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Effect of Dry Season Supplementary Feeding and Parity on Performance of Desert Sheep in North Kordofan State, Sudan

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Abstract

This study was conducted at North Kordofan State, Sudan the study aimed to investigate the effects of parity order and supplementary feeding at mating, late pregnancy and pre-lambing period on ewe productive and reproductive performance for Desert sheep during the dry season. Eighty (80) ewes were selected from the flock of Desert sheep for this study. Ewes were weighed and randomly divided into four groups A, B, C and D, each group with 20 ewes, ewes were assigned to supplementary feeding treatments as group A was supplemented with diet one, group B was supplement with diet two, group C was supplement with diet three and the last group D as a control. Supplementary groups A, B and C were offered with supplementary feeding for Four weeks during pre mating (flushing), Four weeks post mating, and two months pre lambing and three months post lambing. Supplementation was offered at evening with 350 grams/ewe/day. Body weight of ewes at pre- and post- mating, pre- and post- lambing till weaning was recorded. The data revealed significant ($P < 0.05$) effect of steaming up and supplementary feeding on body weight at mating and before lambing. Body weight improved significantly ($P < 0.05$) for supplemented groups compared with control one. Ewes in group A showed higher ($P < 0.05$) weight compared with other. Supplementation to ewes has positive effect ($P < 0.05$) on body weight at weaning. Parity showed higher significant ($P < 0.05$) effect on ewe's body weight, where weight was improved at mating and before lambing with increase of parity order. Also parity order has significant ($P < 0.05$) effect on body weight change post lambing and weaning time. supplementary feeding has significant ($p < 0.05$) effect to reproductive traits and prolificacy where conception rate, lambing rate increased in supplemented groups A, B and C as compared with group D , abortion rate was decreased. Conception and lambing rate were increased and abortion and mortality rate were decline d with advance of parity. Litter size was increased significantly ($p < 0.05$) with supplementation and parity. In conclusion Parity order and supplementation (flushing and steaming-up) with to Sudanese Desert ewes during breeding period had positive effect and improved the reproductive performance of the ewes.

Keywords

Desert sheep, supplementation, parity, body change, reproductive traits

1. Introduction

Livestock play an important role in the livelihoods of many of the world's poorest people, acting as a source of both

credit and savings in rural areas that are remote from financial services, providing food and cash income for the urban as well as the rural poor, and for many people offering a route out of poverty. The Sudan national sheep flock is estimated to be 50.9 million heads [1]. In the Sudan tropics, Kordofan states Desert sheep is the main breed, playing a maternal role for lamb production. Sudan desert sheep are raised mainly under harsh dry land farming conditions for meat production [2]. The most important factor determining the success of sheep production is reproductive efficiency, since the reproductive and productive traits of the ewe have important contribution to the biological efficiency and profitability of the production system [3], i.e. puberty, oestrus, ovulation, gestation and successful lambing, as well as survival and growth after birth.

Sheep in hot semiarid areas are reared in extensive system. The productive potential of sheep in these environments is influenced by the exposure to harsh climatic factors [4]. Sheep grazing in this ecological zone face extreme fluctuations in the quantity and quality of feed on offer year round [5]. The existing livestock feeding system in the Sudan is based mainly on grazing, crop residues such as straw and supplemented by small quantities of low-cost compound feed. Shortage of feed and water contribute to reduced productivity and reproductive performance of livestock. This includes slow growth rate of animals, loss of body condition, reduced milk production and poor reproductive performance in mature animals [6].

The cumulative effects of nutritional and walking stress during grazing in the hotter parts of the year compromise the productive and reproductive performances of the sheep through reduced feed intake, modified endocrine profile, lower rumination and nutrient absorption and higher maintenance demands [7]. Variation in live weight change in the ewe flock during periods of poor nutrition can affect farm profitability through the effects of live weight loss on potential stocking rate, management interventions including supplementary feeding, and ewe and lamb survival and productivity [8].

A ewe's live weights and parity and age along with nutrition and season, have been reported to influence reproductive performance [9]. Since A ewe's body weight will vary over the season depending on the feed available and her needs. A ewe's energy needs will double in late pregnancy and triple in lactation. Having enough feed to meet her changing needs is important for production and profit. Increasing the premating weight and parity or age of ewes could increase the pregnancy rate and multiple births [10-11]. Nutritional interventions involving season-specific feeding and micronutrient supplementation may help the animal to sustain its production during adverse environmental conditions [7]. In order to improve the productive and reproductive capacity of smallholder ruminant animals, there is a need to look at ways of extending the availability and quality of feedstuffs produced on smallholder farms using simple and cost effective options, to face the lack of feed due to climate change. Therefore, this paper focused on the effect of supplementary feeding during pre-mating, late pregnancy and post-lambing period on ewe productive and reproductive performance and birth and weaning weight, for Desert sheep in North Kordofan state, Sudan.

2. Methods

The present study was conducted at Foja village, Bara locality, North Kordofan State, Sudan from December 2016 to November 2017 (Longitudes 31.47˚-30.05˚ N, Latitudes 14.37˚-13.34˚E). The mean monthly temperature ranged from 31.3 C° in April to 25.8 C° in July, annual rainfall ranging between 500-800 mm, with peak rain in August [12].

The study was carried out on Eighty (80) indigenous Desert sheep during the normal breeding season (February-March). Sheep were reared on natural grazing. Ewes were ear tagged, weighed and randomly divided into four groups A, B, C and D, similar initial body weight (44.46 kg) in complete randomized design. They were randomly assigned to supplementary feeding treatments as group A (20 ewes) was supplemented with diet one, group B (20 ewes) was supplement with diet two, group C (20 ewes) was supplement with diet three and the last group D (20 ewes) as a control (Unsupplemented with any diet depend on pasture only as practice by farmers) (showed inTable1). All animals were treated with the necessary medication against endo-and ecto-parasites.

Ewes were grazed daily between 0800 am to 1800 pm on natural vegetation and in the evening they were kept indoors in enclosures. In addition to grazing (supplementary groups A, B and C), the animals were provided with concentrate mixture were offered with supplementary feeding for Four weeks during pre mating (flushing), Four weeks post mating, and at two months of late gestation (pre lambing) (Steaming-up) and three months post lambing. Supplementation was offered at evening with 350 grams/day/head. [13] standards were taken into account for meeting nutrient requirements. Four mature rams introduced to experimental groups ewes. The body weights of mating animals were recorded at mating, pre lambing, post lambing and weaning. The recorded data on different fertility traits, weight at conception, lambing and weaning (kg), conception, lambing rate (%), abortion and mortality rate(%) and litter size (number) of sheep were analyzed following complete randomizes design (CRD) using the Proc GLM of Social Sciences, software package [14]. Duncan's Multiple Range Tests (DMRT) was also used to test significance differences among means; analysis of covariance was carried out.

Table 1. Ingredients of the experimental feed stuffs

Components (%)	Ration 1	Ration 2	Ration 3
Sorghum grains	40	35	30
Groundnut Cake	35	30	25
Groundnut Hulls	20	30	40
Shells	4	4	4
lick salt	0.25	0.25	0.25
Common salt	0.75	0.75	0.75
Chemical composition of the experimental feed stuffs			
DM%	96.38	97.16	82.84
CP %	27.5	18.6	16.86
CF%	23.33	34.10	36.07
EE %	7.49	9.89	7.76
NFE %	33.05	30.41	30.58
Ash%	8.63	7.84	8.73
ME(MJ/ Kg DM)	11.42	11.26	10.51

The metabolizable energy values were calculated from chemical composition according to [15]. ME (MJ/Kg/DM) = 0.012CP + 0.031EE + 0.005CF+0.014NEF

3. Results

3.1 Effect of feeding and parity on subsequent body weight changes

The results pertaining to the effect of nutrition and parity order on body weight pre- and post mating and pre- lambing (plotted in Table 2). The data revealed significant ($P < 0.05$) effect of steaming up and supplementary feeding on body weight at mating and before lambing. Body weight improved significantly ($P < 0.05$) for supplemented groups compared with control one. Ewes in group A showed higher ($P < 0.05$) weight compared with other, whereas weight was 49.58 ± 1.30, 50.40 ± 1.40 and 47.28 ± 1.25 kg for body weight at mating, pre and post lambing respectively. Group D showed lowered mating weight 45.85 ± 1.37 kg, before lambing 46.59 ± 1.49 kg and post lambing 44.53 ± 1.40 kg. Feed that offered to ewes has positive effect ($P < 0.05$) on body weight at weaning, Ewes in the supplemented groups showed higher weaning weight compared with control ewes, whereas 45.70 ± 1.16 , 43.33 ± 1.16 and 41.73 ± 1.16 kg for group A, B and C respectively compared with 40.70 ± 1.34 kg for group D. The supplementary feed has significant effect ($P < 0.05$) on ewes weight change, as weight post lambing, where group A recorded better body weight change 3.12 ± 0.13 kg, this significantly ($P < 0.05$) affect body weight change at weaning time, whereas less lost weight-1.58 ± 0.15 kg. Group B obtained 2.83 ± 0.13 kg and 2.03 ± 0.15 kg change in weight post lambing and weight lost at weanining time. Control group was less weight changed post lambing 2.06 ± 0.14kg and higher weight lost at weaning.

The analysis of variance of parity showed higher significant ($P < 0.05$) effect on ewe's body weight at mating, pre and post lambing, where weight was improved at mating and before lambing with increase of parity order (showed in Table 2). Ewes in 3rd parities have superior to 2nd and primiparous parities. A primiparous ewe has recorded less weight than weight increased in 2nd and 3rd parities. Body weight at mating was 55.75 ± 0.75 kg, 47.14 ± 0.41 kg and 41.41 ± 0.57 kg for 3rd, 2nd and 1st parities ewes respectively. Weight pre- mating was 58.25 ± 0.82kg, 47.92 ± 0.44 kg and 41.98 ± 0.59 kg for 3rd, 2nd and 1st parities ewes respectively. Parity order showed significant ($P < 0.05$) effect on weight at weaning time. High weight obtained by 3rd parity 51.29 ± 0.74 kg and less weight by primiparous parities 37.57 ± 0.5 kg. Also parity order has significant ($P < 0.05$) effect on body weight change post lambing and weaning time, where 3rd parities had higher body weight change 3.29 ± 0.17 kg biggest weight lost at weaning-3.71 ± 0.21kg. Less body weight change post lambing was in primiparous ewes 2.09 ± 0.12 kg and negative lower weight lost at weaning -2.34 ± 0.15 kg. Ewes with 2nd parities had recorded medium weight change post lambing 2.71±0.09 Kg and 2.94±0.11 Kg as weight loses Table (2).

Table 2. Effect of feeding, parity and birth type on body weight and body changes at calving and weaning

		Variables					
Animal Group	No. of ewes	Body wt at mating	Body wt pre-lambing	Body wt post-lambing	Body wt at weaning	Body wt change after lambing	Body wt change after weaning
A	20	49.58 ± 1.30[a]	50.40 ± 1.34[a]	47.28 ± 1.25[a]	45.70 ± 1.16 [a]	3.12 ± 0.13[a]	-1.58 ± 0.15 [c]
B	20	47.45 ± 1.30[b]	48.15 ± 1.34[b]	45.35 ± 1.25[b]	43.33 ± 1.16 [b]	2.83 ± 0.13[a]	-2.03 ± 0.15 [b]
C	20	46.18 ± 1.30[b]	46.63 ± 1.34[c]	44.33 ± 1.25[c]	41.73 ± 1.16 [c]	2.33 ± 0.13[b]	-2.58 ± 0.15 [ab]
D	20	45.85 ± 1.37[c]	46.59 ± 1.49[c]	44.53 ± 1.40[c]	40.70 ± 1.34 [c]	2.06 ± 0.14[b]	-3.83 ± 0.17 [a]
Parity order							
primiparous	24	41.41 ± 0.57 [c]	41.98 ± 0.59 [c]	39.91± 0.55[c]	37.57 ± 0.55 [c]	2.09 ± 0.12[a]	-2.34 ± 0.15[a]
2nd parity	44	47.14 ± 0.41[b]	47.92 ± 0.44[b]	45.21 ± 0.41[b]	42.23 ± 0.40 [b]	2.71 ± 0.09[b]	-2.94 ± 0.11[b]
3rd parity	12	57.50 ± 0.78[a]	58.25 ± 0.82[a]	55.00 ± 0.76[a]	51.29 ± 0.74 [a]	3.29 ± 0.17[ac]	-3.71 ± 0.21[c]
	80	47.08± 2.49	47.75± 2.54	45.15± 2.40	42.31± 2.29	2.61± 0.28	-2.89± 0.27

[ABC] Values in same column with different superscripts differ at P<0.05

3.2 Effect of supplementation strategies and parity order on reproductive traits

The data concerning the effect of supplementation and parity order on some reproductive traits of the experimental animals (demonstrated in Table 3). The data indicated significant (P<0.05) effects of supplementation and steaming up on reproductive traits. The conception rate among the four groups was 100 for A, B and D groups and 90% for control group D. The lambing rate attained 100% in the two groups (A and B). Group (D) showed lower conception and lambing rate compared with supplemented groups (A, B and C). High abortion rate was observed in group D than group C. No abortion and mortality rate was noticed in group A and B. Supplementation and steaming up significantly affected mortality rate, where high rates was scored by group D.

Reproductive traits was also affected by parity order, Conception increase with advance of parity number, where conception and lambing rate was very high (P<0.05) in ewes with 3rd parities and lower in 2nd and primiparous parities. Increase of parity order decline of abortion and mortality rate. Where abortion and mortality rate was higher (P<0.05) in primiparous parities they were 4.35% and 4.17% respectively and were none in ewes with 3rd parities.

Table 3. Effect of supplementation and parity order on ewes reproductive traits

Animal Group	**No. of serviced ewes**	**Conception rate (%)**	**Lambing rate (%)**	**Abortion rate (%)**	**Mortality rate (%)**
A	20	100	100	-	-
B	20	100	100	-	-
C	20	100	95	5	-
D	18	90	88.89	5.56	10
Parity order					
primiparous	24	95.83	95.65	***4.35***	***4.17***
2nd parity	44	***95.45***	95.35	***2.38***	***2.27***
3rd parity	12	100	100	0	0
Overall mean	78	97.5	95.97	2.56	2.50

3.3 Effect of supplementation strategies and parity order on litter size

The data pertaining to the effect of dietary energy level on litter size (presented in Table 4). Data showed that steaming up and supplementation feeding improves body condition and reproductive traits compared with control group. Feeding of supplementary and steaming up rations secured significant (P<0.05) effect on ewes litter size. The biggest litter size was secured by the group A (1.35) followed by the group B (1.20), group C (1.11) and the lowest (1.00) rec-

orded by the group D. Also parity order has significant (P<0.05) effect on litter size. Litter size increase with increase of parity number, where high litter size recorded by ewes born three times (1.50) than ewes born twice (1.17) and finally lower litter size observed in primiparous ewes with (1.00).

Table 4. Effect of supplementation and parity order on litter size

Animal groups	No. of lambs	Litter size
A	27	1.35±0.09[a]
B	24	1.20±0.07[b]
C	21	1.11±0.08[c]
D	16	1.00±0.11[c]
Parity order		
primiparous	22	1.00±0.08[b]
2nd parity	48	1.17±0.06[b]
3rd parity	18	1.50±0.11[a]
Overall mean ±SE	88	1.17±0.09

[abc] Values in the same column with different letters are significant at P<0.05

4. Discussion

4.1 Effect of feeding and parity on subsequent body weight changes

The objective the current study was to investigate the increasing levels of concentrate supplementation and steaming up during pre and post-mating period and pre and post lambing period on body weight around lambing and its impact on post lambing on productive and reproductive performance of desert ewes. In this study live weight of pregnant ewes during gestation was affected by the amount of available energy for foetal growth. Therefore, changes in the weight of gravid ewes can be used to monitor foetal development. Supplementation and steaming up with concentrate that given to desert ewes had improved the weight of the animals at mating, post lambing and weaning time, this increase in weight in supplemented and steaming up ewes had positive effect on weight change at lambing and post lambing, where those ewes were less weight lost during lactation and lambs suckling when body at negative energy balance. These results were in line with [1-16] and [17] who confirmed that a diet with 45% concentration supplementation significantly improves the weight and performance of Tibetan sheep. [18-19] stated that flushing and steaming-up affected ewe weight at lambing ($p < 0.05$) and reproductive performance, his results were noticed in this study. [20-21] demonstrated that the inadequacy of nutrients supply during late pregnancy period is clearly reflected in the apparent body weight losses and increased abortions and mortalities.

Also results from this study were similar to that obtained with [22] 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. Similarly [10, 11, 23], they stated that increasing the pre mating weight and age of ewes could increase the pregnancy rate and multiple births. Also [24], reported that supplemented group of sheep gained significantly higher body weight than that of control. Improve weight of supplemented groups may be due to that supplementation of pregnant ewes during late two months of gestation may provide adequate energy and protein to insure good body weight during lambing, since grazing alone low sheep performance mainly attributed to the decrement in herbage supply (both in quantity and quality). Ewes on the high supplementation and steaming-up ration gained more weight than those on control groups. Author [25] demonstrated that protein supplementation to ewes grazing low quality pasture improved their body weight, body condition score and reproductive performance. Contrast to these results [26-27] reported that concentrate supplementation did not influence body condition score and weight. Generally balanced feeding promoted better growth rate when comparing to traditional way of feeding applied by farmers. This may be attributed to the reduced nutritive requirements provided by farmers. Local feeding management did not meet the sheep requirement from crude protein and metabolizable energy.

Parity order effect significantly body weight at service, lambing and post lambing. Ewes with parity three where heavier during all period of gestation than ewes with parity one and two, this may be that older ewes had complete their body so they less weight loses, the current findings are similar to [9-28] they stated that there were positive change in body weight for ewes that lambing more than one times, also there were less weight lost after lambing and weaning. [29] reported that primiparous ewes had a lower body weight during gestation compared with multiparous which affects

ewe's fertility. Contrast to these results [30] reported a greater effect of ewe live weight on reproductive performance in younger ewes than older ewes.

4.2 Effect of supplementation strategies and parity order on reproductive traits

Flushing is understood as the rapid increase in ovulation rate of ewes receiving a nutrient supplementation before mating. In this study nutrition (steaming up and supplementation) had improved ewes reproductive traits, where higher conception and lambing rate were notice in supplemented groups, these results agreed with [19-31] who reported that the highest lambing rates were in ewes that had been both flushed and steamed-up. Flushing and steaming-up had increased prolificacy as observed for Sudanese desert sheep by [32-33].

Also similar results were obtained by [7-34] that the conception rate of ewes was significantly higher in the treated group than the control and he concluded that nutritional supplements had a positive impact on reproductive performance. [35] stated that nutrient deficiency potentially acts on the reproductive process and affects estrus behavior and ovulation rate. [19-36] reported differences in nutrition probably account for most of the variation in reproductive performance. Also [31] stated that the strategic supplementary feeding of ewes increased lambing rates of ewes, agreed with [37] that poor nutrition leads to reduce conception and lambing rates.

Abortion rate for ewes steaming-up and flushing was very low and high for unsupplemented ewes, this result is agreed with [38-39] and [32] who found that supplementary feeding had resulted in a 21.0% decrease in abortion rate. Also [31] stated that the strategic supplementary feeding of ewes reduced abortion and mortality of ewes, agreed with [37] that poor nutrition leads to increase embryonic loss. [40] found lowered abortion rates in supplemented group compared with none supplemented ewes that recorded highest abortion rate (15%). Mortality was lower in steamed-up ewes than in the other unsteamed-up groups. Many researchers confirm that poor nutrition leads to reduced conception, embryonic losses, reduced lambing rates and high ewe mortality [19, 41, 42]. Generally the effects of pregnancy stress on ewes due to inadequate nutrients supply are manifested in increased abortions, weight loss and mortality.

Parity order affected significantly the reproductive parameters, old ewes positively showed higher conception and lambing rate, this finding was similar to the other researcher results [10, 11, 22, 23, 43, 44] and [34] demonstrated that they increasing the age of ewes could increase the pregnancy rate and multiple births, also [26] reported that ewe age significantly affected both the pregnancy and lambing rates, primiparous ewes had a higher lambing rate (72.0%) than that (44.2%) of multiparous ewes, and he concluded that old aged ewes had a less conception rate than 1 to 2 years aged ewes. Also [43] reported that the fertility rate was lower in 1.5-year-old ewes than in older ewes. Same results were obtained by [45] reported that decreasing reproductive performance after approximately five parities can be explained by an increase in twinning rate and conception rate with age.

It noticed that in this work that abortion and mortality rate tend to decrease with increase of parity order of ewes, these findings agreed with [46-47] and [48] who reported that ewes' parity significantly affected the mortality rate in lambs, the trend observed was a decrease in mortality rate from the first to the third ewes' parity, and he concluded that the decrease in mortality rate with the increase in ewes' parity indicates that good mothering ability of older ewes compared with maiden ewes. This general picture agrees with described findings of [47] he stated that the decrease in mortality rate with the increase in ewes' parity indicates that good mothering ability of older ewes compared with maiden ewes. Also high mortality rates were reported for lambs born to 2-year-old ewes by [49] and [50-51] they demonstrated that the greater incidence of lambing mortality in younger ewes (i.e. first parity ewes) relative to older ewes corroborates previous studies in sheep.

On the other hand [52] reported that mortality increased with parity. This difference in abortion and mortality rate observed here compared with other studies might be attributed to different farm management programs, farm management and particularly feeding programs, have a major effect on certain parameters including survival and mortality rate. [43] reported that lower survival rates for lambs from the youngest ewes could be explained by weaker prenatal nutrition due to young ewes being smaller and/or still developing in addition to providing poorer postnatal maternal care that may lead to hypothermia. This difference in mortality rate with other studies mentioned here might be attributed to different farm management programs, farm management and particularly feeding programs.

4.3 Effect of supplementation strategies and parity order on litter size

The average litter size reported in this study was 1.17±0.09, similar result were obtained by [47] for local sheep crosses with Dorper, and higher than finding of [53] (1.04). Litter size here was lower than what reported by [54] (1.21), [55], [47] for Washera sheep (1.19).

The of plane of nutrition (steaming up plus supplementation) and good body weight in this study had improve litter size, supplementation to ewes grazing low quality pasture improved their litter size compared with un supplemented group, same trends were obtained by [10-39] whom reported that the level of nutrition has effect on litter size in that, poor nutrition during service period lead to reduced ovulation rates hence number of fetus in uterine and increase em-

bryonic mortality and consequently decrease litter size. Also agreed with [23] he reported that offspring number and sheep efficiency were affected by the increase in the ewe live weight. [30] reported a greater effect of ewe live weight on reproductive performance in younger ewes than older ewes. Also [43-56], who showed that litter size was more in the protein supplement group than the control group (no supplements of protein). Increasing the pre mating weight ewes could increase the pregnancy rate and multiple births [10, 11, 39]. [57] demonstrated that litter size increased significantly with increased live weight at mating due to increase nutrition during late gestation. Also agreed with [58] he demonstrated that increase in reproductive rate in supplemented ewes was due to increases in both conception rate and fecundity, with a higher proportion of pregnant ewes, and a higher proportion of multiple pregnancies, in the supplemented groups. Contrast to these results [34] reported that the number of fetuses per ewe pregnant was not influenced by level of nutrition. Results in this study showed that ewes depend on natural grazing alone scored lower litter size, similar result obtained by [59] who stated explained lower litter size in terms of the scarcity and low quality of the forage in the tropical rangelands, which are subject to uncertain seasonal rainfall patterns, and where supplemental feed is also scarce and economically unfeasible.

Parity of ewes had showed significant difference in litter size that higher parity ewes gave higher litter than lower parity ones. This results was agrees with findings of [33, 39, 59] and [60] reported that performance of primiparous ewes showing the lowest values by young and primiparous ewes and increased with advances in parity. [61] reported that the multiparous ewes showed a higher body weight (46.32 vs. 38.71 kg) and larger litter size (1.45 vs. 1.06 kg) than the primiparous ewes. According to [60], average litter size increased from 1.27 to 1.53 from the first to the fifth lambing in Blackbelly sheep. [54] demonstrated that the highest litter size was recorded at the fifth parity (1.35+0.07) and the lowest litter size was recorded at first parity (1.04+0.04) and concluded that there was a general tendency that litter size increased with an increase in parity up to fifth parity and dropped at the six and more parities. These results disagreed with [45] he reported that the reproductive efficiency of ewes from six years old onwards may tend to decrease.

5. Conclusion

Flushing, steaming-up and parity order of Sudanese Desert ewes during breeding period improved the reproductive performance of the ewes, with high conception and lambing rates. It would, therefore, be strategically to provide the grazing nomadic desert sheep herds with adequate feeds for reproduction during the mating periods, as well as for generating sufficient body reserves for meeting production and reproduction requirements during the dry season. This would require provision of feed supplements in attempt to balance the seasonal nutritional inadequacies of the natural pasture. It is recommended that, Supplementation during mating and late pregnancy should be undertaking using groundnut seed cake, groundnut hulls or other relevant local ingredients.

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