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IMPACT OF FEED SHORTAGE ON THE PERFORMANCE OF DESERT BARKI SHEEP AND GOATS UNDER ARID CONDITIONS: II. LONG FEED SHORTAGE FOR EWES AND EWE-LAMBS

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SUMMARY

The study investigates the effect of long feed shortage (LFS) on the performance of desert Barki ewes and ewe-lambs under arid conditions. The trial started January 2020 with 45 weaned Barki ewe-lambs and 30 ewes. The ewe-lambs were divided into two groups; control group (C; 15 ewe-lambs) and treatment group (T; 30 ewe-lambs). The C group were fed Alfalfa hay and concentrates up to five months of age, while the T group was fed 50% of concentrates for three months (LFS). Where they showed significant losses of 11.1% in their body weight (BW). Followed by a compensatory feeding of 125% concentrates for three months, losses in their BW reduced to only 2.4%. The effect of the LFS on the reproductive traits was limited, except for BW at the1st estrus (2.9 kg less).

For the first three months of lactation, thirty desert Barki ewes were fed individually on concentrates and Alfalfa hay. The treated ewes (T, 20) were fed on 50% concentrate as of NRC allowances (LFS). They lost 9.2 kg of their BW vs. 5.5 kg for the control (C, 10). Total milk yield over 12 weeks of lactation decreased significantly by 15%. Losses in BW increased with the advance of the FS period. Most important, losses in BW recovered fast with feed availability, reflecting the capacity of desert Barki sheep to compensate losses in their BW. A vital character which had been developed naturally by the desert animals over centuries of adaptation to arid conditions.

Keywords: Feed shortage, desert sheep, compensatory feeding, arid conditions

INTRODUCTION

Feed shortage (FS) is a common feature under arid conditions; it is considered one of the main constraints for animal production in the arid and semi-arid regions. Animals always suffer frequent incidence of long feed shortage (LFS), as a result of the drought and overgrazing. El-Shafie *et al.* (2024) stated that feed shortage is the main constraint for improving animal production in the arid area. Animals raised at the Coastal Zone of Western Desert (CZWD) of Egypt are facing 3-5 months of feed shortage in summer, depending on the rain fall (Galal *et al.*, 1996, and Shalaby, 1999). Improving nutritional status of the desert sheep and goat in the CZWD at the dry season increases their productivity by 27% (El Shaer, 2004).

El Shafie *et al.* (2024) reported significant effect of both short FS (for one week) and medium FS (for one month) periods on the performance of Barki sheep and goats, animals recovered shortly with feed availability. The impact of prolonged FS periods on the animal performance needs further investigation. The present study investigated the effect of long feed shortage (LFS) on the performance of desert Barki ewes and ewe-lambs, and how they cope with it under the arid conditions of CZWD of Egypt.

MATERIALS AND METHODS

The study was carried out at Borg El-Arab Research Farm, of Animal Production Research Institute located at the CZWD; within the activity of "Adapt- Herd", a EU-PRIMA Collaborative Project between France, Spain, Tunisia, and Egypt. The studied arid area stretches over 525 km on the Mediterranean Sea, west of Alexandria, at latitudes 21º and 31º north and longitudes 25º degrees and 35ºeast. The present study consisted of two trials, the first concerned Barki ewe-lambs, whereas the second involved lactating Barki ewes.

***Ewe -lambs trial*:**

The trial started January 2020, with 45 weaned Barki ewe- lambs (two months of age), weighing on average 19.5±0.73 kg. The ewe-lambs were divided into two groups: 15 control (C) and 30 treated (T).

The two groups were subjected to group feeding (according to their BW) on Alfalfa hay and concentrate feed mixture (CFM), of 14% CP and 65% TDN, according to the NRC (2007) allowances, for three months. The T ewe-lambs were fed 50% concentrate of their feed requirement for three months (long feed shortage, LFS), followed by three

months compensatory feeding (125% concentrate allowances), simulating the breeders practice at the incidence of drought. The ewe-lambs return to normal feeding till lambing (Tables1 and 2). Diets were offered twice a day at eight am and three pm; water and mineral blocks were freely available.

Animals were weighed weekly, and daily feed intake was calculated. Ewe-lambs were subjected to estrus detection at six months of age for attaining puberty. They joined fertile rams at 12 months of age. Conception rate, twinning rate, still birth and kg born were estimated.

Table 1. Feeding protocol for the treated (T) ewe-lambs during the whole experimental period

Month	1	2	3	4	5	6	7	8	9	10	11	12
Feeding regime	Suckling		Normal feeding (Alfalfa hay + 100% conc.)			Long feed shortage (Alfalfa hay+ 50% conc.)			Compensatory feeding (Alfalfa hay + 125% conc.)			Normal feeding (Alfalfa hay + 100% conc.)

conc.: concentrates

Table 2. Dry matter intake (DMI) of control(C) and treated (T) ewe-lambs during the different feeding periods

Feeding regime	Days	Daily DMI (kg)		Total DMI (kg)	
		C	T	C	T
Normal feeding	82	0.623	0.623	51.1	51.1
Longfeed shortage	91	1.056	0.726	96.1	66.1
Compensatory feeding	92	1.056	1.221	97.2	112.3
Normal feeding	31	1.056	1.06	32.7	32.7
Total DMI during LFS				277.1	262.2

Mature ewes' trial:

Thirty desert Barki mature ewes (in their second week of lactation, 54.7±2.4 kg average body weight) were distributed according to their age and parity in two groups: control (C, 10 ewes) and treated (T, 20 ewes). Experimental work started March, 2022. Ewes were fed individually on concentrate feed mixture and Alfalfa hay (14% CP and 65% TDN) according to NRC (2007) allowances. The treated ewes (T) were fed 50% concentrate +Alfalfa hay for three months (LFS), after which they return to normal feeding. Water and mineral blocks were available freely for the animals all the time. Milk yield was measured on a fixed day every week using oxytocin injection plus hand milking method (Ünal *et al.*, 2007). Traits measured were weekly changes in body weight (BW), daily milk yield (DMY) till the end of lactation (12 weeks), and dry matter intake. Milk samples were taken biweekly for composition analysis (fat, protein, and solid not fat%).

Statistical analysis:

Data of both trials were analyzed using the linear model procedure of SAS (2013)
according to the following model,

$Y_{ij} = \mu + T_i + e_{ij}$ where,

Y_{ij} is the estimated value of different variables of ewe lambs and ewes,

μ is the overall mean,

T_i is the fixed effect of i^{th} treatment, (1= control and 2= treatment); and

e_{ij} is the random error distributed by $(0, \sigma_e^2)$.

RESULTS

Ewe -lambs trial:

The two ewe-lambs' groups showed similar growth performance up to the 5th month of age, when the FS treatment (50% concentrate feed) started (Table 3 and Fig 1). At the 8th month (end of FS) the T ewe-lambs had 11.1% lower ($P<0.05$) BW than that of the C group, with half the growth rate of the C group. The compensatory feeding (125% concentrate feeds) significantly diminished the differences in BW to only 2.4% at yearling, and the differences between the two groups became statistically insignificant.

These reflect the capacity of DBS to compensate for losses in their BW after LFS in response to compensatory feeding. Such fast compensatory weight gain is vital for the desert animals in the arid areas with the frequent incidence of FS.

Table 3. Ewe- lambs body weight(kg) and average daily gain(g/d) with long feed shortage (LFS)

Items	Body weight		Average daily gain	
	C	T	C	T
Total dry matter intake/ewe-lamb (kg)	277.1	262.2		
Initial body weight at 2m. of age (kg)	19.5 ± 0.73	19.5 ± 0.5	……	……..
Weight at the 5th m. of age (normal feeding)	26.5 ± 0.7	25.8 ± 0.4	118.5 ± 5.8	107.8 ± 3.1
Weight at the 8th m. of age (end of feed shortage)	36.8^{a} ± 0.7	32.7^{b} ± 0.4	101.1^{a} ± 6.0	55.9^{b} ± 1.7
Weight at 11th m. of age (end of compensatory feeding)	43.4^{a} ± 0.7	40.5^{b} ± 0.4	62.6^{a} ± 3.9	102.6^{b} ± 3.2
Weight at 12th m. (at 1Stmating)	46.1 ± 1.3	45.0 ± 0.7	40.0 ± 6.7	48.9 ± 3.5

[a, b] Within each trait, means with different superscripts differ significantly at 1% probability.

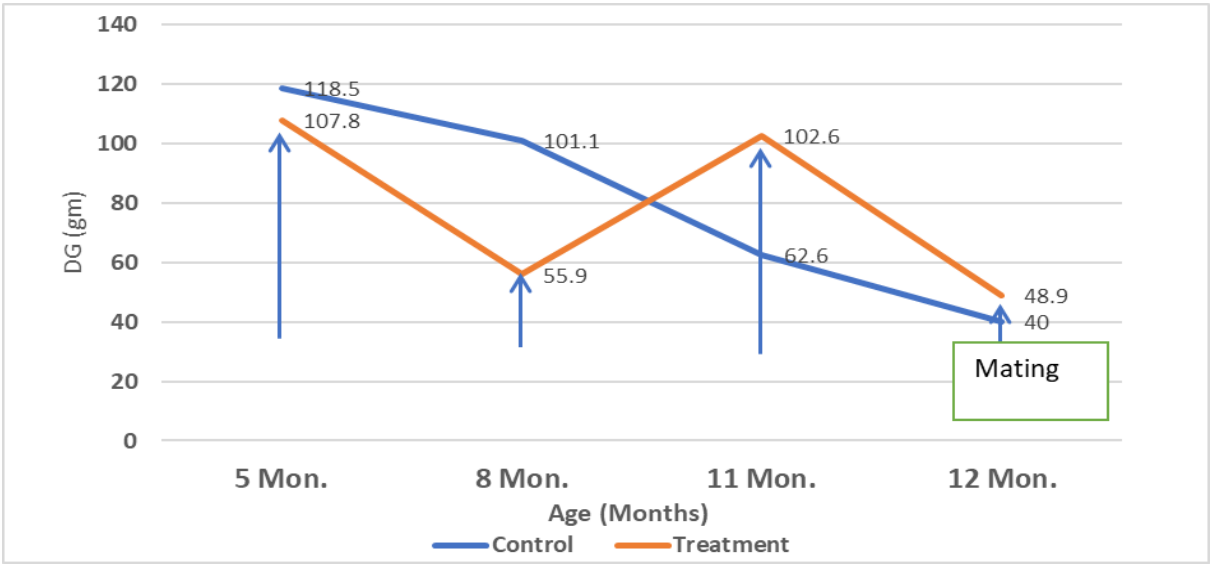

Fig. 1. Average daily gain (ADG, g/d) during different feeding periods.

Differences in the reproductive performance; age at the 1st estrus, age at the 1st mating, age and weight at the 1st lambing were insignificant between the T and the C ewe-lambs (Table 4). However, the T group attained puberty at significantly lower BW (-2.9 kg). Differences in BW reduced to 1.1 kg at the 1st mating and diminished at the1stlambing.

Table 4. Reproductive performance of Barki ewe- lambs during the experimental period

Items	Control	Treatment
Age at 1st estrous (days)	290.9* ± 6.81	303.8 ± 5.11
Weight at 1st estrous (kg)	41.9^{a} ± 1.06	39.0^{b} ± 0.69
Age at 1st mating (days)	372.1 ± 2.81	373.8 ± 2.46
Weight at 1st mating (kg)	46.1 ± 1.32	45.0 ± 0.65
Age at 1st lambing (days)	522.4 ± 6.53	523.8 ± 2.46
Weight at 1st lambing (kg)	51.2 ± 1.49	51.1 ± 1.15
Conception rate %	93.3	93.3
Still birth %	0	3.6
Kgs. born	3.9 ± 0.14	3.7 ± 0.11

[*a, b] Means with different superscripts differ significantly at 5 % probability.

Mature Barki ewes:

Barki ewes weighed 54.7±2.4 kg on average at the beginning of the trial; BW decreased as lactation advanced, starting from the second week (peak of lactation) till the12 weeks of lactation. Losses in the ewes' BW were significantly larger in the T group than those of the C group (-9.2 kg vs. -5.50 kg) (Table 5). With the concentrates shortage in the diet of the T ewes, animals ate more roughages with low nutrient contents, which reduced DMI / kg of milk, to be 1.51 kg in the T group vs. 1.27 kg for the control group (Table 5).

Table 5. Performance of desert Barki ewes with long feed shortage

Traits	Control group	Treatment group
Initial weight (kg)	54.7 ± 2.4	54.0 ± 1.7
Losses in ewes body weight(kg)	-5.5^{a*} ± 2.55	-9.2^{b} ± 1.30
Daily milk yield during LFS (kg)	1.1 ± 0.07	1.0 ± 0.05
Total milk yield during whole lactation period (kg)	89.8^{a} ± 8.9	78.2^{b} ± 2.4
Offspring daily gain during suckling (g)	270^{a} ± 15.2	230^{b} ± 20.3
Offspring weaning weight (kg)	26.1^{a}±1.12	23.5^{b} ± 0.60
Kg DM/ Kg milk	1.51	1.27
Kg TDN/kg milk	0.96	0.81
Milk fat (%)	8.81 ± 0.22	9.05 ± 0.22
Milk protein (%)	9.84 ± 0.13	9.72 ± 0.05
Milk SNF (%)	3.76 ± 0.05	3.77± 0.06

$^{*\,a,b}$ Means with different superscripts differ significantly at 5% probability.

Feed shortage decreased daily milk yield (DMY) of Barki ewes to 1.2 kg in the 2nd week of lactation vs. 1.5 kg for the C ewes (Fig. 2). Total milk yield (TMY) decreased (P<0.05) in the T ewes to 78.2 kg vs. 89.8 kg in the C ewes. Daily milk yield of the two groups got closer to each other toward the end of lactation (520 g/d and 600 g/d, respectively, Fig. 2). Pulina et al. (2012) reported a significant decrease in milk yield of Sardi ewes with feed restriction, and they recovered completely their milk yield by the end of the feed shortage period.

The treated Barki ewes showed clear individual variation in the shape of their milk curve over 12 weeks of lactation (Fig. 3). Some ewes (10%) dried-off early at 8 weeks, whereas some others continue milking up to 18th weeks of lactation. Some ewes showed their peak of lactation at the 2nd week, some others had it at the 4th week. The persistency estimate of the milk curve of the T ewes was 2.46 kg, which was close to the estimates reported by El-Shafie *et al.* (2024) for Barki sheep under medium FS.

Differences in milk composition (fat, protein and SNF %) between the C and LFS treated ewes were statistically insignificant (Table 5).

The decrease of MY in the T ewes was reflected on the growth performance of their offspring, which had significantly less weaning weight (23.5 kg vs. 26.1 kg for C ewes).

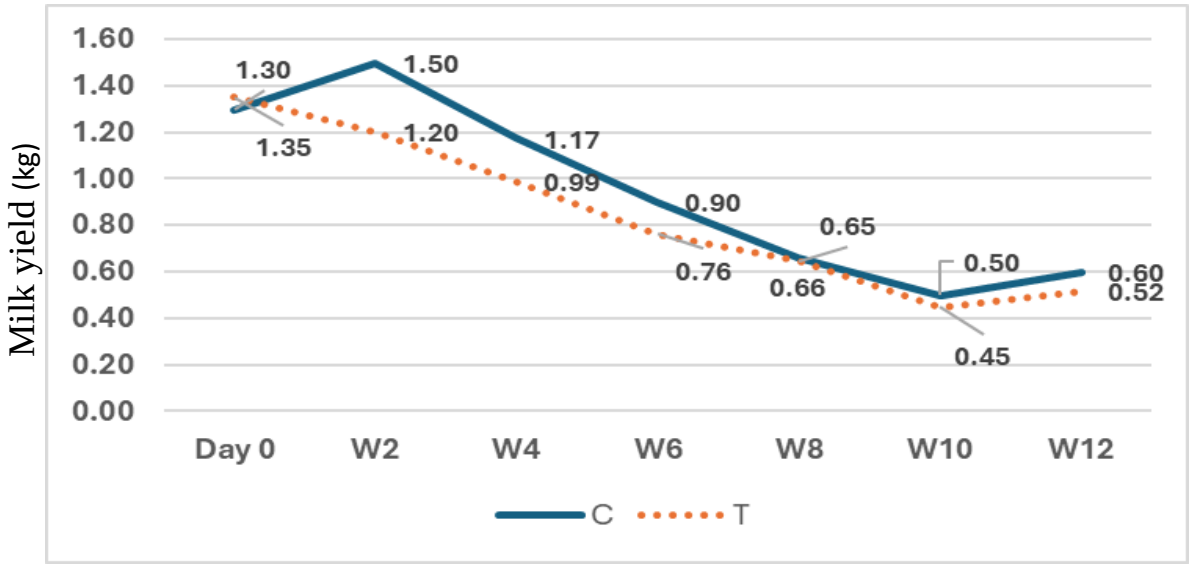

Fig. 2. Daily milk yield (DMY, kg) of the(T) Barki ewes during long feed shortage.

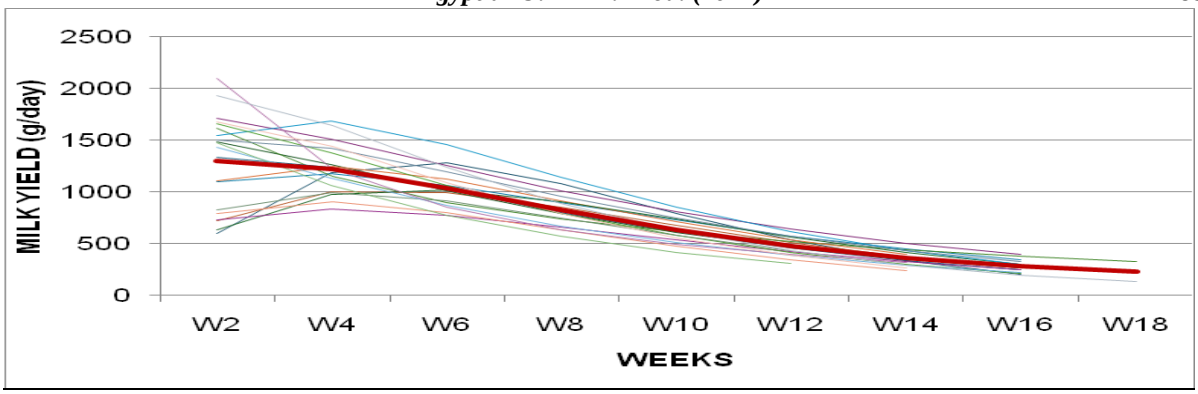

Fig. 3. Individual milk curve of the treated Barki ewes with long feed shortage.

DISCUSSION

Long feed shortage for 3 months of desert Barki ewe-lambs and ewes, as occurred frequently in the arid area, caused significant losses in their BW. However, they expressed fast compensatory growth with the compensatory feeding. Differences between the T and C groups became statistically insignificant at mating. These results reflect the capacity of DBS to compensate losses in their BW fast when feed is available. Such characteristics are vital for desert animals raised in arid areas, with frequent incidence of FS periods. The effect of FS on the reproductive performance of the ewe-lambs was limited and fully recovered by compensatory feeding.

Long feed shortage significantly decreased TMY of Barki desert ewes (15% on average), with limited effect on milk composition. Daily milk yield of the T ewes got closer to the normal ones by end of lactation (at 12 weeks). Al-Saiady*et al. (*2006) reported that restricted feeding of Awassi and Sawakni ewes by 15% significantly reduced their milk production. Growth performance of the present Barki offspring was significantly lower in association of the decrease in their milk yield. Barki desert sheep were reported to be non-dairy animals (Aboul Naga *et al*., 1981), their milk production is just enough to feed their lambs for 2-3 months.

It is of interest to notice that the LFS affects milk production of Barki desert sheep more than their BW. Atti Naziha *et al.* (2004) attributed the changes in BW of the subtropical sheep with FS due to the mobilization of their body fat reserves, including the fat-tail, to provide the nutrients requires for milk production to feed their lambs. Abdalla *et al*. (2014) confirmed that arid sheep are more tolerant to FS than arid goats due to their body fat deposition, including fat tail. Al Jassim *et al. (*2002) reported that fat tail plays an important role in the adaptation of sub-tropical sheep to FS in the arid and semi-arid areas. Seijan *et al.* (2014) illustrated that feed availability after FS period promotes feed energy intake to compensate the losses in their BW.

Fig. 4 compares the present results with those reported by El-Shafi *et al.* (2024) for the effect of short FS (one week, WFS), and medium FS (one month, MFS) on performance of the Barki ewes. Losses in BW increased as the FS period gets longer, being -5.4 for one week, -8.7 kg for one month and 9.2 kg for 3 months FS. Most importantly, losses in BW in all cases diminished fast with feed availability, a vital privilege developed by the desert sheep because of the impact of frequent incidence of FS periods. A similar trend was also observed for the effects of FS periods on MY (Fig. 5).

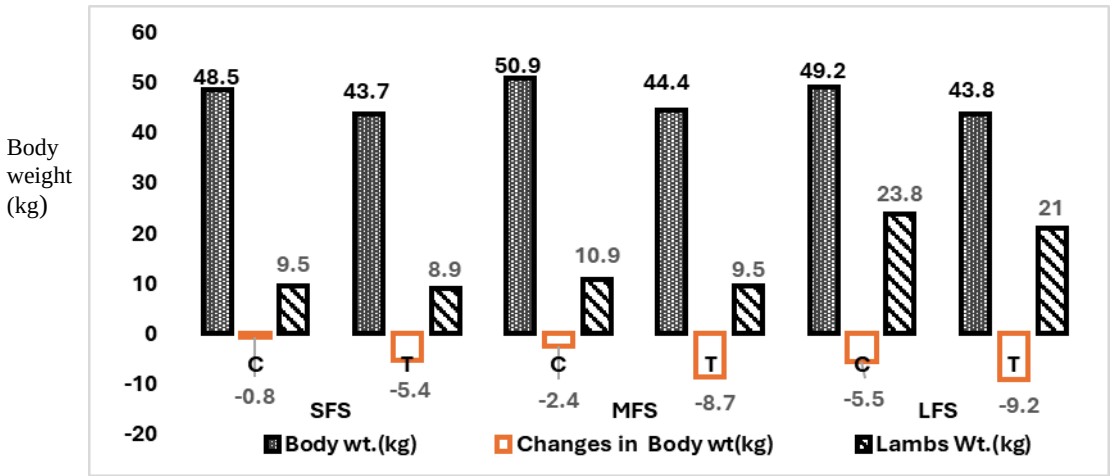

Fig (4). Body weight of Desert Barki sheep under different FS periods.
(SFS short FS, MFS medium FS, and LFS long FS)

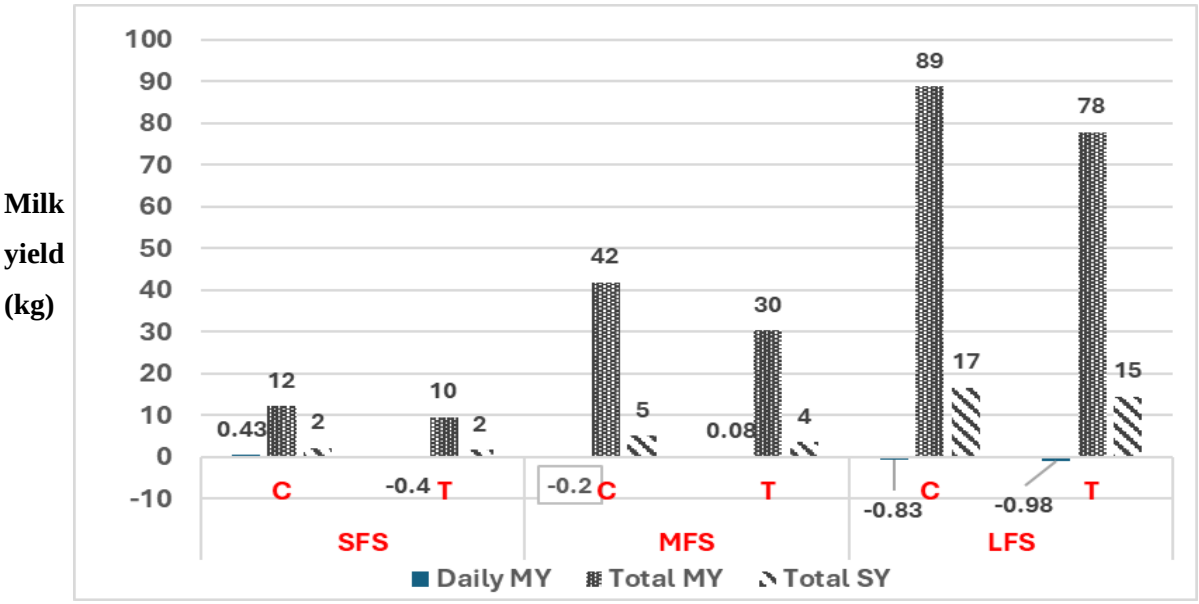

Fig. 5. Daily milk yield of Desert Barki sheep under different FS periods.
(SFS short FS, MFS medium FS, and LFS long FS)

CONCLUSIONS

Incidence of long feed shortage (LFS) periods is a common phenomenon in arid areas. The present work indicates that LFS causes significant losses in the BW of DBS with less effect on their milk production; the losses increased as the FS period advanced. Most interestingly, desert sheep recover their losses fast with feed availability, which is a privilege for desert animals they developed over centuries of natural selection under the arid conditions.

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أثر نقص الأعلاف على أداء الأغنام والماعز البرقي الصحراوية بالمناطق الجافه: (٢) أثر نقص الأعلاف لفترات طويلة على اداء النعاج والحوليات

فا تن أبو عمو، محمدالشافعي، السعيدالوكيل، أيمن صابر، طه عبد الصبور، طارق عبد الخالق، عادل أبو النجا

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تناولت الدراسة تأثير نقص التغذية لفترة طويلة على أداء النعاج والحوليات البرقي الصحراوية في ظل الظروف القاحلة. تم تقسيم الحوليات المفطومة إلى مجموعتين؛ المجموعه المقارنه (١٥حوليه) والمجموعه المعامله (٣٠ حوليه). الحجازي تم تغذية الحوليات طبقاً لمقررات الـ NRC على دريس البرسيم الحجازي وخليط المركزات حتى عمر ٥ أشهر. ثم اعطيت المجموعة المعامله ٥٠٪ من المخصصات المركزه لمدة ٣ أشهر (نقص غذائي طويل)، حيث تعرضت لفقد معنوي لوزن الجسم قدره ١١,١٪. وعند عمر ٨ أشهر، تم إعطاؤها تغذية تعويضية (١٢٥٪ مركزات) لمدة ٣ أشهر، مما قلل الفقد في الوزن إلى ٢,٤٪. وكان تأثير النقص الغذائي على الصفات التناسليه محدودا، باستثناء الوزن عند الشبق الأول (٢,٩ كجم أقل).

التجربة الثانية أجريت على النعاج البرقي الناضجة، ١٠ نعاج (مجموعه مقارنه) و٢٠نعجة (المجموعه المعامله). تم تغذية النعاج بشكل فردي على خليط المركزات ودريس البرسيم الحجازي. وتم تغذية النعاج المعامله على ٥٠٪ من المركزات لمدة ثلاثة أشهر. حيث فقدت ٩,٢ كجم من وزنها مقابل ٥,٥ كجم للمجموعة المقارنه وانخفض إنتاجهامن الحليب بنسبة ١٥٪.

يزداد الإنخفاض في وزن الجسم مع طول فترة النقص الغذائي. والأهم انه في جميع الحالات، يتم إستعادة الخساره في وزن الجسم فور توفر العلف، مما يعكس قدرة أغنام البرقي الصحراوية على التعويض السريع للإنخفاض في وزن الجسم. وهي ميزه حيويه طورتها الحيوانات الصحراويه عبر قرون من التكيف الطبيعى على الظروف القاحله.