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EFFECT OF SUPPLEMENTARY FEEDING WITH RESIDUAL OF SESAME CAPSULE TO LACTATING DESERT GOAT DURING DRY PERIOD IN NORTH KORDOFAN STATE, SUDAN

I. Bushara[1*], Fathia G.I. Godah[1]

[1]Department of Animal Production. Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan

Abstract. This experiment were conducted with Desert goats in ELObied locality, Northern Kordofan state, to evaluate the effects of concentrate supplementation of sesame capsule residual on body weight changes and reproductive performances of grazing desert goats. Twenty eight (28) adult doe's and two buck of Desert goats were used in experiment. The does were divided into four groups of similar initial body weight. They were randomly assigned to four supplementary feeding treatments. Group A (7 does) was used as a control (un supplement as in farmer practice), the second group B was supplement with diet of 99% sesame capsule residual, group C with diet of 74% sesame capsule residual and group D was supplemented of 49% sesame capsule residual. All does in all groups were subjected to natural grazing. The results indicated that supplemented does secured higher significantly (P<0.05) body weight before kidding, where animals in group C had better body weight before kidding than other groups. High weights were secured by group C (28.74kg), B (26.57kg) and D (27.94kg), where control group A secured lowered body weight before kidding (25.07kg). Also the results indicated that the body weight at kidding, weaning and body weight change of supplemented groups was significantly (P<0.05) affected by nutrition, where higher body weight were obtained by supplemented groups compared with control group. The respective body weights at kidding were 23.33, 25.23 and 25.63kg for B, C and D groups respectively. Supplementation favored significantly (P<0.05) higher weaning weight for supplemented group than un-supplemented group (control). The results indicated that the dams experienced variable body weight losses imposed by supplementation, the body weight losses was significantly (P<0.05) higher in the control group10% compared to the supplemented groups B (3.9%), C (1.47%) and D (6.75 %) from kidding to weaning time. The results indicated that supplementation that offered to does significantly (P<0.05) effect litter size, however group C secured the largest litter size (1.57) than group B and D with 1.29 together. The supplementation with sesame capsule residual secured highly (P<0.05) significant total and daily milk yield. The supplemented groups produced higher milk with significance (P<0.001) high in fat and lactose.

Keywords: *Desert goat, supplement, sesame capsule residual, body change, reproductive, Sudan.*

Corresponding Author: *Ibrahim Bushara, Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan,*
e-mail: bushara3030@yahoo.com

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1. Introduction

Goats are among the earliest animals been domesticated and are found worldwide and majority of the world's goat population is found in the small holder farming system where nutritional conditions are often sub-optimal (Sibanda *et al.*, 1999). Goat ruminants play a crucial role in food production and provide meat and milk and its products in developing countries, the goat population has increased worldwide during the last three decades and is presently estimated at approximately 840 million head

(Simela & Merkel, 2008), of which 95% are meat goats (Thompson, 2006). Mean, while Sudan has one of the largest population of goat estimated to be about 44 million head, in greater Kordofan total goats is estimated at 7.9 million and about 4 million are found in north Kordofan (MARF, 2012). Livestock in Sudan play a high position role to increase the national income and contribute more than 20% of locally produces and 40% of the agricultural sector contribution and over 25% of the total Sudanese export. The large population of goats is mainly composed of Nubian, Desert, Nilotic and Mountain breeds (Taggar), widely distributed in all ecological zones from arid northern region to humid southern Sudan. All of these types of goats are classified as meat types except Sudanese Nubian goat (AOAD, 1990).

Sudanese desert goats like most other goats in tropical countries are kept and raised for meat production especially in rural areas and are rarely milked especially in rural areas, and they also provide some milk for family needs and household cash income for smallholder farmers (Galal, 2005., Toplu & Altinel, 2008). Their importance comes from the fact that they have a wide range of adaptability and high ability to survive and produce in harsh conditions where other livestock cannot (EL-fadil, 2001). Reproductive performance is one of the main determinants of productivity of the goat and it will be applied to the breeding of animals for meat production (Delgadillo, 2007). The level of reproductive performance is dependent on the interaction of genetic and environmental factors, but this performance is particularly susceptible to the latter, which is very crucial from point of view of nutrient requirements, for example, the seasonal availability of nutrients can affect reproduction considerably (Moaeen-ud-Din *et al.*, 2008). Ruminant livestock in most parts of the tropics graze extensively on naturally growing forages which are poor in quality where rainfall and forage availability are scare (Devendra, 2001). So, energy intake fluctuates according to the season and the ability of the owner to provide supplementary feeding this is very difficult (Bushara & Abu Nikhaila, 2102) so, there is a great shortage in animal feed stuffs particularly during summer season. This should have an impact on productivity trait of goats, as body weight at pre and post kidding, birth weight, weaning rate and mortality rate, as animals may use more energy searching for grazing over long distance than the energy they gain from this poor quality feed (Mahgoub & Lu, 2004).

In recent years, the price of energy sources had dramatically increased with the increase demand for animals feeding. The increases of feed prices encouraged nutritionists to search for cheaper high energy feed ingredients (Roca Fernandez & Rodriguez, 2012). The majority of North Kordofanian smallholder goat farmers resort to the easily available, cheap and abundant crop-residues from post-harvest farm operations to feed their animals instead of using the expensive, conventional concentrate ration. These crop residues are also limiting in nutrients necessary for maintenance and production. However, feed supplementation packages for improving reproductive and lactation performance of small ruminants during the long dry periods of the year are currently not available in North Kordofan. However, in order to determine to sasses and to know knowledge of the reproductive and productive potential of the desert goat, the aim of this study was to investigate the effect of pre-and postpartum feed supplementations of sesame capsule residual on some reproductive and productive, this including; Doe body weight change, Milk production and milk composition and Litter size.

2. Materials and methods

The experiments carried out in ELObeid in North Kordofan State, Sudan (Latitudes 11^{o}:15'-16^{o}:30'N; Longitudes 27-32^{o}E). Average temperature varies between 30-35^{o}C during most of the year with peaks of above 40^{o}C during April, May and June. The rainy season extends from July to October with maximum rainfall in August. Long-term averages annual rainfall is about 280 mm (Technoseve, 1987).

Experimental animals

Twenty eight (28) adult doe's Desert goats were employed in this experiment. The goats are purchased from local market around that area. The does were of different in age with a range of >1 year to three years of age, with average body weight of 21.4 kg. The animals were divided into four similar groups each with seven animals. The does were randomly individually penned, equipped with feeding and drinking troughs. Prior to commencement of treatments the goats were ear-tagged, vaccinated against diseases endemic to the area such as anthrax and Hemorrhagic septicemia and drenched with broad spectrum anthelmintic (Ivomic). Seven days were allowed as adaptation period for goats to be adapted for feed treatments. Goats are weighed at the beginning of the experiment and then at weekly interval.

Housing and feeding management

The goats were randomly divided into four equal groups (A, B, C and D) of seven does according to their body weight. Group A (R0) was used as control, (n=7 does, mean body weight 22.5 kg), was managed according to the prevailing traditional system which relies mainly on grazing with no supplementation. Group B (R1) (n=7 does, mean body weight 22.6 kg) supplemented by with 99% sesame capsule residual (Jaojaw), Group C (R 2) (n=7 does, mean body weight 22.8 kg) supplemented by with 74% sesame capsule residual and Group D(R 3) (n=7 does, mean body weight 22.4 kg) supplemented by with 49% sesame capsule residual. All groups were allowed for free grazing. Each doe in group B, C and D were then supplemented by 350 gm of ration 1, 2 and 3 daily. The Four groups were housed in partially shaded pens, constructed from iron bars and wire. Each pen was equipped with feeders and water troughs with clean water. Inside each enclosure the animals were kept together at sufficient distance space, and offered feed and water in gathered troughs for supplemented groups only. All groups were daily turned to grazing from 8.00 a.m to 6.00 p.m. Supplementation to group B, C and group D was performed during night after grazing time.

Data recording

Data of 28 parent female goats were arranged according to feeding system. The dam live body weight was monitored before kidding and during a complete lactation season up to weaning, litter size and body weight were recorded at weekly interval and milk yield, milk composition were also monitored up to three months.

Milk Composition

Fresh milk samples were taken at monthly interval for chemical analysis for three months. The Milk samples (20 ml) from each group were collected in sterile containers and kept in a refrigerator adjusted at 5 C^{0} pending the analysis for chemical composition.

The analysis has been done according to methods of AOAC (1990)**,** in the laboratory of Animal Production of ELObeid agricultural Research Station, North Kordofan state.

Chemical composition of feeds

The ingredients used in concentrated ration formulation, supplemented diets (ration 1, 2 and 3) and the natural grazing (Grasses, shrubs, herbs and trees) were analyzed using proximate analysis according to procedures described by the Association of the Official Analytical Chemists, AOAC (1997) (Table.1).

Table 1. Ingredients and Chemical composition of the rations

Components (%)	**Ration 1(%) for group B**	**Ration 2(%) for group C**	**Ration 3(%) for group D**
sesame residual capsule (Jaojaw)	99	74	49
Sorghum grains	0	10	20
Rosella seeds	0	10	20
Groundnut hulls	0	5	10
Common Salt	0.75	0.75	0.75
Lick stone salt	0.25	0.25	0.25

Supplement types	**DM%**	**CP%**	**CF%**	**E.E%**	**NFE%**	**Ash%**
Ration 1	97.75	10.8	10.8	3.04	57.75	5.7
Ration 2	96.75	20.5	20.5	8.65	34.85	4.10
Ration 3	96.55	11.4	11.4	3.45	52.9	6.75

Table 2. Chemical Analysis of some grasses in wet and dry season during study period

Plant species	**DMI**	**CP**	**CF**	**EE**	**NEF**	**Ash**	**ME(Mj/Kg**
			Wet season				
Dactyloctenium aegyptium	89.6	12.44	6.9	1.4	62.3	10.4	10.99
Echinocloa colonum	88.5	5.00	9.55	2.8	68.5	9.65	11.54
Eragrostis termula	95.5	6.00	12.89	2.3	69.11	4.51	15.57
Cenchrus biflorus	90.1	10.5	9.2	1.8	62.5	9.9	11.88
Schoenefeldia gracilis	92.8	10.5	10.3	3.1	57.3	11.6	11.32
Zornia glochidiata	90.2	10.75	9.65	1.7	46.6	9.8	8.82
			Dry season				
Cenchrus biflorus	88.9	3.3	73.7	29	11.3	11.1	5.93
Eragrostis termula	93.3	2.9	80.5	0.8	9.00	6.8	5.95
Schoenefeldia gracilis	93.3	2.2	79.2	0.8	11.1	6.7	6.03
Cenchrus setigrus	96.3	4.7	80.8	1.0	9.8	3.7	6.29

Statistical analysis

The data from feeding trials and reproductive traits were statistically analyzed according to complete randomizes design using SPSS (SPSS, 2000).v.14.0 software package. Duncan's Multiple Range Tests (DMRT) (Duncan, 1955) was also used to test significance differences among means; analysis of covariance was carried out

3. Results

Effect of supplement type on the body weight at kidding, at weaning and body weight changes

The data in Table 3 indicated the effect of supplementation on body weight of the does at kidding, at weaning time and body weight change. The results indicated that supplementation that offered to animals groups significantly (P<0.05) affected body weight before kidding, where animals in group C had better body weight before kidding than other groups. High weight were secured by group C, B and D, where control group A secured lowered body weight before kidding. The results showed that the body weight at kidding, weaning and body weight change of supplemented groups was significantly (P<0.05) affected by nutrition, where higher body weight were obtained by supplemented groups compared with control group. The respective body weights at kidding were 23.33, 25.23 and 25.63kg for B, C and D groups respectively. The weaning body weight of the supplemented groups was significantly (P<0.05) higher for supplemented group than unsupplemented (control group). The results indicated that the dams experienced variable body weight losses imposed by supplementation, similarly the body weight losses was significantly (P<0.05) higher in the control group10% compared to the supplemented groups as 3. 9, 1.47 and 6.75 % for group B, C and D respectively from kidding to weaning time.

Table 3. Effect of supplementation on the body weight at kidding, weaning and body weight changes

Animal Group	N	Body wt before kidding	Body wt at kidding	Body wt at weaning	Body wt change	%change
Group A	7	25.07^{c}	24.57^{b}	21.91^{c}	-2.66^{a}	10.83
Group B	7	26.57^{bc}	23.33^{c}	22.54^{c}	-0.79^{c}	3.39
Group C	7	28.74^{a}	25.23^{a}	24.86^{a}	-0.37^{d}	1.47
Group D	7	27.94^{b}	25.63^{a}	23.90^{b}	-1.73^{b}	6.75
Overall mean ± SE	28	27.24±.80*	24.69±0.90*	23.03±0.98*	1.39±0.64*	5.61

^{abcd} Values in same column with different superscripts differ at P<0.05 and P<0.001

Effect of supplementation on litter size of desert does

Results of effect of feeding regime on litter size were presented in Table (4). The results indicated that supplementation that offered to does significantly (P<0.05) affect litter size, however group C secured the largest litter size (1.57) than group Band D with 1.29.

Table 4. Effect of supplementation, season of birth and parity on litter size on desert goats

Animal Group	No. of does	No. of kids	Litter size
Group A	7	8	1.14±0.14^{c}
Group B	7	9	1.29±0.18^{b}
Group C	7	11	1.57±0.20^{a}
Group D	7	9	1.29±0.18^{b}
Overall mean ± SE	28	37	1.32±0.09*

^{abc} Values in same column with different superscripts differ at P<0.05

Effect of supplementation on milk yield

Table 5 showed the effected of supplementation on total milk yield. The supplementation had a highly significant (P<0.01) effect on production on 3rd month, total milk production and daily milk yield. The does in group C significantly (P<0.05) had more milk (30.82kg) than those in group D and B as 28.20 and 27.42 kg respectively. The least milk was produced by the A group (control) of (22.79kg) and which was significantly less than supplemented groups (P<0.05). The daily milk production indicated that the does supplemented with supplement sesame residual capsule yielding significant (P<0.001) than control groups.

Table 5. Effect of supplementation on milk production/kg

variables	N	1st month	2nd month	3rd month	Total milk	Daily milk
Animal Group						
Group A	7	5.24	7.81	9.75^{c}	22.79^{c}	0.25^{c}
Group B	7	6.50	9.50	11.41^{b}	27.42^{b}	0.30^{b}
Group C	7	7.15	10.23	13.63^{a}	30.82a	0.34^{a}
Group D	7	6.64	10.23	11.01^{b}	28.20b	0.31^{b}
Overall mean ± SE	28	6.38±0.58	9.49±0.88	11.45±0.89*	$27.30\pm1.9^{*}$	$0.30\pm0.02^{**}$

^{abcd} Values in same column with different superscripts differ at P<0.05 and P<0.001

Effect of supplementation on milk composition

The effect of supplementation, season of birth and parity order on milk chemical composition of experimental goats is illustrated in Table (6). The data indicated that supplementation had exerted a significant (P<0.01) effect on fat and lactose content. The fat content was highest in the D group (3.84) and lower in B group (3.23) compared with control group A. The lactose content was significantly (P<0.01) higher in the two supplemented groups (D and C) compared with the group A (control). The respective lactose values were 4.16, 3.89, 3.74 and 3.51 for D, C, B and A groups respectively. The data also indicated non significant effects of supplementation on crude protein and ash content.

Table 6. Effect of supplementation on milk composition

variables	N	Fat	Crude protein	Lactose	Ash
Animal Group					
Group A	7	3.23^{c}	3.29	3.51^{c}	0.80
Group B	7	3.30^{b}	3.46	3.74^{b}	0.83
Group C	7	3.31^{b}	3.47	3.89^{b}	0.83
Group D	7	3.84^{a}	3.17	4.16^{a}	0.80
Overall mean±SE	28	3.42±0.12*	3.41±0.18	3.82±0.23*	0.81±0.01

^{abc} Values in the same column with different letters are significant at P<0.05

4. Discussion

Effect of supplementation on body weight at kidding, at weaning and body weight changes

The live weight of pregnant does during gestation was affected by the amount of available energy for foetal growth. Therefore, changes in the weight of gravid does can be used to monitor foetal development (Akingbade *et al*., 2001). In this experiments the supplementation with sesame capsule residual (SCR) that given to desert does had improved the weight of the animals, high weight were secured by supplementation group and lowered body weight before kidding secured by control group, this may be due to that supplementation of pregnant does during late two months of gestation may provide adequate energy and protein to insure good body weight during kidding. Since the weight of the doe has considerable effect on kid birth weights, this results agreed with Hossain *et al. (*2003) and EL-Hag *et al.* (2007) who reported that Flushing and steaming up had increased at lambing in Desert sheep. The usual changes in the live weight of dam during gestation are often assumed to be indicative of prenatal development of foetus(es). Same statement reported by Robinson *et al*. (2006) who said that the main role of nutrition to goat to ensure that they achieve their target condition score 3-3.5 on five point scale at mating for maximum ovarian rate and reproductive performance. Also results from this study were similar to that obtained with Hamada *et al*. (2013) who reported that pregnant dam (sheep or goat) supplemented with high level of concentrate during last six weeks of pregnancy had significantly higher body weight compared to non-supplemented dam. Also, the body weight of concentrate supplemented dams was significantly increased after supplementation with high level of concentrate compared to their weights before supplementation which agreed with Hamada *et al*. (2013).

The postpartum weight in supplemented goats which obtained in the present study was very higher, due to the prepartum supplementary rations, since nutrition is one of the environmental factors that affect reproduction in farm animals (Mioč *et al*., 2008). Adequate energy supplementation during pregnancy enables storage of energy reserves, resulting in better body condition at birth, minimizing the negative effects of fat mobilization during early lactation, and an increase in milk production and weight gain (Eknaes *et al*., 2006); this was on line with Avondo *et al.* (2008) and Rastogi *et al.* (2003) who reported that reproductive performance body weight is influenced by nutrition and body condition score or live weight especially during the immediate pre-and-post mating period, and this quite evident that the prepartum supplementation increase weight during post-kidding in this study. This result also is agreed with findings of Madibela and Segwagwe (2008) and with Madibela *et al.* (2002) who reported that supplementation of grazing goats with concentrate and or Lablab hay result increase live weight gain.

The value of body weight at weaning was very high for the concentrate ration(supplemented group with sesame capsule residual (SCR)) compared with the un-supplemented group, the change in body weight mass after parturition throughout the lactation and weaning periods was highly significant. Similar results were reported by Gubartalla *et al.* (2002). Due to good feed that given to supplemented does, they show significant less body weight losses because of lactation, where more body losses were obtained by does just depend on natural grassing, this results match Rojo-Rubio *et al*. (2016) whom reported that rapid rate of foetal growth during the final six weeks of pregnancy imposes a metabolic challenge to the doe, which is met by the mobilization of maternal body tissue and this may result in weight loss of doe, if the dietary supply of nutrients is inadequate. Similar results were shown by Kerslake *et al.* (2010) who reported that restricted goats lost 8.2% of body weight than control goats. Also agreed with Pambu *et al*. (2011) mentioned that high-yielding goats during early lactation require great amounts of energy when the feed intake capacity is limited, which results in the animals mobilizing their body energy reserves. Toledo *et al* (2002) mentioned that lactating animals should be offered adequate energy from the feed so that they can use energy efficiently to prevent weight losses during lactation and produce to their maximum milking potential.

Effect of supplementation on litter size of desert does

The average litter size for Desert goat in this study was 1.32±0.09; this result is lower than that obtained by Bushara *et al*. (2017c) for same breed (1.50) and for Taggara goat (1.42), Sumartono *et al*. (2016) 1.75, Pan *et al*. (2015) Black Bengal goats (1.8), Haldar *et al*. (2014) 1.75, this results of litter size is higher than that obtained by Mengistie *et al*. (2013) for Central Highland goats (1.16±0.04) and Rojero *et al*. (2005) for Celtibernan (1.1).

The of plane of nutrition and good body weight in this study had improve litter size, where supplemented groups with sesame capsule residual (SCR) showed best litter size compared with un supplemented group, same trends were obtained by Acero-Camelo *et al*. (2008) 1.6 and 1.3 for goats given high and low energy level, Faruque *et al*. (2010) has shown that litter size is higher in intensive systems compared with semi-intensive systems, contrast to this Malau-Aduli *et al*. (2004) demonstrated that, supplementation with concentrate and crop-residues did not affect litter size. Generally the reduction in litter size observed in the present study in does was possible due to a reduced ovulation rate in this group of does. Some authors have provided evidence of a retarded fetal folliculogenesis by maternal malnutrition (Rae *et al*., 2001), or may be due to low body weight during ovulation.

Effect of supplementation on milk yield

Milk production and composition are more depending on composition of the diet fed to animal, the energy balance and energy reserved of the animal. Morand-Fehr *et al*., (2000) note that, higher level of energy intake normally increase milk production which containing lower level of fat. Differences in the milk composition of goats have been attributed to factors such as age and plane of nutrition. The average total milk production for Desert goats in this study was 27.30±1.97 kg, this is equivalent to 0.30 kg per day in a lactation period of 90 days, this level of production was comparable to that reported by Bushara *et al*. (2011, 2010) for Taggar goats, and lower than that reported by Agnihotri and Rajkumar (2007) and Berhane and Eik (2006) for Feral goats. However; higher levels of production were reported by Greyling *et al*. (2004) for Boer goats, Guney *et al*. (2006) and El-Abid, and Abu Nikhaila (2010) for Damascus goats. Also the milk yields here were higher than has been reported for other tropical meat breeds Degen (2007) and Alexandre *et al*. (2002).

The present study indicated that there were highly significant differences in lactation milk yield and daily milk yield between goats of different nutritional supplements with sesame capsule residual during early lactation. The superiority of the goats of group (C) supplement with 49% sesame capsule residual than the goats on other supplemented groups and control one, may be attributed to the higher level of energy and protein fed to group C as compared to other groups. The dietary concentrate level and nature of specific concentrate and forage feedstuffs impact level of milk production and characteristics of milk and milk products (Goetsch *et al*., 2011). Animal does on framer's practice (control group) had lower milk yield compared with fed groups, this may be due to that, and animals may not get their enough nutrient requirements to meet mammary growth and milk production. Does on control flock began to mobilize their reserve more than does on fed group. Same results obtained by Williams *et al.* (2012), Lefrileux *et al.* (2012) and Jubartall *et al*. (2002) who reported that supplementing goat ration will increase milk production. The significant positive response in milk production observed in does of supplemented groups might be due to sufficient energy intake by those females that allow for improved production, this agree with the findings of Fawzi and Azmi (2011) and Gargouri *et al*. (2006). Generally Tropical breeds have low milk yield due to their low genetic potential and prevailing environmental conditions like stress caused by harsh weather and diseases.

Effect of supplementation on milk composition

Based on our results, the milk composition was slightly affected by diet, this agreed with Brito *et al*. (2011) who reported that supplementing goat ration will increase milk constituents. The control diet caused lower milk content compared with the experimental supplemented goats with sesame capsule residual (SCR). This results confirmed by Póti *et al*. (2015) and Toledo *et al*. (2002) who reported that different feeding strategies have different impact on the chemical composition of goat milk. Also agreed with Morand-Fehr *et al*., (2000) who note that, the effect of concentrate diet under grazing condition has little effect on the milk composition. Also Bushara *et al*. (2010) reported that average of fat lower in milk of goats given zero concentrate ration type. May be the differences in composition due to lactation curve which agreed with Idamokoro *et al*. (2017) who reported that, milk fat, protein, and solid non-fat were negatively correlated to increase in milk yield with advance lactation period.

Evaluation of feed cost and revenue from milk production

Economical efficiency (price of milk/cost of consumed feed) illustrated revealed that ration One had the best economical feed efficiency (8.00) compared to the control ration (3.4) respectively. The results are in agreement with those reported by Abd El-Rahman *et al*. (2003) and Mousa (2011) reported that the feed cost was relatively lower than control when goats and sheep were fed rations contained 30-40% acacia.

5. Conclusions

It will be concluded that does fed supplemented diet with sesame capsule residual, they showed less lost in body weight during lactation period and minimizing the negative effects of fat mobilization during early lactation, produced higher milk yield with higher contents of fat, protein, and lactose compared to those grazing pasture only. The increased levels of supplementation might increase the availability and proper balance of nutrients to the doe. This in turn resulted to the higher supply of nutrients to the dose which reflects increase in milk yield. Therefore with similar grazing and roughages available, does should be supplemented with high amount of supplement diet during gestation and the level should be increased gradually during lactation period to obtain higher body weight at kidding and higher milk yield. Also economic efficiency of milk production using concentrate supplementation should be considered when deciding levels of concentrate supplementation to feed.

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