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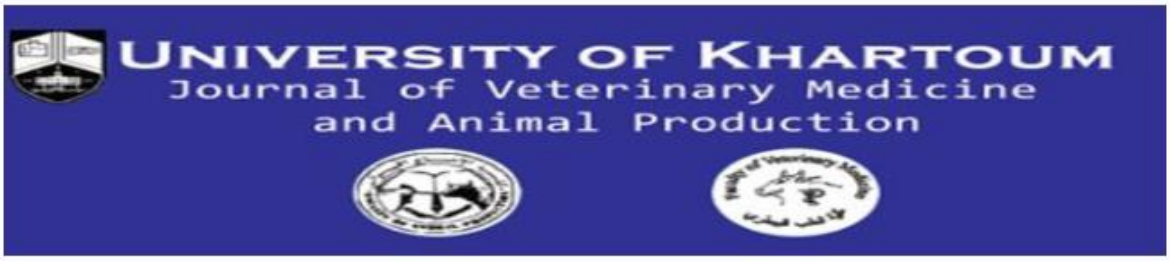

Effect of Different Management Patterns on Sheep under Range Conditions in North Kordofan State, Sudan: 1 Ewes Reproductive Performances and Lamb Growth

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Abstract

This study was conducted to evaluate effects of modifying the traditional grazing practices on desert ewes reproductive performance and lamb growth in North Kordofan State, Sudan. Eighty ewes were divided into four groups with similar weight and age, and assigned randomly to four differed in management patterns. The groups were: GDW5 group (control) managed to emulate the traditional local practice; where the animals were grazed in morning and evening periods, kept under trees' shade at noon and watered every 5 days. GNW3 group, animals were grazed in the nighttime kept under shade in the daytime and had watered every 3 days. GNW1 group, animals were grazed in the nighttime, kept under shade in the daytime and water access every 1 day. (GNW1+S) group, animals were grazed in the nighttime; kept under shade in the daytime, watered every day, and supplemented with concentrated. During the breeding season, all ewes were allowed to mate with rams. Lambs born were weaned after 4 months. Then raised for 2 months, during which lambs of each group was managed similar to their dams. The results showed that pregnancy and lambing rates were 85% in GDW5 group (traditional management), increased significantly to 95% in GNW3 group, and to 100% in GNW1 and GNW1+S groups. The litter size also increased from 1.0 in GDW5 group to 1.10, 1.05 and 1.45 for GNW3, GNW1 and GNW1+S groups, respectively with significant differences among the different groups. Lamb loss percentage was 25% in GDW5 group and decreased significantly to 5% in GNW3 and GNW1 groups, and to 0 % in GNW1+S group. Birth, weaning, and final weights were significantly affected by management pattern. GNW3, GNW1 and GNW1+S groups had 30.5%, 39.1%, and 73.9%, respectively heavier birth weight than the control group. The weaning weight increased by 28.9%, 34.4%, and 43.6 % in GNW3, GNW1 and GNW1+S respectively, compared to that of the control group. Whereas, the increment in final weight was 21.1%, 25.7%, and 30.0% for GNW3, GNW1 and GNW1+S respectively, compared to control group. In conclusion, sheep night grazing with water access within short intervals improved reproductive performance, decreased lamb's

mortality rate and increased birth and weaning weights. Night grazing and daily watering sheep plus supplementation had dramatically effects in increasing in the number of litter size, birth and weaning weights and reduced mortality rate. Lambs after weaning can maintain good growth performance without supplementation when a high-quality pasture was available.

Key words: Sheep, Grazing time, Water, Supplementation. Reproductive, Lambs, Performance

المستخلص

جريت الدراسة لتقييم آثار تعديل ممارسات الرعي التقليدية في ولاية شمال كردفان بالسودان على تكاثر النعاج وأداء الحملان لأغنام الصحراء السودانية. تم تقسيم ثمانين نعجة إلى أربع مجموعات ذات وزن وعمر متشابهين ، وقسمت عشوائياً في أربع مجموعات معالجة اختلفت في وقت الرعي ، الوصول إلى المياه أو مكملات العلف. كانت المجموعات: مجموعة GDW5 (مجموعة التحكم) تمت إدارتها لتقليد الممارسات المحلية التقليدية. حيث كان يتم رعي الحيوانات في فترات الصباح والمساء ، ويتم الاحتفاظ بها تحت ظلال الأشجار عند الظهر وتسقي كل 5 أيام. مجموعة GNW3 كانت ترعي في الليل ، و ايقائها في ظل الاشجار نهارًا وتسقى كل 3 أيام. المجموعة GNW1 كان يتم رعي حيوانات في الليل وإبقائها في الظل نهارًا ، و تخصل على المياه يوماً. المجموعة (GNW1 + S) كان يتم رعي حيوانات في الليل و تبقى تحت الظل في النهار ، تسقى كل يوم و أُعطيت مركزات علفية. خلال موسم التكاثر. تم السماح لجميع النعاج بالتزاوج مع الكباش. تم فطام الحملان بعد 4 أشهر. تمت رعايتها لمدة شهرين بعد الفطام تم خلالها معاملة حملان كل مجموعة على نمط أمهاتهم. أظهرت النتائج أن معدلات الحمل والولادة كانت 85٪ في مجموعة GDW5 (التحكم) ، وزادت معنوياً إلى 95٪ في مجموعة GNW3 ، وإلى 100٪ في مجموعة GNW1 و GNW1 + S. زاد حجم المواليد من البطن الواحدة من 1.0 في مجموعة GDW5 إلى 1.10 و 1.05 و 1.45 لمجموعات GNW3 و GNW1 و GNW1 + S على التوالي مع وجود فروق معنوية بين المجموعات المختلفة. كانت نسبة خسارة الحمل 25٪ في مجموعة GDW5 وإنخفضت معنوياً إلى 5٪ في مجموعة GNW3 و GNW1 ، وإلى 0٪ في مجموعة GNW1 + S. تأثرت أوزان الميلاد والفطام والأوزان النهائية معنويا بنمط الرعاية. كان لدى مجموعات GNW3 و GNW1 و GNW1 + S 30.5٪ و 39.1٪ و 73.9٪ على التوالي وزن ولادة أثقل من المجموعة الضابطة. زاد وزن الفطام بنسبة 28.9٪ و 34.4٪ و 43.6٪ في GNW3 و GNW1 و GNW1 + S على التوالي ، مقارنة مع المجموعة الضابطة. بينما كانت الزيادة في الوزن النهائي 21.1٪ و 25.7٪ و 30.0٪ لـ GNW3 و GNW1 و GNW1 + S على التوالي ، مقارنة بمجموعة التحكم. يُستنتج من هذا أن رعي الأغنام الليلي مع الوصول إلى المياه على فترات قصيرة أدى إلى تحسين الأداء الإنجابي ، وخفض معدل وفيات الحملان وزيادة أوزان الولادة والفطام. كان للرعي الليلي وسقي الأغنام يوميًا بالإضافة إلى المكملات العلفية آثار كبيرة في زيادة عدد المواليد وأوزان الولادة والفطام وانخفاض معدل الوفيات. يمكن للحملان بعد الفطام أن تحافظ على أداء نمو جيد بدون مكملات علفية عندما يتوفر مرعى عالي الجودة.

الكلمات المفتاحية: الضأن، زمن الرعي، الماء، مكملات، تناسل، حملان، اداء.

Introduction

Sheep population in Sudan is estimated to be 40 million sheep. More than 15 million heads of sheep are slaughtered annually for local consumption and export (MARF., 2017). Desert sheep type represents about 85% of total sheep in Sudan (Sulieman *et al*., 1990). Kordofan area is the main source of sheep for export (El-Hag *et al*., 2001). Semi-arid area of North Kordofan State is the homeland of Hammari and Kabashi Desert sheep ecotypes, where about 9 million heads are found (MARF., 2017). Traditional natural grazing is the main production system in Sudan and the main source of sheep exports. In traditional grazing practice, sheep flocks graze in morning and evening periods and kept under trees shade around camps at noon to rest and nurse lambs, which are separated from ewes in the early morning. Sheep watering frequency is 3-5 days during the dry season (Idris *et al*., 2010). The breeding season is controlled to be in February and March so that lambing time

is during the rainy season (July – September) when plentiful good-quality forage is available. During the dry season (November– June), animals are expose to a series of environmental stresses, mainly inadequate feed and lack of drinking water (El-Hag *et al*., 1998). The scarcities of feed and water and high ambient temperature have negative effects on the reproduction and production of the sheep in this area (El-Hag *et al*., 2001). The traditional grazing practice in this condition results in a poor productivity and readiness lambs for local and export markets. This study was conducted to evaluate effects of modifying of the traditional grazing pattern, in terms of grazing time, water access or feed supplementation on ewes' reproductive and lamb's performance of desert sheep.

Materials and methods

Study area

This study was conducted in Mahgour village, located in latitudes 11° 5′ - 13° 75′ N and longitudes 27°-29° 5′ E, in ELNuhoud, locality, North Kordofan state, Sudan. The rainy season in the area extends from July to September with a peak in August. Average annual rainfall is 300 mm in the north and about 400 mm in the south parts. The temperature ranges from 42° C (April - July) to 14° C (December - January) (ELNuhoud Meteorological Station2017). The grasses are mostly annual, including, *Dactylcotenium aegyptium*, *Cechrus biflorus*, *Echinochloa colonum, Eragrostis aspera,*and *Andropogon gayanus*.

Experimental animals

A total of 80 ewes, 2 to 3 years-old Sudan Desert sheep Hammari ecotype with live weight range from 35 to 40 kg, were used in this study. The animals were dewormed (Bimectin injection 10%), vaccinated against the endemic diseases in the study area (Sheep pox, hemorrhagic septicemia and anthrax), identified with numbered ear tags, and subjected to an adaptation period of two weeks before the trial. During the breeding season (February to March), mature rams were introduced to the experimental ewes at the ratio of 1 ram: 20 ewes. Born lambs were ear-tagged and left to suckle for 4 months. After weaning, lambs were dewormed (Bimectin injection 10%), vaccinated against the endemic diseases, and raised with their dams for two months.

Experimental design

Ewes were divided to four groups of similar weight and age, and assigned randomly to four treatment groups, which differed in grazing time, water access or feed supplementation. The groups were:

1. GDW5 group: control emulating traditional farmer practice; where the animals were grazed in morning and evening periods, kept under trees shade at noon and had water access every 5 days.
2. GNW3 group: animals were grazed during the night, kept under shade in the daytime and had water access every 3 days.
3. GNW1 group: animals were grazed during the nighttime, kept under shade in the daytime and had water access every 1 day.
4. GNW1+S group: animals were grazed during the nighttime, kept under shade in the daytime, had water access every 1 day, and supplemented with 1 kg concentrate ewe/day over the whole experimental period.

After weaning, lambs of each group were managed similar to their dams. In GNW1+S group, lambs were supplemented with 250 g concentrate lamb/ day (Table 1).

Data collection

The following reproductive and productivity parameters were calculated.

Fertility rate (%) = (number of ewes pregnant/number of ewes mated) x 100.
Lambing rate (%) = (number of ewes lambed per ewes mated) x 100.
Litter size = (number of lambs per lambed ewes).
Weaned rate (%) = (number of lambs weaned /number of ewes mated) x 100.
The lamb weight was taken at birth then weekly for 6 months using a spring balance.
Samples of supplemental diet fed to GNW1+S group were subjected to proximate analysis according to the standard methods (AOAC 1998). The composition and chemical analysis are presented in Table 1.

Statistical analysis

Data were subjected to one-way analysis of variance using SAS for Windows (SAS 2003). Least-square means were computed and tested for differences by Duncan multiple range test. Differences between the least squared means were considered to be significant at $p < 0.05$.
Windows.

Table 1. Ingredients and proximate analysis of the supplemented diet

Ingredients	% (AS fed)
Sorghum grain	33
Groundnut cake	20
Groundnut hulls	46
Common salt	1
Chemical composition	% on dry matter basis
Crude protein (CP)	17.99
Crude fiber (CF)	16.75
Ether extract (EE)	05.60
Nitrogen free extract (NFE)	51.64
Ash	09.28
ME(MJ/kg) calculated	11.96

*Metabolizable energy was determined according to MAFF (1979)

Results

Reproductive performance

Table 2 shows ewes' reproductive performance of the different experimental groups. Fertility and lambing rates increased significantly from 85% in GDW5 group (traditional management), to 95% in GNW3 group, and to 100% in GNW1 and GNW1+S groups. Litter size varied significantly among the treatment groups. The lowest litter size (1.00) was recorded in GDW5 group while GNW1+S group scored the highest litter size (1.45). In GNW3 and GNW1, the litter size was 1.11 and 1.05 respectively. Lamb loss percentage decreased greatly ($p< 0.05$) from 25% in GDW5 group to 5% in GNW3 and GNW1 groups, and 0 % in GNW1+S group. The difference was not significant between GNW3 and GNW1 groups. The numbers of lambs weaned in each group were 10, 19, 21, and 29 lambs for GDW5, GNW3, GNW1 and GNW1+S, respectively.

Table 2: Effects of different management patterns on ewe's reproductive performance

Parameter	Experimental Groups			
	GDW5	GNW3	GNW1	GNW1+S
Fertility rate (%)	85[c]	95[b]	100[a]	100[a]
Lambing rate (%)	85[c]	95[b]	100[a]	100[a]
Litter size	1.00[d]	1.11[b]	1.05[c]	1.45[a]
Lambs loss (%)	25[a]	5[b]	5[b]	0[c]
Weaning rates (%)	50[d]	95[c]	105[b]	145[a]

GDW5= Control, Animals were grazed in Morning and evening periods, kept under trees shade at Noon, and had water access every 5 days; GNW3= Animals were grazed in the night-time, kept under shade in the daytime and had water access every 3 days; GNW1= Animals were grazed in the night-time, kept under shade in the daytime and had water access every 1 days; GNW1+S= Animals were grazed in the night-time, kept under shade in the daytime, had water access every day, and supplemented

[a,b,c,d] Values with different superscripts within a row differ significantly at $P< 0.05$.

Growth rate of lambs

Lambs birth weight and weaning weight (at 4 months) and final weight (at 6 months) are presented in table 3 and their average daily growth rate in monthly intervals is illustrated in Figure 1. Birth, weaning, and final weights were significantly affected by management pattern. GNW3, GNW1 and GNW1+S groups had 30.5%, 39.1%, and 73.9%, respectively heavier birth weight than the control group. Weaning weight increased by 28.9%, 34.4%, and 43.6 % in GNW3, GNW1 and GNW1+S respectively, compared to that of the control group. The increment in final weight was 21.1%, 25.7%, and 30.0% for GNW3, GNW1 and GNW1+S respectively, compared to control group. The differences in weaning weight, final weight, and total gain were not significant among GNW3, GNW1 and GNW1+S groups. The pattern of daily growth rate of lambs before and after weaning was different (Figure 1). The average daily gain before weaning was 137.22, 165.59, 163.87, and 167.84 g/ day for GDW5, GNW3, GNW1 and GNW1+S groups respectively, with significant difference between control and treated groups, where after weaning was 117.50, 134.07, 113.82, 109.40 g/ day for GDW5, GNW3, GNW1 and GNW1+S groups respectively.

Discussion

The sheep breeding season and gestation periods in the study area usually occur during the dry season (November to June) when the animals are exposed to inadequacies of feed and water, and high ambient temperature. These critical conditions result in a low reproductive performance and high mortality rates (El‐Hag *et al*., 2007, El-Hag *et al*., 1998, Idris *et al*., 2010). The result of a low reproductive performance of the control group (GDW5) in our study is in accordance with those previously mentioned studies. The modifications of the traditional grazing practice, in terms of grazing time, water access or feed supplementation in GNW3, GNW1 and GNW1+S groups resulted in significant improvement in fertility, lambing rate, litter size and a decrease in lambs loss. The positive effect of night grazing and keeping animal under shade during the

daytime in improvement of reproductive performance can be attributed to the effect of these treatments in reduction heat stress on animals. It is well known that heat stress has a negative effect on feed intake and animal performance (Mufarrih, 1991; Dixon *et a*l., 1999; Bayer *et al*., 1987).

Table 3: Effects of different management patterns on birth weight and growth performance of lambs

Parameter	Experimental Groups			
	GDW5	GNW3	GNW1	GNW1+S
No. of lambs	10	19	21	29
Birth weight (kg)	2.30± 0.29^{c}	3.00± 0.28 ^{b}	3.20±0.26 ^{b}	4.00± 0.19^{a}
Weaning weight (kg)	19.50± 1.17^{b}	25.00± 1.19 ^{a}	26.20± 1.97^{a}	28.00± 0.79^{a}
Final weight (kg)	25.70± 1.08^{b}	31.30± 1.12 ^{a}	32.30± 1.02^{a}	33.40± 0.74^{a}
Total weight gain(kg)	23.40± 1.25^{b}	28.30± 1.16 ^{a}	29.10± 1.52^{a}	29.40± 0.77^{a}

GDW5= Control, Animals were grazed in Morning and evening periods, kept under trees shade at Noon, and had water access every 5 days; GNW3= Animals were grazed in the night-time, kept under shade in the daytime and had water access every 3 days; GNW1= Animals were grazed in the night-time, kept under shade in the daytime and had water access every 1 days; GNW1+S= Animals were grazed in the night-time, kept under shade in the daytime, had water access every day, and supplemented

^{a,b,c,d} Values with different superscripts within a row differ significantly at P< 0.05.

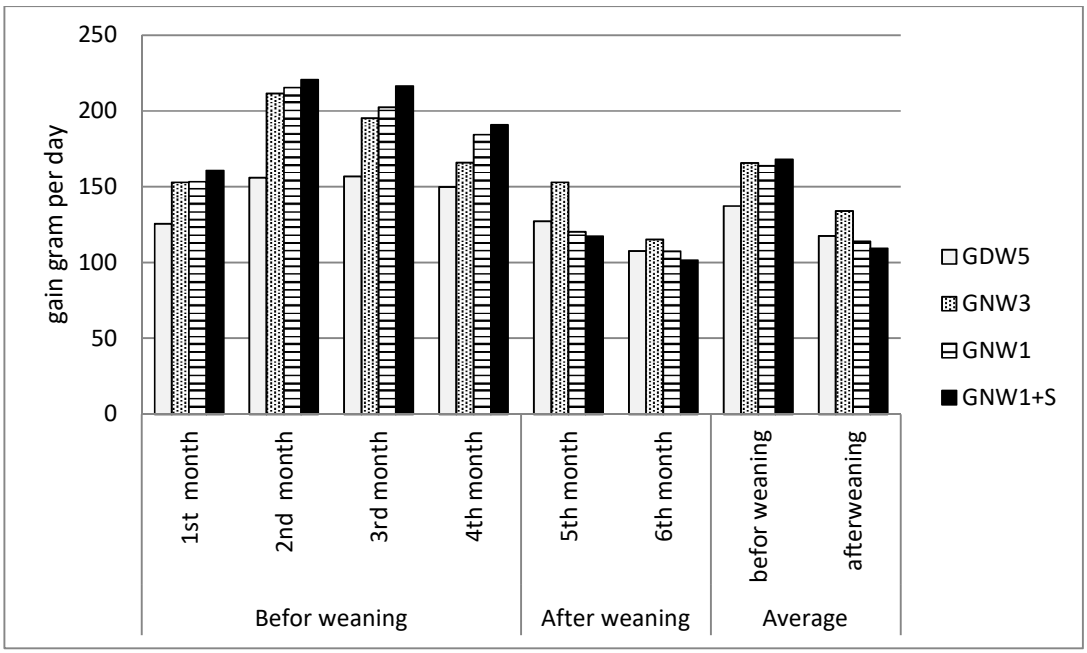

Figure 1: Daily gain of lambs of different management patterns (before and after weaning)

Heat stress was also found to have a direct effect in reducing ewes' reproductive efficiency during the first period of pregnancy (Soto *et al*., 1998) and seriously reduced the total embryo cell number and placenta size (Marai *et al*., 2007). Night grazing is an important herd management strategy to reduce heat stress (Dixon *et al*., 1999, Bayer *et al*., 1987). Use of shade during the breeding season also found to reduce heat stress and increased the overall herd pregnancy rate in a subtropical environment (Soto *et al*., 1998). In the same context, (Mufarrih, 1991) found that night grazing and keeping animals in shade during the daytime also increased litter size in desert sheep.

Reducing the period of water interval in the current study had positive effects on reproductive performance. That was clear when comparing GNW3 and GNW1 groups, which deferred only in water access time. GNW1 group, which offered water daily, had a significantly higher fertility rate, laming rate and weaning rate than GNW3 group, which had water access every 3 days. The effect of water deprivation on reproductive performance can be attributed to its effect on reducing the daily feed intake and body weight in sheep (Alamer and Al-hozab, 2004). Animals of group GNW1+S, which grazed in the nighttime, kept under shade in the daytime, had water access every day, and supplemented with concentrate diet, scored the best performance among the experimental groups. In addition to the positive effect of night grazing and daily water access in reducing the heat stress and increasing feed intake, supplementation of ewes with concentrate diet before breeding season (flushing) and during gestation (steaming-up) and suckling periods have been reported to improve productivity performance of desert sheep (El‐Hag *et al*., 2007, Idris *et al*., 2011). The highest litter size in this group, due to twins and triple lambing, can be attributed to the improvement of nutrient supply before and during breeding season. Nutritional flushing in ewes amplified FSH secretion and stimulation of folliculogenesis (Scaramuzzi *et al*., 2006).

Lamb birth and weaning weights were significantly heavier in the treated groups than the control group. The heights lamb birth and weaning weights were scored by group GNW1+S. This is due to the feed supplementation during late gestation that provided adequate energy and protein to support embryonic and fetus growth, maintenance of animal physiological needs, mammary gland growth colostrum and milk yield (Ocak *et al*., 2005).

Concentrate supplementation after weaning did not improve lambs growth rate. The difference between the control group, which showed a high growth rate, and supplemented group was not significant. The higher growth rate of the un-supplemented lambs can be due to the compensatory growth of these groups after the insufficient milk yield during weaning. Similar results were reported (Hopkins and Tulloh, 1985).

Conclusions

Night grazing of sheep with water access within short intervals increased pregnancy, lambing, and twining rates, birth and weaning weights; and decreased lamb mortality rate. Night grazing and daily watering sheep plus supplementation had dramatic effects in increasing litter size and birth weight and reduction of mortality rate. Lambs after weaning can maintain good growth performance without supplementation during the rainy season when a good pasture is available.

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