 1.8 kg). This explained why balanced nutrition during late stage of gestation is critical for the development of fetal because about 80% of birth weight of a developing fetus is obtained during this period [16,17]. The weaning weight for (GIII) group surpassed significantly ($P<0.05$) as compared with (GII) and (GI) groups, which were (12.6±1.0), (9.0±1.1) and (7.2±0.4) kg, respectively (Table 1). Certainly, the weaning weight of the (GII) and (GIII) groups reflected the nutritional advantages of dams of these groups which were able to supply more milk [12] to their kids, who attained 20% and 43% more weight, respectively compared with kids from (GI) group. Additionally, weaning weight was affected by birth weight [18,19]. The body weights at 6 and 9 months, and also growth rates (pre-and post-weaning, and total) were significantly ($P<0.05$) higher in group (GIII) in comparison to comparable traits between (GII) and (GI) groups (Table1). Herein, during six months period kids of the second (GII) and third (GIII) groups attained 14% (12.5 vs. 10.7 kg) and 37% (16.9 vs. 10.7 kg) more marketable live weight, respectively compared with the (GI) group kids. Whereas, kids of (GIII) attained 26% (16.9 vs. 12.5 kg) more weight than that of (GII) kids. This might be due to the earlier weights effect as high positive correlations existed among body weights at birth, weaning and 6-month, and growth rate [10,18]. The present results were in accordance to earlier investigators [8,10] who pointed out that dams supplemented with concentrates during late gestation had higher kids birth weights and their subsequent weights, and growth rates.

There were no significant difference between two types of birth on weight traits and growth rates, although the single birth kids scored numerically higher values than twin births for all these traits (Table 1). Similar findings were indicated for body weights [20,21] and growth rates [22]. However, other authors observed that type of birth had a significant impact on post-kidding body weights and growth rates [23-26].

Male kids exceeded females significantly ($P<0.05$, Table 1) in their birth weight (2.4 vs. 1.8 kg), weaning weight (12.5 vs. 7.1 kg), weight at 6 months (16.5 vs. 10.6 kg), weight at 9 months (21.2 vs. 14.7 kg), and pre-weaning (111 vs. 57 g/d), post-weaning (48 vs. 42 g/d) and total growth rates (69 vs. 48 g/d). It is generally confirmed

by many workers that male kids are significantly heavier and have a higher growth rate than females [21,27-29]. The superiority of males over females in terms of body weight and daily gain in weight might be attributed to androgen acts as an anabolic hormone [27,28]. Who also stated that males are more aggressive and active than females, and may consume more milk and feed.

Table (1): Effect of dam's feed supplement, birth type and sex of birth on the growth of goat kids (Mean±S.E).

Factors	No.	Birth weight (kg)	No.	Weaning weight (kg)	Pre-weaning growth (g/d)	Weight at 6 months (kg)	Weight at 9 months (kg)	Post-weaning growth (g/d)¥	Overall growth (g/d)
Overall mean	35	2.1±0.1	29	10.1±0.7	87±6.8	13.9±0.7	18.3±0.8	46±1.1	60±2.7
dam's feed supplement		**		**	**	**	**	*	**
GI	11	1.8±0.1^{b}	7	7.2±0.4^{b}	60±4.6^{b}	10.7±0.5^{b}	14.9±0.5^{b}	42±3.0^{b}	48±1.9^{b}
GII	11	2.3±0.2^{a}	10	9.0±1.1^{b}	75±10.2^{b}	12.5±0.9^{b}	16.9±1.0^{b}	44±2.0^{b}	54±3.4^{b}
GIII	13	2.3±0.1^{a}	12	12.6±1.0^{a}	113±9.8^{a}	16.9±1.0^{a}	21.4±1.2^{a}	49±2.5^{a}	71±4.1^{a}
Type of birth		NS		NS	NS	NS	NS	NS	NS
Single	9	2.3±0.2	8	11.3±1.9	100±18.1	14.7±2.0	19.6±2.2	46±3.3	64±7.5
Twin	26	2.1±0.1	21	9.6±0.6	82±6.5	13.6±0.7	17.8±0.7	46±1.0	58±2.5
Sex of birth		**		**	**	**	**	*	*
Male	18	2.4±0.1^{a}	16	12.5±0.8^{a}	111±8.1^{a}	16.5 ±0.8^{a}	21.2±0.9^{a}	48±1.7^{a}	69±3.3^{a}
Female	17	1.8±0.1^{b}	13	7.1±0.3^{b}	57±2.9^{b}	10.6±0.3^{b}	14.7±0.3^{b}	42±1.1^{b}	48±0.9^{b}

*: P<0.05; **: P<0.01; NS: Non-significant. ¥: 6 months.
a,b Means with different superscripts within each factor/column differ significantly (P<0.05).
GI: 250 g black barley/doe/day; GII and GIII: 500 and 750 g concentrate diet/doe/day, respectively.

From the results shown in Table (2), it can be noticed that supplemented concentrate feed groups differed from traditional farmer's practice group in primary (P) follicle density/mm^2 (2.7±0.18, 2.2±0.13 and 2.3±0.24; P>0.05), secondary (S) follicle density/mm^2 (15.0±1.14, 10.0±0.36 and 9.6±1.24; P<0.05), S+P density/mm^2 (17.7±1.28, 12.2±0.43 and 11.9±1.44; P<0.05) and S/P ratio (5.5±0.27, 4.7±0.24 and 4.2±0.27; P<0.05) for the (GIII), (GII) and (GI), respectively. Similarly, supplementation of grazing Inner Mongolian Cashmere goats during late pregnancy significantly increased kids mature secondary follicle density [11]. Also, supplements provided to Angora does in the mid pregnancy and early post-natal showed a positive effect on the secondary follicle density and S/P ratio of the kids [30].

Neither type of birth nor sex of birth had a significant effect on follicle traits (Table 2). In this regard, it was indicated that no difference in the ratio of S/P follicles between

Kids born single versus kids born as twin in Cashmere -Producing Spanish goats [31]. Who also proposed that does bearing twins have an inverse effect on the follicle initiation, therefore pregnant twin does require more nutrients when compared with pregnant single does, so it is important to ensure does have an adequate supply of energy or nutrients during pregnancy. It was confirmed earlier to the non-significant effect of sex on follicle traits of Maraz goat [32].

Table (2): Effect of dam's feed supplement, birth type and sex of birth on the follicle traits of goat kids (Mean±S.E).

Factors	No.	Follicle characteristics			
		Primary follicle density /mm2	Secondary follicle density /mm2	S+P density/ mm2	S/P ratio
Overall mean	18	2.4±0.12	11.5±0.81	13.9±0.90	4.8±0.19
dam's feed supplement		NS	**	**	*
GI	6	2.3±0.24	9.6±1.24^{b}	11.9±1.44^{b}	4.2±0.27^{b}
GII	6	2.2±0.13	10.0±0.36^{b}	12.2±0.43^{b}	4.7±0.24^{ab}
GIII	6	2.7±018	15.0±1.14^{a}	17.7±1.28^{a}	5.5±0.27^{a}
Type of birth		NS	NS	NS	NS
Single	8	2.3±0.24	11.1±1.52	13.4±1.74	4.8±0.25
Twin	10	2.4±0.09	11.9±0.87	14.3±0.92	4.9±0.29
Sex of birth		NS	NS	NS	NS
Male	7	2.6±0.16	12.0±1.42	14.6±1.54	4.5±0.34
Female	11	2.2±0.15	11.2±1.00	13.4±1.14	5.0±0.22

*: P<0.05; **: P<0.01; NS: Non-significant.
a,b Means with different superscripts within each factor/column differ significantly (P<0.05).
GI: 250 g black barley/doe/day; GII and GIII: 500 and 750 g concentrate diet/doe/day, respectively.

A comparison of the greasy fleece weight, staple length, fiber length and fiber diameter of Maraz goat kids in response to dam's feed supplement, is presented in Table (3). It appears that the values of fiber characteristics were significantly (P<0.05) higher in (GIII) followed by (GII) and then (GI). Kids from the second (GII) and third (GIII) groups produced 21% (703.3 vs. 533.3 g) and 32% (813.3 vs. 553.3 g) higher fleece weight, respectively compared with the (GI) group kids. Whereas, kids of (GIII) produced 14% (813.3 vs. 703.3 g) higher fleece weight than that of (GII) kids. The plausible explanation is that insufficient nutrition causes less, finer, and shorter fibers to be produced [33,34]. Bearing into mind to heavier and higher S+P follicle density/mm^2 for kids in (GIII) compared to other groups (Tables 1&2). In turn, fiber growth was affected by nutritional manipulation [7,30]. Similar trends to the current results were stated that supplementary feeding of under grazing goats late of gestation increased fiber production of their offspring [9,11].

Kid's type of birth proved to have a non-significant effect on all hair physical properties though the greasy fleece weight of single kids was higher than that of twins (720 vs. 666 g, Table 3). Similar observation was obtained in yearling Markhoz goats [35]. Additionally, it was demonstrated that supplementation to Angora does during the last third of pregnancy and lactation significantly increased Mohair production by 13% in single kids compared to twin litter kids and the Mohair had longer staples, but there was no detectable effect on kids Mohair fiber diameter [36].

Male kids surpassed females significantly (P<0.05, Table 3) in their fleece weight (854.3 vs. 585.5 g), staple length (11.0 vs. 9.6 cm), fiber length (13.7 vs. 11.5 cm) and fiber diameter (29.8 vs. 26.2 µm). In general, males produced heavier greasy fleece weight, longer staple and fiber lengths, and coarser fiber diameter than females [3,9,34,37]. The apparent difference in fiber production between males and females was attributed to the larger size and the better feeding given to males [38].

Table (3): Effect of dam's feed supplement, birth type and sex of birth on the fiber production of goat kids (Mean±S.E).

Factors	No.	Fiber characteristics			
		GFW(g)	SL(cm)	FL(cm)	FD (µm)
Overall mean	18	690±40.99	10.2±0.33	12.3±0.40	27.6±0.82
dam's feed supplement		*	***	**	*
GI	6	553.3±55.12^{b}	8.7±0.20^{c}	11.0±0.15^{b}	23.8±0.81^{b}
GII	6	703.3±73.33^{ab}	10.3±0.57^{b}	12.2±0.61^{b}	28.8±0.83^{a}
GIII	6	813.3±43.72^{a}	11.4±0.41^{a}	13.8±0.57^{a}	30.1±1.10^{a}
Type of birth		NS	NS	NS	NS
Single	8	720.0±80.67	10.3±0.65	12.8±0.82	27.9±1.60
Twin	10	666.0±38.99	10.0±0.29	12.0±0.31	27.4±0.85
Sex of birth		***	*	*	*
Male	7	854.3±37.08^{a}	11.0±0.58^{a}	13.7±0.65^{a}	29.8±1.00^{a}
Female	11	585.5±36.59^{b}	9.6±0.27^{b}	11.5±0.29^{b}	26.2±0.99^{b}

GFW: Greasy fleece weight; SL: Staple length; FL: Fiber length; FD: Fiber diameter.
*: P<0.05; **:P<0.01; ***: P<0.001; NS: Non-significant.
a,b,c Means with different superscripts within each factor/column differ significantly (P<0.05).
GI: 250 g black barley/doe/day; GII and GIII: 500 and 750 g concentrate diet/doe/day, respectively.

The results demonstrated a significant increase in body weight traits, growth rates, follicle traits except primary follicles, and fiber characteristics of goat kids fed their dams high supplementary concentrate diet (750 g/doe/day). So, supplementation with an increased level of feeding concentrate pre-and post-partum for Maraz goats, under farm conditions, is necessary to optimize their offspring's productive performance.

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Conflict of interest

The authors declare, the publication of this research paper does not present a conflict of interest for them.

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