

Effect of diet supplementation on growth and reproduction in camels under arid range conditions

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Eighteen pregnant dromedary females (*Camelus dromedarius*) were used to determine the effect of concentrate supplement on growth and reproductive performances in *peri-partum* period. The females were divided into supplemented (n = 9; S) and unsupplemented (n = 9; C) experimental groups. All animals grazed, with one mature male, 7 to 8 hours per day on salty pasture rangelands. During night, they were kept in pen, where each female of group S received 4 kg/d of concentrate supplement during the last 3 months of gestation and 5 kg/d during the first 3 months *post-partum*. During the last 90 days of gestation daily body weight gain (DBG) was at least tenfold more important in group S than in group C (775 g vs. 72 g respectively). Supplementation affected birth weight of offspring (30.3 kg vs. 23.4 kg) and its DBG (806 g vs. 430 g) in group S and group C respectively. During the *post-partum* period, females in group S gained in weight (116 g/d) whereas females in group C lost more than 200 g/d. The mean *post-partum* interval to the first heat and the percentage of females in heat were 29.5 d and 44.4% vs. 41.2 d and 71.4% for the C and S groups, respectively. We conclude that under range conditions, dietary supplementation of dromedary during late pregnancy stage and *post-partum* period improves productive and reproductive parameters.

Keywords. Dromedaries, supplementary feeding, perinatal period, growth, birth weight, reproduction, arid zone, Tunisia.

Effet de la supplémentation alimentaire sur la croissance et la reproduction des dromadaires en conditions arides. Dix-huit chamelles gestantes, pâturant 7 à 8 h/j sur un parcours à plantes halophytes dans le sud tunisien, ont été soumises à deux régimes alimentaires différents afin d'étudier l'effet de la supplémentation sur les performances de production et de reproduction chez les dromadaires. Chaque chamelle du lot supplémente (n = 9, lot S) a reçu quotidiennement, à partir du 10^e mois de gestation et jusqu'à la mise-bas, 4 kg d'un aliment concentré. Au cours des 3 mois *post-partum*, cette supplémentation a été augmentée à 5 kg. Les femelles du lot contrôle (n = 9, lot C) quant à elles n'ont reçu aucune supplémentation. Un mâle géniteur âgé de 8 ans a été gardé avec le troupeau. Durant les 3 derniers mois de gestation, le gain moyen quotidien (GMQ) était 10× plus élevé chez les chamelles du lot S que chez les femelles du lot C (775 g vs. 72 g respectivement). La supplémentation a significativement affecté le poids du nouveau-né (30,3 kg vs. 23,4 kg respectivement dans le lot S et le lot C) et le GMQ 0–90 du chamelon (806 g vs. 430 g respectivement dans le lot S et le lot C). Durant la période *post-partum*, les femelles du lot S ont gagné du poids (+116 g/j) alors que celles du lot C ont perdu plus de 200g/j. L'intervalle *post-partum* au premier accouplement et le pourcentage des femelles saillies étaient de 29,5 j et 44,4 % vs. 41,2 j et 71,4 % respectivement chez les chamelles du lot C et les chamelles du lot S. Nous pouvons conclure que dans les conditions d'élevage des dromadaires sur parcours, la supplémentation alimentaire pendant la période *peri-partum* peut améliorer les performances de production et de reproduction de cette espèce.
Mots-clés. Dromadaire, alimentation complémentaire, période perinatale, croissance, poids à la naissance, reproduction, zone aride, Tunisie.

1. INTRODUCTION

In Tunisia, camels are traditionally reared in extensive area. However, the intensification of the production is starting efficiently. In many arid countries too, we can observe a high development of intensive dairy farming

on sub-urban areas. The influence of nutrition on milk, growth and reproduction has been extensively investigated in conventional farming species and it is generally concluded that decreased nutrient intake reduces the growth of calves, delays the onset of puberty in heifers (Formigoni *et al.*, 1996) and increases the *post-partum*

interval to conception in dams (Lalman *et al.*, 2000). In contrast, feeding to improve body condition before calving can increase both calf birth weight, its subsequent gains and reproduction efficiency of the dam (Houghton *et al.*, 1990). In dromedary, several productive and reproductive characteristics such as restricted breeding season, long gestation period, low daily body weight gain, and high calf mortality appear to be the major constraints to increase productivity of dromedary herds (Ismail, 1990). However, there is few and fragmented information on the effects of nutritional deficiencies on the dromedary performances at critical periods including puberty and parturition (Moslah, 1993). Therefore, this study was designed to determine the effect of diet supplementation on growth and reproduction performances in *post-partum* period in dromedary camels.

2. MATERIAL AND METHODS

2.1. Animal management and experimental design

The experiment was conducted from September 1994 to June 1995 at the Arid Lands Institute Experimental Station situated in the southern Tunisia (33° 30' N, 10° 40' E). This region is characterized by an arid climate with a mean annual rainfall of about 180 mm. Eighteen pregnant dromedary females (Maghrebi breed), belonging to a 40-head herd, were used for this experiment. The herd was kept in the pen during the night and moved to the range during the day to spent 7 to 8 hours grazing. The animals had access to water twice a day. Pasture in which the animals graze covers approximately 500 ha which are dominated by salty native species (*Arthrocnemum indicum* Moq., *Limoniastrum gyunianum* L., *Nitraria retusa* (Forsk.), etc.).

The experimental animals were allotted, in equal number, to a supplemented (S) or unsupplemented (C) group based on the body weight (S group: 359 ± 22 kg vs. C group: 362 ± 32 kg; P = 0.138), gestation days (S group: 252 ± 20 days vs. C group: 241 ± 30 days; P = 0.156) and age of the female (S group: 6.9 ± 3.2 years vs. C group: 6.7 ± 3.4 years; P = 0.455). The daily dry matter intake was determined during a 4 weeks pre-experimental period and calculated at 7.3 kg/d/head (Hammadi *et al.*, 1998).

At sunset, each female of group S received 4 kg/d of concentrated supplement (**Table 1**) during the last 3 months of gestation and 5 kg/d during the first 3 months *post-partum*. These amounts were estimated using the dairy bovine requirements (INRA, 1978) and the net energy standard values for camels (Guerouali *et al.*, 1995). This concentrate was formulated and quantified to supply 70% of total daily requirement energy during the 3 *pre-* and 3 *post-partum* months for a 360 kg dromedary female producing 5 liters of milk per day during the first three months of lactation.

Table 1. Ingredients and chemical composition of the concentrate — *Constituants et composition chimique du concentré.*

Ingredients % full matter basis		Chemical composition % dry matter (DM) basis	
Barley	60,0	DM (% full matter basis)	90,9
Wheat bran	17,5	OM	91,9
Olive cake	17,5	CP	11,4
CMV	5,0	ADF	13,2
		NDF	31,6

CMV = Mineral and vitamin supplement; OM = Organic matter; CP = Crude protein; ADF = Acid detergent fiber; NDF = Neutral detergent fiber.

The body weight of animals was controlled every 2 weeks and calf body weight were recorded within 12 h after calving.

2.2. Statistical analysis

Statistical analysis of data was performed with SAS computer software (SAS, 1989). Two calves from group S were lost accidentally and their dams were excluded from some parts in the study. General Linear Model (GLM) procedure was used to study the effect of supplementation on the duration of gestation and the *post-partum* interval (PPI), the birth weight of calves, and the body weight and the daily body gain (DBG) of camel calves and dams. Values are presented as means ± Standard Deviation (SD). Chi-square test (χ^2) was used to analyze differences in the numbers of dams mated in the two dietary groups.

3. RESULTS

3.1. Calving, gestation duration and growth of calves

The distribution of the birth dates shows a small heterogeneity between the two dietary groups. During February, 44.6% of calving occurred in group S and 55.6% of calving in group C. Calving for remaining animals occurred in January and March.

Duration of gestation in female of dromedary is not affected by dietary level and overall mean was 384.8 ± 14.0 days.

Birth weight was affected (P < 0.01) by *pre-partum* nutritional level of the dam (**Table 2**). Body weight at 30, 60 and 90 days of age was higher (P < 0.001) for calves from the S group than from the C group (**Table 3**). Average DBG from birth to 90 days was 806 ± 56 g and 430 ± 112 g in S and C groups respectively.

3.2. Body weight and growth in females

Evolution of the body weight in the females during the experience period is shown in **figure 1**. Ninety days before calving, female weighted in average 378 ± 25 kg

Table 2. Effect of dietary level on the duration of gestation (DG) and the birth weight (BW) of camel calves (means \pm SD) — *Effet du niveau alimentaire sur la durée de la gestation (DG) et le poids à la naissance (BW) des jeunes dromadaires (moyennes \pm déviation standard).*

	Dietary level			Level of significance
	Mean	Group S	Group C	
n	18	9	9	-
DG (days)	385 \pm 14	385 \pm 15	384 \pm 14	NS
BW (kg)	27 \pm 5	31 \pm 4	23 \pm 2	***

n = number of observations; NS = $P > 0.05$; *** = $P < 0.001$

Table 3. Effect of dietary level on the evolution of body weight (BW, kg) and daily body gain (DBG, g) of camel calves (means \pm SD) — *Effet du niveau alimentaire sur l'évolution du poids vif (BW, kg) et le gain de poids quotidien (DBG, g) des jeunes dromadaires (moyennes \pm déviation standard).*

	Dietary level			Level of significance
	Mean	Group S	Group C	
n	16	7	9	-
BW day 30	48 \pm 9	56 \pm 6	41 \pm 6	***
BW day 60	65 \pm 17	83 \pm 7	52 \pm 8	***
BW day 90	79 \pm 23	103 \pm 6	62 \pm 11	***
DBG 0–90 d	580 \pm 212	806 \pm 56	430 \pm 112	***

n = number of calves; *** = $P < 0.001$

and 377 \pm 33 kg in group S and group C respectively. Supplementation of group S prevented weight loss and was reflected in a DBG which was more than tenfold important ($P < 0.01$) in group S than in group C (775 g vs. 72 g respectively). At parturition, females weighted in average 448 \pm 18 kg and 384 \pm 28 kg in group S and group C respectively. Weight losses at parturition (difference between pre- and postcalving weights) were influenced by *pre-partum* dietary level ($P < 0.001$) and females lost 58 \pm 9 kg and 41 \pm 7 kg in supplemented and unsupplemented groups respectively.

After calving, females in group S remained heavier ($P < 0.001$) than females in group C and the difference of the average body weight between the two groups was 55 kg, 72 kg and 73 kg at 30, 60 and 90 *post-partum* days respectively. Average DBG from day 15 to day 90 *post-partum* was 116 \pm 130 g and -203 \pm 135 g in group S and group C respectively.

3.3. Post-partum sexual activity

Sexual activity in dromedary may occur early after calving and PPI was equal to 41.2 \pm 15.1 days and 29.5 \pm 9.4 days for females in group S and group C respectively but the difference between the two groups

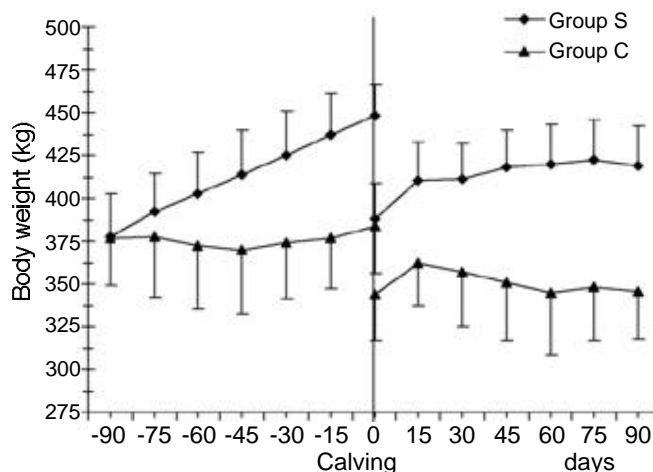


Figure 1. Evolution of body weight of dromedary females before and after calving — *Évolution du poids vif des femelles dromadaires avant et après la parturition.*

was not significant ($P > 0.05$). In the first 60 *post-partum* days, 71% and 44% females of the group S and group C were mated. After this date no mating was observed and the sire was not sexually active. The number of the mated females in group S (5/7) did not differ from the one in the group C (4/9) ($\chi^2 = 0.28$; $P > 0.05$).

4. DISCUSSION

The birth weight of the camel calf is found to be affected by level of nutrition. This finding was also reported for other farmer species such as cows (Charmly *et al.*, 1999) and ewes (Wallace *et al.*, 1996). The higher birth weight gives advantage for calves to grow and to have a good body weight at weaning. However, during the first month, nutritional requirements for young camel remain limited and a small quantity of milk is sufficient for a moderate gain. In the two subsequent months, difference in calf weight gain reflects difference in milk production between supplemented and unsupplemented females (Hammadi *et al.*, 1998).

Undernutrition during the last months of gestation could result in diminished rates of body weight gain, loss of body weight in dams and abortion of primiparous females. Weight losses at parturition are evaluated to 13 and 11% of the precalving weight and are, in agreement with value (13%) reported by Marston *et al.* (1995) for cows. During the *post-partum* period, females in group S were able to produce sufficient milk for calves and to gain 116 g/d in body weight. In contrast, females in group C lost more than 200 g/day specially to produce milk for their calves. These performances probably found expression of positive and negative energy balances for supplemented and unsupplemented females respectively.

The dromedary lasted in gestation for 12 months and three weeks which is not affected by dietary

effect. This finding is generally in agreement with other published works (Abdel Rahim, El-Nazier, 1993; Moslah, 1993).

Sexual activity in dromedary occurred after one month of calving. This finding is similar to the value (29 ± 12 days) reported by Abdel-Rahim and El-Nazier (1993) for three Najdi dromedary herds reared in a semi-intensive system. Despite enhancement in percentage of mated females by feeding supply was not statistically significant, the increase of 27% obtained in our study, could be a good justification to the dromedary farmers to supply their animal in reproductive period. As previously reported for dromedary (Hammadi *et al.*, 1998) and for cows (Lakhdissi *et al.*, 1988), duration of *post-partum* interval in suckling females is positively correlated to daily milk production. In high producing dairy cows, increased production had different effects on reproduction (Moallem *et al.*, 1997). When energy supply is insufficient, the mammary gland receives nutritional priority over the reproductive system due to an inverse relationship between production level and reproduction function (Nebel *et al.*, 1993).

5. CONCLUSION

Feed supplementation to female camels in the last phase of pregnancy and the beginning of lactation improves the birth weight of calves, the DBG of young and adult camels, and the percentage of females mated. However, it's more economic and practical for breeders in range to reduce period of supplementation to the two last months of gestation and the two first months after calving. Other research studies about interaction between nutrition, production and reproduction functions in dromedary are very important to improve the productivity of this species under arid range conditions.

Bibliography

- Abdel-Rahim SEA., El-Nazier AE. (1993). Factors affecting camel reproductive performance in tropics. *In* Saint Martin (ed.), *Peut-on améliorer les performances de reproduction des camélins ?* Paris 10–12 Septembre 1990. *Etud. Synth. IEMVT* **41**, p. 131–146.
- Charmly E., Small JA., McRae KB. (1999). Influence of post-calving supplemental protein on calf performance and reproductive efficiency for beef cows fed silage. *Can. J. Anim. Sci.* **79**, p. 97–106.
- Formigoni A., Cornil MC., Prandi A., Mordenti A., Rossi A., Portetelle D., Renaville R. (1996). Effect of propylene glycol supplementation around parturition on milk yield, reproductive performance and some hormonal and metabolic characteristics in dairy cows. *J. Dairy Res.* **63**, p. 11–24.
- Guerouali A., Zine-Filali R., Vermorel Wardeh MF. (1995). Maintenance energy requirements and energy utilization by dromedary at rest. (Actes du Séminaire sur l'élevage et l'alimentation du dromadaire. Douz, Tunisie, Oct. 1992). *Options Méditerranéennes*, Série B **13**, p. 59–69.
- Hammadi M., Khorchani T., Khaldi G., Abdouli H., Slimane N., Renaville R. (1998). Effect of dietary supplementation on productive and reproductive performance of dromedary camels under arid range conditions. *In* *Third Annual Meeting for Animal Production and Future Perspectives*. Abou-Dhabi, May 1998.
- Houghton PL., Lemenager RP., Horstman LA., Hendrix KS., Moss GE. (1990). Effects of body composition, *pre*- and *post-partum* energy level and early weaning on reproductive performance of beef cows and preweaning calf gain. *J. Anim. Sci.* **68**, p. 1438–1446.
- INRA. (1978). *Alimentation des ruminants*. Versailles, France : INRA, 598 p.
- Ismail M. (1990). Situation et perspectives de l'élevage camelin en Tunisie. *Rev. Rég. Arid.* **1/90**, p. 115–134.
- Lakhdissi H., Haddada B., Lahlou-kassi A., Thibier M. (1988). Conduite de la reproduction en grands troupeaux laitiers dans les conditions marocaines. II. Reprise de l'activité cyclique postpartum. *Rev. Elev. Méd. Vét. Pays Trop.* **41**, p. 441–447.
- Lalman DL., Williams JE., Hess BW., Thomas MG., Leisler DH. (2000). Effect of dietary energy on milk production and metabolic hormones in thin, primiparous beef heifers. *J. Anim. Sci.* **78**, p. 530–538.
- Marston TT., Lusby KS., Wettemann RP., Purvis HT. (1995). Effects of feeding energy or protein supplements before or after calving on performance of spring-calving cows grazing native range. *J. Anim. Sci.* **73**, p. 657–664.
- Moallem U., Kaim M., Folman Y., Sklan D. (1997). Effect of calcium soaps of fatty acids and administration of somatotropin in early lactation on productive and reproductive performance of high producing dairy cows. *J. Dairy Sci.* **80**, p. 2127–2136.
- Moslah M. (1993). L'amélioration de la productivité du dromadaire en Tunisie par la séparation précoce du chamelon et l'allaitement artificiel. *In* Saint Martin (eds), *Peut-on améliorer les performances de reproduction des camélins ?* Paris 10–12 Septembre 1990. *Etud. Synth. IEMVT* **41**, p. 225–237.
- Nebel RL., McGilliard ML. (1993). Interactions of high milk yield and reproductive performance in dairy cows. *J. Dairy Sci.* **76**, p. 3257–3268.
- SAS (1989). *SAS/STAT, User's Guide*, Version 6. 4th ed. Cary, NC: SAS Institute Inc.
- Wallace JM., Aitken RP., Cheyne MA. (1996). Nutrient partitioning and fetal growth in rapidly growing adolescent ewes. *J. Reprod. Fertil.* **107**, p.183–190.