

Effect of pre-and post-partum Feeding levels on live weight and Milk yield of Maraz goats

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Abstract

The aim of this study was to investigate the effect of supplementary concentrate feed and *ad libitum* wheat straw throughout grazing Maraz does at commercial farm on pre-and post-partum body weight, and production of milk and its composition. The experimental design was supplementation from two months pre-partum to two months post-partum with three dietary groups (8 does each). The first does group (GI) was fed whole black barley at 250 g.doe.day (traditional farmer's practice), while does of the second (GII) and third (GIII) groups were fed a concentrate diet at 500 and 750 g.doe.day, respectively. Results revealed that does weight gain before kidding and body weight throughout the experimental period increased significantly in the (GIII) group compared with other groups. Does of the second (GII) and third (GIII) groups produced 5% (52.2 vs 49.7 kg) and 30% more milk (71.1 vs 49.7 kg), respectively compared with the (GI) group does. Whereas, does of (GIII) produced 27% more milk (71.1 vs 52.2 kg) than that of (GII) does during the suckling period. Furthermore, the low level of the feeding of the first group (GI) obtained significantly higher milk fat% but lower protein% compared to other counterparts. Milk production was affected significantly by the type of birth during the pre-weaning period. In conclusion, feed supplementation with an increased level of feeding concentrate pre-and post-partum in Maraz does was displayed to be advantageous in comparison to the first group (GI) as well as to those given low-level feeding of concentrate diet.

Keywords: Does, early lactation, late gestation, milk production, supplementation.



Introduction

Small ruminants and in particular goat is the most important living source for people inhabiting in regions not suitable for crop cultivation and cattle production. Their genuine capacity to adapt to various environmental conditions, and use marginal land to produce milk and meat of high quality (19,20,25). Native goats are considered an important livestock due to their significant functions for the production of organic meat and milk, especially under the traditional extensive grazing systems (2).

Indigenous Maraz/Meriz goats are raised for the production of hair, meat and milk. They can withstand harsh conditions in the mountainous region of Kurdistan, Iraq (3). Nevertheless, there was no improvement for this genetic resource due to no strategy and vision for the breeding plan being set in Iraq to maximize animal products (meat and milk) to satisfy domestic demand and promote food security (6,7).

Maraz goats in the region generally depend on grazing natural vegetation (grasses, shrubs and browse plants) during the entire year. This traditional practice may lead to a problem of a low productivity of this breed (3), specially during November to February, as this time coincide with a period in which the majority of does are in late pregnancy and early lactation, when their nutrient requirements are highest (9). Therefore, supplementary feeding in the form of a small amount of feed (barley and straw) only during the winter season when there is a shortage of green pasture and deciduous type brows trees may alleviate the shortage of feed.

Nutrition plane supplementation during late gestation and early lactation significantly affecting does productive performance (14-16,26,27). Therefore, due to the unavailability of research results related to the impact of feeding levels in late pregnancy and post-natal on the productive performance of Maraz goats, the objective of this experiment was to investigate the effect of supplementary concentrate feed in comparison to the traditional farmers practice, under farm conditions during the winter season, on body weight changes for does during late pregnancy and post-partum, as well as milk production and its composition.

Materials and methods

This study 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).

Location:

The experiment was conducted at a private commercial farm located in Qadrawa village, Sangasar, Rania, Sulaimani, Iraq, during August 2021 to June 2022.

Animals and management:

Fifty Maraz does aged 3-5 years old and of relatively similar in weights and coat color were obtained, from one farm having over 300 does. As well as seven fertile bucks free of Brucellosis were hired from the same farm. After being disinfected ten days before the goats' arrival, a barn was provided to shelter the goats. The goats were identified using



plastic ear tags. The herd was placed under a regular health program before being randomly distributed to the experimental groups; the goats were vaccinated against Foot and Mouth Disease (an endemic disease) and Enterotoxemia, as well as drenched against internal Parasites by proper anthelmintic. In addition, dipping was done for all animals with insecticide to control the external Parasites. Accurate knowledge of the day of conception is essential for the accurate manipulation of nutritional groups, so the estrus of the goats was synchronized. On August 14 and 21 intravaginal sponges (60 mg Medroxyprogesterone acetate/sponge, LABORATORIOS HIPRA, S.A., SPAIN) were inserted. Sponges were removed 13 days later. This was followed by an intramuscular injection of 500 IU PMSG per doe after sponge withdrawal. On the second day of sponge removal, the goats were randomly placed in pens with bucks at the ratio of one buck per three to four goats for 72 hours. All does were carefully scanned by ultrasonic at 69-76 days after breeding. Depending on the diagnosis of pregnancy and the date of mating, 24 does (40.3 ± 0.63 kg body weight) were ensured and assigned into three equal groups (8 of each) based on their age and body weight at the end of the third month of pregnancy. The does were kept in an enclosed barn divided into three separate pens supplied with mangers and water troughs, and were fed as three separate experimental groups. 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 after an adaptation period of ten days. 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 fed twice a day (8.30 am and 8.30 pm). Chopped wheat straw was offered *ad libitum* to all groups after eating experimental diets. The animals had free access to water and mineral blocks (Butter Blocks® NUTRI FARM, Greece). In addition, all animals were allowed to exercise and graze on available fallen tree leaves in the fields adjacent to project area for few 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 during the end of January and beginning of February, 2022. The type of birth was 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 level of feeding 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.

Experimental measurements:

All does were weighed at the beginning of the experiment, at the last two months of pregnancy, 24 hours after birth, and at monthly intervals thereafter just prior to morning feeding. Milk yield was



recorded biweekly intervals starting from the second week post-kidding until the end of the first-month post-weaning. In the day of the test, kids were separated from their does overnight (at 8.00 pm - 8.00 am). Does were hand milked and the quantity of milk was recorded and then multiplied by 2 to obtain daily milk yield. On the same test-day, milk samples (50 g) were immediately analyzed by EKOMILK TOTAL to determine the milk composition including fat%, protein%, lactose%, solid non-fat% and total solid%.

Statistical analysis:

The statistical analysis of data was performed using the General Linear Model; GLM procedure of the Statistical Analysis System; SAS (23) to study the effect of level of feeding and type of birth on studied traits. Significant differences among means were detected by using Duncan Multiple Range Test using SAS.

Results and Discussion

The results in Table (1) show that all the experimental does had comparable initial live weight, whereas average body weight before kidding and weight gain during the last two months of pregnancy of does supplemented-concentrate diet (GIII) were significantly ($P < 0.05$) higher than does of (GII) and (GI). The weight gains for (GI), (GII) and (GIII) groups were (2.9 ± 0.19), (4.3 ± 0.97) and (8.0 ± 0.72) kg, respectively. This result is in agreement with that observed by Rastogi *et al.* (22), that the gross gain in weight of does at 21 weeks of gestation was significantly lower in low supplemented feed group compared to those groups of higher supplemented feed. Also, it was reported that during late pregnancy, does under high feeding levels obtained significantly higher weight gain than other does groups with low feeding levels (11,12).

Table 1. Effect of level of feeding on changes of body weight (BW) during pre-partum period (Mean \pm SE)

| Factor | No. | Initial BW (kg) | BW before kidding (kg) | BW gain before kidding (kg) |
|------------------|-----|-----------------|-------------------------------|-----------------------------|
| Overall mean | 24 | 40.3 \pm 0.63 | 45.4 \pm 0.79 | 5.1 \pm 0.60 |
| Level of feeding | | NS | * | * |
| GI | 8 | 40.3 \pm 0.99 | 43.2 \pm 0.84 ^b | 2.9 \pm 0.19 ^b |
| GII | 8 | 40.5 \pm 1.24 | 44.8 \pm 0.88 ^{ab} | 4.3 \pm 0.97 ^b |
| GIII | 8 | 40.1 \pm 1.20 | 48.1 \pm 1.70 ^a | 8.0 \pm 0.72 ^a |

* $P < 0.05$; NS: Non-significant.

^{a,b} Means with different superscripts within each 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 effect of level of feeding and type of birth during post-partum period on does body weight changes are presented in Table (2). The results indicated that the effect of level of feeding was significant ($P < 0.05$) on all weight changes except weight loss during kidding (Table 2) which, presumably due to similarity in litter sizes among groups as the total number of kids born were 11, 11, and 13 for (GI), (GII), and (GIII) groups, respectively (Table 3). Additionally, does weight at kidding was significantly ($P < 0.05$) higher in (GIII) group than the comparable values obtained for (GII) and (GI) groups. Hence, after kidding (GIII) group weight gained on average 1.7 kg ($\approx 4\%$ of initial weight) while (GII) and (GI) groups lost 2.7 kg ($\approx 7\%$ of initial weight) and 4.6 kg ($\approx 11\%$ of initial weight), respectively. Also, it appears from Table (2) that average body weight of does offer high plane of nutrition was significantly ($P < 0.05$) higher than the does that provided low plane of nutrition during lactation period and at the first-month post-weaning. Does weight recovery from the last two months of pregnancy stage to kid's weaning stage was significantly ($P < 0.05$) increased in accordance to the level of nutrition. The weight recovery for (GI), (GII) and (GIII) groups were (82.0 ± 1.66) , (91.7 ± 2.70) and (99.8 ± 1.40) %, respectively (Table 2). The possible explanation of the significant increase after birth in live weight of (GIII) does compared to (GII) and (GI) does is due to rapid rate of foetal growth in the late stage of gestation imposes a metabolic challenge to the doe. As a result of this physiological stress maternal body tissue is mobilized (13) and leads in doe's weight loss and death if insufficient nutrients in

feed are supplied (9,22). The current results resemble to earlier reports of previous investigators (11,12,15,22,27) who demonstrated that does supplemented with high level of concentrate in late pregnancy were heavier during post-partum than those that non and/or supplemented with low level of concentrate. Recently, it was reported that the final body weight of Rayeni Cashmere does fed diet supplemented with higher energy level was significantly ($P < 0.05$) improved at the end of 16 week after kidding (26). Also, previously it was indicated that feed-restricted does (70% of energy) lost $\approx 10\%$ body weight in comparison to control does fed *ad libitum* during the last one third of pregnancy (11). In the current study, type of birth had no significant ($P > 0.05$) effect on body weight traits of does (Table 2). Similar findings concerning a non-significant effect of type of birth on Angora does live weight after kidding (15) and also on Native Bengal ewes live weight after lambing, at weaning and weight recovery after lambing were obtained (1).



Table 2. Effect of level of feeding and type of birth on changes of body weight (BW) during post-partum period (Mean±SE)

| Factors | No. | BW at kidding (kg) | BW loss after kidding (kg) ¹ | BW loss during kidding (kg) ² | NO. | BW at first month of suckling (kg) | BW at second month of suckling (kg) | BW at weaning (kg) | BW at post-weaning (kg) | BW recovery (%) |
|------------------|-----------------|------------------------|---|--|----------------|------------------------------------|-------------------------------------|------------------------|-------------------------|------------------------|
| Overall mean | 21 | 38.7±0.86 | 1.9±0.76 | 6.9±0.28 | 20 | 38.4±0.93 | 39.0±1.06 | 37.0±0.79 | 34.9±0.53 | 91.6±1.98 |
| Level of feeding | | * | * | NS | | * | * | * | * | * |
| GI | 7 ⁺ | 35.9±1.17 ^b | -4.6±0.41 ^b | 7.4±0.36 | 6 [¥] | 35.1±1.13 ^b | 34.4±1.33 ^c | 33.6±1.28 ^b | 32.8±1.07 ^b | 82.0±1.66 ^c |
| GII | 7 ⁺⁺ | 38.4±0.65 ^b | -2.7±1.42 ^b | 6.7±0.53 | 7 | 38.0±0.81 ^{ab} | 38.6±0.83 ^b | 37.0±0.74 ^a | 35.5±0.57 ^a | 91.7±2.70 ^b |
| GIII | 7 ⁺⁺ | 41.9±1.56 ^a | +1.7±0.29 ^a | 6.7±0.56 | 7 | 41.9±1.62 ^a | 43.3±1.39 ^a | 39.9±0.95 ^a | 36.3±0.59 ^a | 99.8±1.40 ^a |
| Type of birth | | NS | NS | NS | | NS | NS | NS | NS | NS |
| Single | 9 | 38.3±1.36 | 2.0±1.34 | 6.9±0.21 | 8 | 38.2±1.53 | 38.8±1.69 | 36.7±1.23 | 34.9±0.66 | 91.4±3.27 |
| Twin | 12 | 39.0±1.14 | 1.8±0.93 | 7.0±0.47 | 12 | 38.6±1.22 | 39.1±1.42 | 37.2±1.08 | 35.0±0.78 | 91.8±2.61 |

* P <0.05; 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.

¹ Difference in BW between kidding and initial weights; ² Difference in BW between before kidding and at kidding weights.

⁺ One does caused by still birth; ⁺⁺ One doe caused by un coincidence of expected parturition; [¥] One does caused by its kid mortality.



Table 3. Number of goat kids at birth in each group

| Groups | Type of birth | | | Total kids |
|--------|---------------|-----------|--------------|------------|
| | Single born | Twin born | Triplet born | |
| GI | 4 | 4 | 3 | 11 |
| GII | 3 | 8 | 0 | 11 |
| GIII | 2 | 8 | 3 | 13 |

Table (4) displays that milk production traits including monthly milk yield (MY), total milk yield (TMY) and average daily milk yield (ADMY) during suckling period were significantly ($P < 0.05$) higher in group (GIII) in comparison to comparable milk production traits between (GII) and (GI) groups. Also, Figure (1) displays that biweekly MY trend for the (GIII) group was systematically higher than that of similar trends of (GI) and (GII) groups, where all groups tend to have similar directions of milk production throughout the experimental periods, from where a constant gradual increase was achieved starting from second week till weaning time. Beyond that, the MY declined rapidly and tailed off gradually to the end of 16-week. Similar pattern of MY curve for the same breed was observed earlier (21). Herein, during suckling period group (GI) does produced 30% less milk (71.1 vs 49.7 kg, $P < 0.05$) and group (GII) does produced 27% less milk (71.1 vs 52.5 kg, $P < 0.05$) compared with group (GIII) does. This may be related to weight loss of does in group (GI) and group (GII) due to low level of feeding during late pregnancy which was not adequate to allow the does to build good body reserves and to supply nutrient required during lactation (9). In addition, the role of post-partum feeding practices was also investigated, with restricted-fed goats (70% of *ad libitum*)

producing 21% less milk on day 21 and 29% less milk on day 42 of lactation compared to *ad libitum*-fed goats (16). Present result is in accordance with those reported by Luna-Orozco *et al.* (12), McGregor (15) and Maldonado-Jaquez *et al.* (14) that does received a high level of feeding during late gestation and early lactation produced more milk than their counterparts received a low level of feeding. As the level of feeding was the same for all does starting from the third month of lactation, a non-significant ($P > 0.05$) difference was expected among groups for MY and ADMY post-weaning (Table 4). Similarly, it has been found that supplementation of whole barley grain levels for the last two months pre-partum to two months post-partum, significantly increased milk production at day 40, whereas no effect at day 100 was detected (15).

Does rearing twin kids produced significantly ($P < 0.05$) more milk than does rearing singles only during pre-weaning period (Table 4) due to the role of both of suckling stimulus and mammary gland development as udder size in twin bearing does larger than single bearing does prior to parturition (5,16,18,28). Furthermore, it was observed that the effect of litter size on MY was confined to the early stages of lactation (4).



Table 4. Effect of level of feeding and type of birth on does milk production (Mean±SE)

| Factors | No. | Pre-weaning | | | Post-weaning | | | |
|------------------|-----|---------------------------|----------------------------|---------------------------|------------------------|------------------------|----------------------------|--------------|
| | | MY First month (kg) | MY Second month (kg) | MY Third month (kg) | TMY (kg) | ADMY (kg) | MY Fourth month (kg) | ADMY (kg) |
| Overall mean | 20 | 18.0±0.97 | 19.4±0.94 | 20.7±0.84 | 58.1±2.20 | 0.64±0.03 | 14.6±0.27 | 0.48±0.01 |
| Level of feeding | | * | * | * | * | * | NS | NS |
| GI | 6 | 15.0±0.83 ^b | 16.5±0.84 ^b | 18.2±0.88 ^b | 49.7±2.41 ^b | 0.55±0.03 ^b | 14.6±0.54 | 0.48±0.02 |
| GII | 7 | 15.7±0.81 ^b | 17.5±0.88 ^b | 19.0±0.69 ^b | 52.2±2.18 ^b | 0.58±0.02 ^b | 14.7±0.30 | 0.49±0.01 |
| GIII | 7 | 22.8±1.13 ^a | 23.9±1.27 ^a | 24.4±1.29 ^a | 71.1±3.63 ^a | 0.79±0.04 ^a | 14.5±0.58 | 0.48±0.02 |
| Type of birth | | * | * | * | * | NS | NS | NS |
| Single | 8 | 15.4±0.88 ^b | 16.6±0.84 ^b | 18.5±0.60 ^b | 50.5±4.40 ^b | 0.61±0.05 | 14.3±0.48 | 0.48±0.01 |
| Twin | 12 | 19.7±1.31 ^a | 21.3±1.2 ^a | 22.1±1.18 ^a | 63.1±3.37 ^a | 0.67±0.04 | 14.8±0.31 | 0.48±0.01 |

* P <0.05; 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.

MY: Milk yield; TMY: Total milk yield; ADMY: Average daily milk yield.



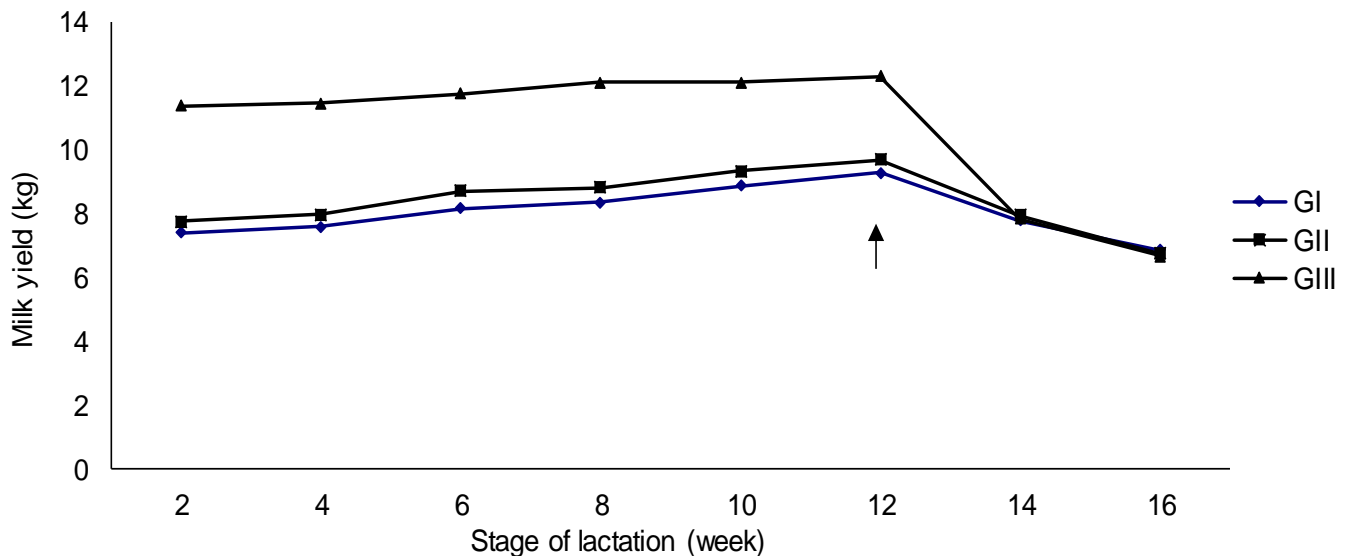


Figure 1. Plot of biweekly milk yield trend throughout the experimental periods. GI: first group; GII: second group; GIII: third group; ↑: weaning

Concerning milk composition, a significant ($P < 0.05$) effect of level of feeding on milk fat and protein percentages was realized during pre-weaning period (Table 5). Whereas a non-significant ($P > 0.05$) effect on lactose, solid non-fat and total solid% among groups was noted except on lactose% at fourth month post-weaning and on total solid% at second and third months of lactation (Tables 5 and 6). The results also indicate that the low level of feeding group (GI) recorded higher fat% but lower values of protein% comparing to other groups (Table 5). This may be attributed to the lower milk yielded by group (GI), as negative correlation between MY and fat% (-0.576) existed for this breed of goat (17). Moreover, it was indicated that depression in goat milk fat percent in response to feeding high concentrate diet has been linked to increase molar percent of propionic acid and decreases of molar percent of acetic acid and ratio of acetate to propionate compared with the high roughage diet (24).

Does with singles produced significantly ($P < 0.05$) more milk fat (5.0 vs 4.7%) at first month, but marginally less protein% than did those with twins ($P > 0.05$). This might be due to MY was higher in does rearing twins; therefore, this result was expected. However, the rest of milk constituents were similar between the groups of both types of birth (Tables 5 and 6). Similar effects on milk composition by type of birth were also obtained (8,10).

Table 5. Effect of level of feeding and type of birth on fat, protein and lactose percentages in milk (Mean±SE)

| Factors | No. | Fat% | | | | Protein% | | | | Lactose% | | | |
|------------------|-----|-----------------------|-----------------------|-----------------------|--------------|-----------------------|-----------------------|-----------------------|--------------|-------------|--------------|-------------|-----------------------|
| | | First month | Second month | Third month | Fourth Month | First month | Second month | Third Month | Fourth Month | First month | Second month | Third month | Fourth Month |
| Overall mean | 20 | 4.8±0.11 | 4.8±0.09 | 4.5±0.10 | 4.4±0.04 | 4.5±0.08 | 4.8±0.08 | 4.8±0.06 | 4.8±0.04 | 4.3±0.05 | 4.3±0.05 | 4.1±0.05 | 3.6±0.04 |
| Level of feeding | | * | * | * | NS | * | * | * | NS | NS | NS | NS | * |
| GI | 6 | 5.4±0.12 ^a | 5.2±0.12 ^a | 5.0±0.14 ^a | 4.5±0.05 | 4.2±0.10 ^c | 4.4±0.14 ^b | 4.5±0.05 ^b | 4.6±0.08 | 4.2±0.15 | 4.3±0.13 | 4.2±0.10 | 3.6±0.08 ^b |
| GII | 7 | 5.0±0.07 ^b | 4.7±0.09 ^b | 4.5±0.05 ^b | 4.4±0.04 | 4.5±0.09 ^b | 4.9±0.09 ^a | 4.9±0.07 ^a | 4.8±0.07 | 4.3±0.06 | 4.3±0.05 | 4.0±0.08 | 3.5±0.06 ^b |
| GIII | 7 | 4.3±0.11 ^c | 4.5±0.12 ^b | 4.0±0.05 ^c | 4.4±0.08 | 4.8±0.09 ^a | 5.0±0.11 ^a | 5.0±0.07 ^a | 4.8±0.07 | 4.3±0.07 | 4.3±0.08 | 4.1±0.05 | 3.8±0.04 ^a |
| Type of birth | | * | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Single | 8 | 5.0±0.12 ^a | 4.8±0.15 | 4.6±0.16 | 4.4±0.06 | 4.4±0.12 | 4.7±0.14 | 4.7±0.07 | 4.6±0.06 | 4.2±0.09 | 4.3±0.07 | 4.1±0.07 | 3.6±0.08 |
| Twin | 12 | 4.7±0.17 ^b | 4.8±0.12 | 4.4±0.14 | 4.5±0.05 | 4.6±0.09 | 4.9±0.11 | 4.9±0.09 | 4.8±0.05 | 4.3±0.06 | 4.3±0.07 | 4.1±0.06 | 3.6±0.06 |

* P <0.05; 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.



Table 6. Effect of level of feeding and type of birth on solid non-fat (SNF) and total solid (TS) percentages in milk (Mean±SE)

| Factors | No. | SNF% | | | | TS% | | | |
|------------------|-----|-------------|--------------|-------------|--------------|-------------|------------------------|-------------------------|--------------|
| | | First month | Second month | Third month | Fourth month | First Month | Second month | Third month | Fourth month |
| Overall mean | 20 | 9.4±0.12 | 9.8±0.10 | 9.6±0.07 | 9.1±0.06 | 14.2±0.15 | 14.3±0.14 | 14.1±0.10 | 13.5±0.08 |
| Level of feeding | | NS | NS | NS | NS | NS | * | * | NS |
| GI | 6 | 9.1±0.22 | 9.4±0.23 | 9.4±0.14 | 8.9±0.13 | 14.4±0.30 | 14.6±0.32 ^a | 14.4±0.22 ^a | 13.4±0.17 |
| GII | 7 | 9.4±0.21 | 9.9±0.12 | 9.6±0.11 | 9.0±0.08 | 14.2±0.27 | 14.5±0.19 ^a | 14.1±0.13 ^{ab} | 13.4±0.11 |
| GIII | 7 | 9.7±0.17 | 9.9±0.13 | 9.8±0.09 | 9.3±0.08 | 13.8±0.16 | 13.8±0.13 ^b | 13.8±0.09 ^b | 13.7±0.10 |
| Type of birth | | NS | NS | NS | NS | NS | NS | NS | NS |
| Single | 8 | 9.3±0.19 | 9.7±0.16 | 9.5±0.09 | 9.0±0.09 | 14.1±0.13 | 14.3±0.17 | 14.0±0.1 | 13.4±0.1 |
| Twin | 12 | 9.5±0.17 | 9.8±0.13 | 9.7±0.09 | 9.2±0.09 | 14.2±0.23 | 14.3±0.22 | 14.1±0.16 | 13.6±0.1 |

* P <0.05; 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.



Conclusion

The results obtained in the present study showed a significant increase in body weight pre-and post-partum, and also milk yield during the suckling period in does fed high supplementary concentrate diets (750 g.doe.day). Therefore, Maraz goat performance may be improved with marginal production through supplementary feed with an increased level of feeding.

Conflict of interest

The authors declare no conflict of interest.

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