Influence of Prolonged Feeding *Atriplex Halimus* (Saltbush) on Pregnant Camels Production and There Calves Performance

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ABSTRACT

This study was conducted to study the impact of long term o feeding *Atriplex Halimus* (saltbush) on she-camel performance during pregnancy and suckling periods to weaning their calves compared with those fed Berseem hay (control group). Results indicated that, no significant effect on the overall dry matter intake (DMI). Pregnant camels groups either fed hay or Atriplex gained 100.80 and 107.13 kg, respectively, with no significant differences. All camel dams exhibited ($P<0.05$) loss in BW (Body weight) during suckling ranged from -20.45 to -31.47 kg for control and Atriplex groups respectively. After weaning all camel dams showed some gain in body weight, which averaged 17.98 and 16.40 kg per head, respectively. Camel dams group fed Atriplex recorded higher ($P<0.01$) drinking water intake. Milk production ($P<0.05$) increased from 3.31 to 4.00 Kg/day/camel, respectively. Milk of camel dams group fed Atriplex contained ($P<0.05$) the higher milk protein, lactose and total solids percent. No significant differences in birth weights, growth rate and weaning weights of calves born for She-camels fed hay or Atriplex diets. These results indicated that camels can challenge hard conditions with good production and reproduction performance.

Key words: She-camel, pregnancy, suckling, weaning, dry matter intake, drinking water.

INTRODUCTION

Camels are the most predominant and producing animals in arid zones and dry lands where other domestic animals can hardly be survived. It is known that camels have remarkable ability to exploit the scanty feed and water in its natural habitat. Also, camels need lower amounts of protein in their rations than other ruminants since they have an exceptional ability to recycle urea as a source of nitrogen when dietary protein is unavailable and have effective mechanisms to conserve energy under hard arid conditions (El-Badawi *et al*. 2021). They also prefer to browse saltbushes for their high moisture and electrolyte content (Edrise, 1991). Camels are reliable milk producers with a long lactation period and they maintain milk production throughout the long dry periods when milk from cattle, sheep and goats is scarce.

Feed shortage is an important constraint to camel production, especially in drought seasons. So, many attempts were carried out to solve this problem throughout using unconventional sources of roughages. Utilizing halophytes and other salt-tolerant plants in the ration of camels is a feasible solution to minimize the problems of feed and water shortage in desert, saline coastal, and subcostal areas (Al-Shorepy *et al*., 2010; Moreno *et al*., 2015). Halophyte shrubs of the genus Atriplex tend to predominate in these areas, mostly because of their resistance to drought, which may be coupled with low or high ambient temperatures (Uchiyama, 1987) and can be a crucial source of perennial fodder for camels.

The present study was aimed to determine the impact of long-term of feeding saltbush on camel production and reproduction performance.

MATERIALS AND METHODS

Twenty-eight pregnant camels were (*Camelus dromedarius*) were used in this experiment. The first group (16 pregnant camels) was fed *ad libitum* berseem hay (control) and the second group (12 pregnant camels) was fed carrying cut fresh leaves and succulent stems of *Atriplex halimus* (saltbush). This feeding system started before the meeting season by about six months and still throughout the pregnancy period (13 months) and up to weaning offspring (10 months). Each animal in the two groups was supplemented with concentrate diet consisted of 60 % ground yellow corn plus 40% ground barley grains to cover 100% of the maintenance energy requirements for pregnant dams according to the recommendation of Wardeh and Farid (1990). The chemical composition of feed ingredients is presented in Table (1). Fresh water was freely available once daily.

Table (1): Proximate composition (%) of feed ingredients (on DM basis)

Feed stuffs	DM (%)	DM composition (%)					
		OM	CP	CF	EE	NFE	Ash
Barley grains	86.33	96.50	10.12	6.04	2.91	77.43	3.50
Yellow corn	87.10	98.66	8.23	1.82	5.30	83.31	1.34
Berseem hay	87.06	87.50	12.28	30.93	2.77	41.52	12.50
Atriplex halimus	25.69	79.25	17.50	23.88	2.92	34.95	20.75

The live weight of the camels were recorded at the beginning of the experiment and every month during the experimental different physiological stages, at calving (body weight on the last day of pregnancy), after calving (post – parturient body weight), at weaning (body weight when calves were weaned at 10 months) and after weaning (body weight was recorded after 4 weeks from weaning). Daily milk yield was measured every two weeks along period of 10 months by using the standard hand–milking procedure after separation of calves from their dams. Hand milking was done twice daily, in the morning and at the evening, at approximately 12 hours interval. Two quarters of the udder were milked, leaving the other two for the calf. Milk obtained was measured with a graduated measuring cylinder of 1000 ml capacity. After milking, samples for each she–camel were taken for the experimental analysis. The body weights of the calves at birth, every 2weeks and at weaning (40 weeks) were recorded. Milk samples were determined for titratable acidity, fat, ash, total solids and total nitrogen contents according to the procedures of the AOAC (1990). Values of pH were measured electrometrically using pH meter. Specific gravity was measured by lactometer. Lactose content was determined by the phenol–sulfuric spectrophotometric method as described by Barnett and Abd–El–Tawab (1957).

The results of the present experiment were subjected to the statistical analysis system according to (SAS, 1988). Mean differences were compared by Duncan's New Multiple Range Test (Duncan, 1955). A completely random design was used.

RESULTS AND DISCUSSION

Dry matter intake (DMI), body weight changes and drinking water

The dietary treatments had no significant effect on the overall DMI of camels and also, during the different physiological stages, either as g / kg $BW^{0.75}$ or relative (%) to BW (Table 2). The values of DMI were almost near to the levels of DM requirements needed for late gestation and lactation, which were recommended by Wardeh and Farid (1990).

Table (2): Dry matter intake, body weight, body weight changes and drinking water of camel dams fed saltbush for long-term period instead of berseem hay

Items	Experimental diets		Sig.
	Hay	*Atriplex*	
Dry matter intake (kg/camel/day)			
Late gestation	8.50	8.70	NS
Suckling period	8.42	8.59	NS
After weaning	8.70	8.82	NS
Overall	8.54	8.64	NS
Dry matter intake (g/kg$W^{0.75}$)	72.51	70.52	NS
Dry matter intake % of BW	1. 48	1.42	NS
Camel dams body weight (Kg)			
Initial	540.60	557.27	NS
At calving	663.60b	707.40a	*
After calving	562.60b	600.27a	*
At weaning	542.35b	568.80a	*
After weaning	560.33b	585.20a	*
Camel dams body weight change (Kg)			
Overall	19.73b	27.93a	*
At calving to after calving	100.80	107.13	NS
After calving to weaning	-20.45b	-31.47a	NS
At weaning to after weaning	17.98	16.40	NS
Water intake (ml/kg$w^{0.82}$)	31.35^{c}	113.76^{b}	**

Means in the same row with a, b are significantly different at *P <0.05 * NS = non- significant

Changing the diet roughage type by replacing Atriplex instead of hay significantly affected the BW of camels. While camel dams fed Atriplex diet recorded the higher ($P<0.05$) BW at calving, after calving, during suckling and after weaning. These results are accordance with the results reported by Mostafa *et al*. (2016). The higher ($p<0.05$) overall BW gain (Kg) of camel dams fed Atriplex compared to camels fed hay may be due to an increase in total body water. This real fact was previously reported by Konig (1993) that sheep and goats fed diets containing different proportions of Atriplex showed significant ($P<0.05$) increase in their body weights, which was mainly due to the increase in total body water. So, this gain in body weight could be illusory because of increased water intake by animals fed Atriplex (saltbush), as indicated by Abu-Zanat and Tabbaa (2005).

The pregnant camels fed either hay or Atriplex gained 100.80 and 107.13 kg, respectively, with no significant differences. All camel dams exhibited some loss in BW during the suckling period ranged from -20.45 to -31.47 kg per head. After weaning, all camel dams showed the same gain in body weight, which averaged 17.98 and 16.40 kg per head for camels fed hay and Atriplex, respectively.

Nevertheless, camels prefer to graze salty green plants like *Atriplex* species for its high moisture and electrolyte contents (Newman, 1979). Shawket *et al*. (2010) and Dioli, (2018) reported that it may be due to the positive response of camels to Atriplex feeding which is attributed to two principal factors: First, camels appear to need more salt, probably more than other herbivores, which is in higher proportion in this plant. This fact was demonstrated previously by Chamberlain (1989) and Dioli, (2018) that camel requires six to eight times the amount of salt required by other livestock. In addition to camels without regular access to salty feed require about 140 g of salt per day. So, traditional grazing management by most camel breeders involves regular supplementation of salt, usually by taking the camels to saline pastures, saline wells or salty earth at least twice a year. It is believed that they will lose condition, abort, give less milk and will be prone to diseases like skin necrosis and arthritis (Peck, 1939), if not given enough salt (Bornstein, 1995). Second, in comparison to bovines, camel saliva contain a varying content of high molecular weight mucinglycoprotein (MGP) that confers protection to the mucosa of the digestive tract from mechanical injuries and fixes the plant tannins preventing their negative effects on protein metabolism in the rumen (Schmidt-Witty *et al*. 1994). In addition, Atriplex being a lush green plant was more palatable and preferred by camels in comparison to the dry clover hay (Shawket *et al,* 2005). These facts explain the equal values of dry matter intake (DMI) by camel dam groups fed either Atriplex or Berseem hay throughout the experimental periods (late gestation, suckling and weaning periods).

Total water intake (ml/$Kgw^{0.82}$) was affected significantly ($P<0.01$) by changing the type of roughage. The camels fed Atriplex recorded significantly ($P<0.01$) higher drinking total water intake as recorded also by Abdel-Wahed, (2020). This may be due to the higher seasonal contents of Na which ranged between 5.59 and 6.66% in the dry matter of Atriplex foliage for spring and fall seasons, respectively (Abu-Zanat *et al.,* 2003). This high level of salt in Atriplex browse may force animals to increase their daily water intake (Abu-Zanat and Tabbaa, 2005).

Camel's Milk production, chemical composition and physical properties

1- Camel's Milk production

Camel milk has unique properties and a number of advantages as compared to milk from other species. Camel milk differs markedly from bovine milk in terms of structural and functional properties of the milk components, and composition of individual proteins and its colloidal structures (Seifu, 2022). So, it is important to understand the impact of long-term feeding Atriplex on animal production especially milk yield which is one of the major sources of income for the pastoral communities. The inclusion of fresh *Atriplex halimus* (saltbush) instead of berseem hay in the diet of camels (Table 3) resulted in a significant increase (P<0.05) in milk production.This could be attributed to the higher moisture content of *Atriplex halimus* in comparison with berseem hay (72.43 *vs.* 12.73 %, respectively). This explanation confirmed the previous finding of Rahman *et al.* (2002) that green forages increase milk yield. Moreover, the high and constant moisture content of salty plants like Atriplex makes them preferable by desert animals (Wardeh, 1990) and it might provide 40-60 % of the water requirements for animals to survive under desert conditions (Macferlane, 1964).

Table (3): Effect of feeding Atriplex (saltbush) on camel's milk production

Item	Mean daily milk yield* (Kg)		Minimum average daily milk yield (Kg)		Maximum average daily milk yield (Kg)	
	Hay	Atriplex	Hay	Atriplex	Hay	Atriplix
Average	3.31± 0.13	4.00 ± 0.16	2.11	2.37	6.0	6.9

*Significant at (P < 0.05)

Also increasing (P<0.05) milk production of camels group fed AH than those fed BH indicated that camels can tolerate the negative effects of secondary chemical compounds (oxalates and tannins) and higher salt content present in Atriplex (saltbush) than small ruminants. Whereas, increasing dietary Atriplex (saltbush) level led to a significant decrease in milk production of Beetal goats in Pakistan (Raza *et al.* 2000) and slight in Awassi ewes (Abu-Zanat and Tabbaa 2005). Daily milk production values of the two experimental camel groups were consistent with those of Ethiopian camels (3.06 – 6.5 Kg /day) as recorded by Simpkin (1993) and Bekele *et al*. (2002), respectively, but less than values were recorded by Karue (1998) for Kenyan camels (6.15 Kg/day). These differences in camel daily milk production might be due to camel species, breed, age, stage of lactation, parity, season of calving, feeding, health of the animal, reproductive status (estrus, gestation), management conditions (milking frequency, the presence of the calf, and method of milking: hand or machine milking), heat stress and availability of water (Farah, 2011, Nagy and Juhasz, 2016, El-Agamy, 2017 and Alhadrami and Faye, 2022).

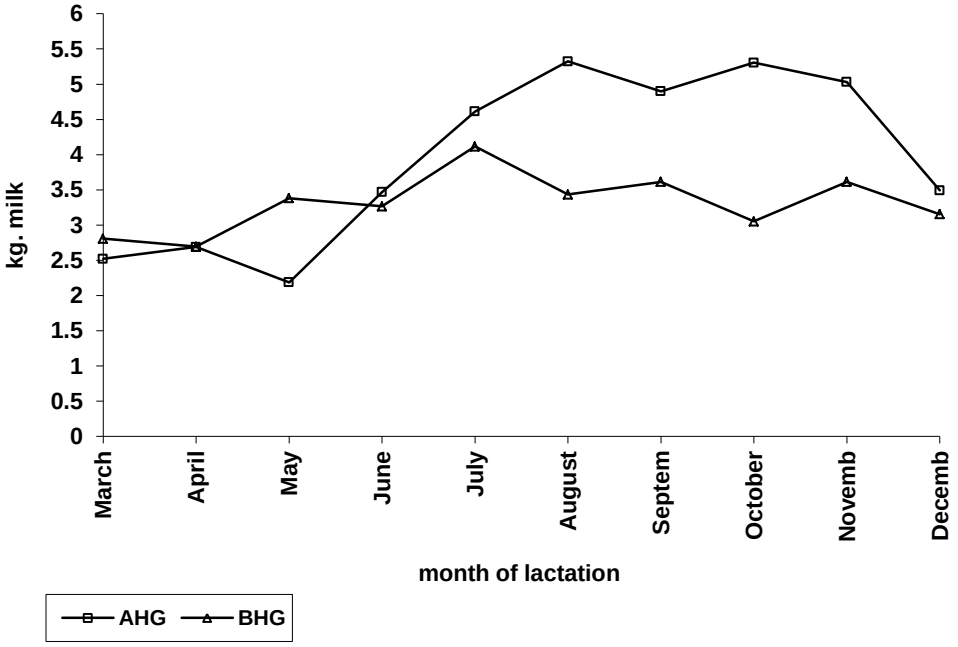

Fig (1): Effect of type of diet on camel's milk production

The lactation curve of camels is influenced by age, parity, level of production, and month of calving (Alavi *et al*, 2017). It is noticeable that camels fed Atriplex had a lactation curve with two peaks at sixth and eighth months of calving whereas, the lactation curve of camel group fed berseem hay has one peak at fifth month of calving. In accordance with the present results, Al–Sheikh and Salah (1994) and Abdalla *et al.*, (2015) found that the lactation curves of camels differ from those of cows and may have one or two peaks.

It was noticed that camels had reached the peak point of the milk yield during the first twenty weeks after parturition (Field, 1979). These results compares favorably with earlier reports by Kuria *et al*. (2004) who recorded peak production between 5th and 7th month of lactation. Farah (1996), Simpkin (1998) and Yagil (2000) had earlier observed that most of the milk peak in camels was produced within the first 6 to 7 months of lactation. The difference in camel's milk yield peak point might be related to the nutritional status of camels during late pregnancy and lactation periods (Lan dete –Castillejos *et al*., 2002 and 2003 and Alavi *et al*., 2017).

2- Chemical composition of camel's milk

Chemical composition of camel milk (Table 4) falls in the ranges which were reported by Khan and Iqbal (2001), 2.9-5.5 % fat, 2.5-4.5 % total protein, 2.9-5.8 % lactose, o.35-0.95 % ash and 11.5-13.7 % total solid. But it seemed lower than, 2.86 % protein, 4.62 % lactose and 0.78% ash (Sankhla *et al*., 2000). These differences in the chemical composition of camel milk may be due to factors like stage of lactation, age, number of calving, nutritional status and water intake (Chamberlain, 1989).

Literature data have shown wide ranges of difference in camel milk composition. Meta-analysis of literature data on gross composition of camel milk (one-humped) gave mean values (in g/100 mL) of 4.14 ± 0.80 for fat content, 3.33 ± 0.52 for total protein, 12.69 ± 1.11 for total solids, 4.18 ± 0.72 for lactose and 0.76 ± 0.09 for ash for milk of East African one-humped camels (Konuspayeva *et al*., 2009).

Table (4): Effect of feeding saltbush on chemical composition of camel's milk

Item	Milk chemical composition				
	Total solids	Total protein	Fat	Lactose	Ash
Berseem hay group	12.10^{b}±0.16	3.10^{b}±0.14	3.30±0.14	4.80^{b}±0.18	0.83±0.03
Atriplex group	12.32^{s}±0.93	3.34^{a}±0.24	3.20±0.26	4.98^{a}±0.81	0.98±0.08

[a, b] Means followed by different letters in the same column are significantly different (P<0.05)

Variation in camel milk composition is attributed to several factors including seasonal variation, variation in water intake, quality of feed, analytical procedures for measurement, milking interval, stage of lactation, breed and climate (Al Haj and Al Kanhal, 2010, Khatoon and Najam, 2017 and Roy *et al*., 2020).

It was noticeable that the milk of camel dams group fed Atriplex contained the higher (P<0.05) protein percentage which may be attributed to the higher crude protein (%) content of Atriplex than berseem hay which confirmed the early conclusion that feed protein content will directly affect milk protein (%) content and responsible for increasing milk lactose (%) content (Wilson, 1984).

3- Physical properties of camel's milk

Physical properties of camel's milk (pH, specific gravity, titrable acidity and conductivity (ms/cm 18°c) were affected by the type of diet. The milk titrable acidity and conductivity values of the camels group fed AH were lower (P<0.05) than those of the camels group fed BH. Such result could be due to the secondary compounds (oxalates and tannins) and the higher salt content of Atriplex. These anti-nutritional factors bind with minerals forming insoluble salts (Ngwa and Nsahlai, 2002 and Ben Salem *et al*., 2002) which lead to decrease (P<0.05) the milk conductivity value for AH camel group. Norberg (2005) stated that milk conductivity mainly depend on soluble salt fractions.

Table (5): physical properties of camel's milk fed Atriplex for long-term

Item	Milk physical properties			
	PH	Specific gravity (%)	Titrable acidity	Conductivity ms/cm 18°c
Berseem hay group	6.67±0.05	0.170^{a}±0.01	1.03±0.02	5.98^{a}±0.25
Atriplex halimus group	6.78±0.09	0.164^{b}±0.01	1.03±0.01	5.16^{b}±0.37

[a, b] Means followed by different letters in the same column are significantly different (P<0.05)

Generally the present values of physical properties of camel's milk fall in the ranges which reported by Swelum *et al*. (2021) and Vincenzetti *et al*. (2022).

Camel calf's birth, weaning and body gain weights

The camels fed the experimental diets produced calves (regardless of sex) almost of same the birth weight (Table 6). In this respect, Bakheit *et al*. (2017) reported that there was a non-significant difference (P>0.05) in birth weight of calves raised under semi-intensive and traditional systems. Overall birth weight of camel calves averaged 33.1 and 34.6 kg born for dams fed hay and Atriplex for long-term, respectively. These values were higher than the birth weight values 31 and 23 kg for calves born from camel dams grazed on salty pasture rangelands with or without concentrate supplementation, respectively (Hammadi *et al.*, 2001).

Table (6): Birth weight, weaning weight and daily live weight gain of calves

Items	Experimental diets		Sig
	Hay	*Atriplex*	
Calves birth weight (kg)			
All	(16) 33.1 ± 7.31	(12) 34.6 ± 8.44	NS
Calves weaning weight (kg)			
All	238.8 ± 11.35	252.4 ± 11.12	NS
Calves daily live body weight gain (g/day)			
All	734.6 ± 10.96	777.9 ± 9.16	NS

Numbers in parenthesis are numbers of animals
NS= non-significant.

Similar body gains (g/day) were exhibited by calves during suckling period regardless of sex and litter size (Figure 2). Calves daily body weight gain results of the present study (734.6 g and 777.9 g/day for calves of dam camel groups fed hay and Atriplex, respectively) were slightly higher than the findings of Bakheit *et al*. (2019) who postulated that the daily body weight gain of camel calves were left on natural pasture and supplemented either watermelon seeds, ground nut cake and ration composed of mixture of watermelon seeds and ground nut cake in equal percentage were 624±28g, 542±19g and 528±12g /day, respectively.

The lack of significant differences in birth weights, growth rate and weaning weights of calves suggest that the nutritive value of treatment diets fed for their dams was comparable.

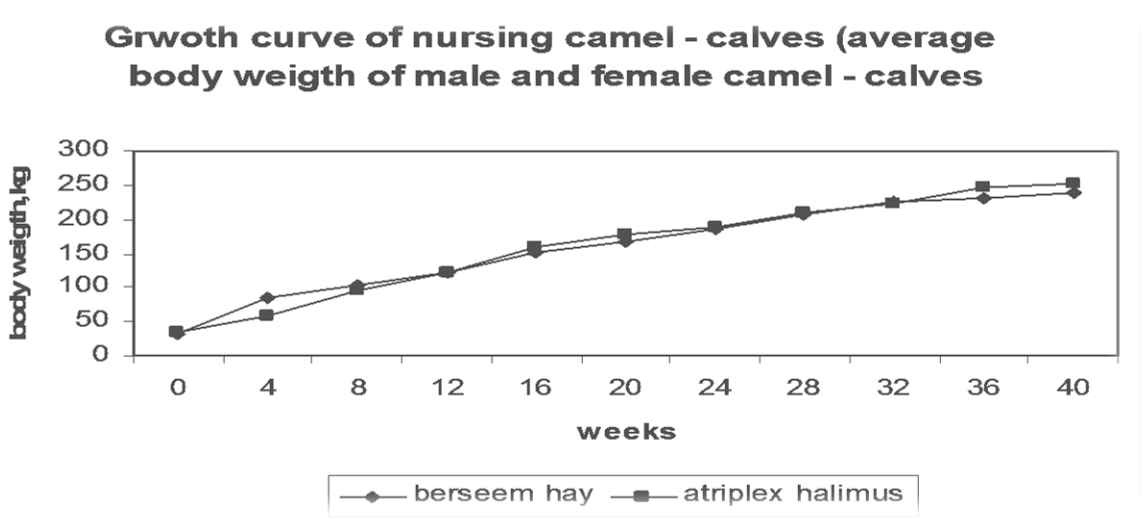

Fig (2): Growth curve of nursing camel – calves.

CONCLUSION

It could be concluded that utilization of Atriplex with suitable source of energy as camel feed during pregnancy and post-partum period could be an appropriate solution for alleviating the hard conditions of climatic changes and desertification problems and providing alternative feed forage when the natural pasture plants resources are shortage. This system of nutrition successfully was sufficient for good milk yield and composition, reproductive performance of She-camels and growth performance of their calves.

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الملخص العربي

تأثير التغذية طويلة الأمد علي القطف لإناث الجمال العشار والحلابة على إنتاج اللبن والأداء الإنتاجى لعجولها

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أجريت هذه الدراسة لدراسة تأثير التغذية طويلة الأمد على الأتريبلكس على أداء الإبل أثناء فترات الحمل والرضاعة وحتى فطام صغارها مقارنة بتلك التي تغذت على دريس البرسيم (مجموعة الكنترول). أشارت النتائج إلى عدم وجود تأثير كبير على إجمالي تناول المادة الجافة (DMI) . اكتسبت مجموعات الإبل الحوامل التي تغذت إما على الدريس أو الأتريبلكس 100.80 و 107.13 كجم على التوالي، دون وجود فروق كبيرة. أظهرت جميع أمهات الإبل($P <0.05$) خسارة في وزن الجسم أثناء الرضاعة تتراوح من -20.45 إلى -31.47 كجم لمجموعتي الكنترول والأتريبلكس على التوالي. بعد الفطام أظهرت جميع أمهات الإبل بعض الزيادة في وزن الجسم، والتي بلغ متوسطها 17.98 و 16.40 كجم للرأس على التوالي. سجلت مجموعة أمهات الإبل التي تغذت على الأتريبلكس استهلاكًا أعلى($P<0.01$) لمياه الشرب. زاد إنتاج الحليب ($P<0.05$) من 3.31 إلى 4.00 كجم / يوم / ناقة على التوالي. احتوى حليب مجموعة أمهات الإبل التي تغذت على الأتريبلكس على نسبة أعلى من بروتين الحليب واللاكتوز والمواد الصلبة الكلية .لا توجد فروق ($P<0.05$) ذات دلالة إحصائية في أوزان المواليد ومعدل النمو وأوزان الفطام للعجول المولودة لإناث الإبل التي تغذت على علائق الدريس أو الأتريبلكس. أشارت هذه النتائج إلى أن الإبل يمكنها تحدي الظروف الصعبة بأداء إنتاجي وتكاثري جيد.

الكلمات الدالة: إناث الجمال، القطف ، معاملات الهضم، وزن الجسم ، الاداء الانتاجي.