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Protein and fat content in colostrum and milk of Barbarine ewes treated by water deprivation during late gestation-early lactation

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Abstract. The effect of water deprivation was investigated in Barbarine ewes raised under dry conditions. In experiment 1, 24 adult ewes were divided into two groups balanced for age and weight. Control ewes (C1) had free access to water while deprived ewes (D2) had free access to water only every 3 days during the last 15 days of pregnancy and the first 60 days of suckling. C1-ewes tended (P>0.05) to accumulate more colostrum at birth and within the first 24 h than ewes subjected to water deprivation. C1 and D1-ewes exhibited the same contents of protein and fat in colostrum. C1-ewes yielded more milk (P<0.01) than D1-ewes on days 30 and 60 post-partum. However, fat and protein contents of milk were similar in the two groups. In experiment 2, 24 adult ewes were allotted to treatments C2 and D2 as above except that for D2-ewes, water deprivation started 50 days before lambing up to 60 days postpartum. Colostrum yield and protein level were not affected (P>0.05) by water deprivation. However, colostrum fat increased (P<0.01) only at 2 hours post-partum. Milk production recorded in days 10 and 45 post-partum was higher (P<0.01) in C2-ewes. Milk fat was not affected (P>0.05) by water deprivation. However, protein concentration was higher (p<0.01) in the milk of D2-ewes and in the milk from C2-ewes controlled at 30, 45 and 60 days of lactation.

Keywords. Water deprivation – Barbarine ewes – Colostrum – Milk – Protein – Fat.

Taux protéique et lipidique du colostrum et du lait de brebis Barbarine ayant subi une privation d'eau durant la fin de la gestion et le début de la lactation

Résumé. *L'effet de la privation d'eau a été étudié chez les brebis Barbarine élevées dans des conditions sèches. Dans l'expérience 1, 24 brebis adultes ont été divisées en deux groupes équilibrés selon l'âge et le poids vif. Les brebis du lot témoin (C1) ont eu un accès libre à l'eau, tandis que les brebis du lot privé (D1) ont eu un accès à l'eau seulement un jour sur 3. L'essai s'est déroulé durant les 15 derniers jours de la gestation et les 60 premiers jours d'allaitement. Les brebis témoins ont une tendance, non significative à accumuler plus de colostrum à la naissance et dans les premières 24 heures par rapport aux brebis soumises à la privation d'eau avec des teneurs comparables en protéines et matières grasses. La production de lait aux jours 30 et 60* post partum *est plus élevée chez les témoins (p<0,01), avec une teneur comparable en matière grasse et en protéines. Dans l'expérience 2, 24 brebis adultes ont été soumises à des traitements C2 et D2 comme dans la 1ère expérience, sauf que la privation d'eau a été appliquée 50 jours avant l'agnelage et jusqu'à 60 jours après la mise-bas. La production de* colostrum *et le niveau des protéines n'ont pas été affectés (P>0,05) par la privation d'eau. Cependant, la teneur en matière grasse a augmenté (P<0,01) à deux heures post-partum. La production de lait a été plus élevée chez les témoins à 10 et 45 post-partum (P<0,01). La teneur en matière grasse du lait n'a pas été affectée (P>0,05) par la privation d'eau. Cependant, la concentration des protéines est plus élevée (p<0,01) dans le lait des brebis privées d'eau (D2) par rapport au lait des brebis témoins (C2) à 30, 45 et 60 jours de lactation.*

Mots-clés. *Privation d'eau – Brebis Barbarine – Colostrum – Lait – Protéines – Matière grasse*.

I – Introduction

Barbarine is the most common breed of sheep in Tunisia. The largest population of the Barbarine sheep is raised in the Center and the South of Tunisia where arid conditions and drinking water scarcity are prevailing. Breeds of ruminants native to arid lands exhibit better performances under harsh environmental conditions than their non native counterparts (Ben Salem *et al.,* 2011) and are able to withstand prolonged periods of undernutrition (Atti *et al.,* 2004) and water deprivation (Bayer and Feldmann, 2003). Late pregnancy and early lactation are critical periods for sheep, and any physiological stress during these stages may affect growth rate of the fetus (Dawson *et al.,* 1999), mammary gland development (Neville *et al.,* 2013), milk production (Aganga, 1992), colostrum yield and quality (Ocak *et al.,* 2005). Information about the combined effect of water stress and gestation – lactation stages in Barbarine breeds is scarce. The objective of this study was to determine the effect of water deprivation during late gestation-early suckling on fat and protein contents of *colostrum* and milk in Barbarine ewes raised under dry conditions.

II – Materials and methods

Two experiments were conducted in the experimental station of the National Institute of Agricultural Research of Tunisia (INRAT) at Bourbiaa (Latitude 36°38′N; longitude 10°07′E). The average annual rainfall is 350 mm. In each experiment 24 pregnant Barbarine ewes were provided from a flock of oestrous synchronised ewes. Dates of mating were recorded individually and animals were divided on the basis of gestational age. Ewes were divided into two groups and were subjected to one of two treatments. Ewes in treatment C (control) had a daily access to tap water and treatment D (deprivation) corresponds to water distribution once every three days where animals were subjected to an adaptation period (10 days). The first experiment (C1, D1) lasted 75 days and water regimes were applied from 2 weeks before lambing until 60 days after (December-February). The second experiment (C2, D2) lasted 110 days and water regimes were applied from 7 weeks before lambing until 60 days after (November- February). Ewes were placed in individual boxes, received 1 kg/ewe/day of barley straw and barley grains (0.5 kg) that was formulated to cover 140% of maintenance requirements of metabolisable energy of ewes. At lambing, the amount of colostrum accumulated was measured by hand stripping of one teat after an intramuscular (im) injection of 10 i.u. of oxytocin to ensure complete milk letdown (Doney *et al.,* 1979). The teat was then covered to prevent suckling. Milking was repeated at 0, 2, 15 and 24 h postpartum with the recorded amount multiplied by 2 to calculate total udder production. Each subsequent yield represented quantities secreted since the previous milking (Boland *et al.,* 2005). At each milking, the amount of colostrum was weighed and a 40 ml-sample was conserved and stored at –20°C for analysis of fat and protein. At 10, 30, 45, and 60 days after lambing, milk yield was determined according to Ricordeau *et al.* (1960). On each milk sampling and after lambs' withdrawn, ewes received an im injection of oxytocin and then were hand-milked. The harvested milk was discarded. Two hours later, the ewes received a second im injection of oxytocin and milk collected was weighed. The yielded volume was then multiplied by 12 to calculate daily milk production. Fat and protein contents were determined, after an adequate dilution, using an integrated milk analyser (Combifoss 5300, Foss Electric, Hillerød, Denmark). Data were analysed using the PROCMIXED procedure (SAS Version 9.1, SAS Inst. Inc., Cary, NC, USA).

III – Results and discussion

1. Colostrum yield, fat and protein contents

There was a wide variation in colostrum yield at each milking (Figs. 1 and 2). Hydrated ewes tended ($P>0.05$) to accumulate more colostrum at birth and within the first 24 h than ewes subject-

ed to water deprivation. The C1 and D1 ewes exhibited the same contents of protein and fat in colostrum. At lambing, the fat content averaged 9.12 and 10.04 g/L (S.E.M = 0.51) and protein content averaged 6.27 and 6.71 g/l (S.E.M. = 0.53) in C1 and D1 ewes respectively. Similarly, at 24 h after birth the values of protein and fat were respectively 4.11 ± 0.36 g/l and 4.74±0.62 g/l in C1 group and 4.06 ± 0.36 g/l and 5.76 ± 0.62 g/L in deprivation-group (P > 0.05). But in experiment 2, colostrums' fat increased (P<0.01) only at 2 hours post-partum (12.7 ± 0.88 g/l *vs* 17.1 ± 0.88 g/l in C2 and D2 ewes respectively). Colostrum production increased between 2 h and 24 h. Rekik *et al.* (2010) reported similar yields in the same sheep breed and season.

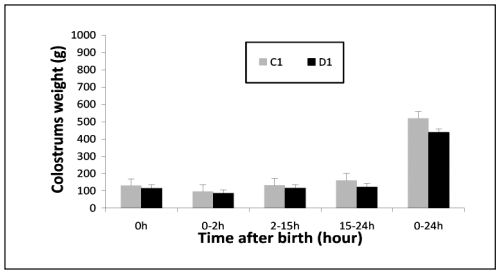

Fig. 1. Average weight (g) of colostrum accumulated at or secreted after parturition. Experiment 1.

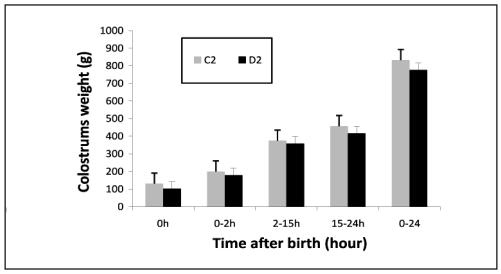

Fig. 2. Average weight (g) of colostrum accumulated at or secreted after parturition. Experiment 2.

2. Milk yield, fat and protein contents

The effect of water deprivation is more pronounced on milk production. In the first experience (Fig. 3) we showed that the C1 ewes yielded more milk (P<0.01) than the D1 ewes on days 30 and 60 post-partum (1487.4 ± 106.2 *vs* 1096.6 ± 106.2 g/24 h and 983.4 ± 70.2 *vs* 639.2 ± 70.2 g/24 h, respectively). However, the fat and protein contents of milk were similar among the two groups (Table 1). But in the second experience (Fig. 2) we showed that milk production recorded in days 10 and 45 post-partum was highest (P<0.01) in C2 ewes (1296 ± 296.4 *vs* 964 ± 216.5 g/24h and 579 ± 193.2 *vs* 370 ± 102.2 g/24 h respectively).

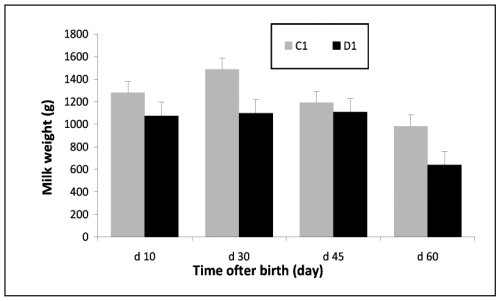

Fig. 3. Average weight (g) of milk secreted at different stage of lactation in experiment 1.

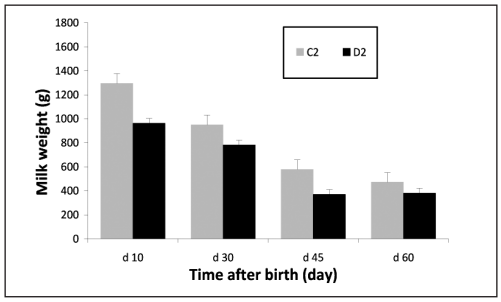

Fig. 4. Average weight (g) of milk secreted at different stage of lactation in experiment 2.

Milk fat was not affected (P>0.05) by water deprivation. However, protein concentration was higher (p<0.01) in the D2 ewes milk than that from C2 ewes controlled at 30, 45 and 60 days of lactation (Table 2). Our results are in line with those obtained by Aganga (1992) on ewes subjected

to 3 days of water deprivation. Different results were reported by Casamassima *et al.* (2008) who did not find any change in the quantity and quality of milk in Comisana sheep under water restriction despite of the decrease of ewes' live weight. Theses authors hypothesized that water restriction improved feed digestion through the increase of the retention time of feed particles in the rumen. Aganga (1992) reported that the milk produced by dehydrated ewes was much more viscous than that produced by watered ewes. Therefore, the protein, fat, ash and non-fat solids contents of the ewes' milk increased with more severe water restriction.

Table 1. Milk's fat and protein concentrations in experiment 1

	C1	D1	SEM, Effect
Fat (g/l)			
up to 10 days	8.475	8.430	0.354 ns
up to 10 days	7.056	6.743	0.456 ns
Protein (g/l)			
up to 10 days	3.900	3.871	0.121 ns
up to 10 days	4.198	3.992	0.143 ns

Table 2. Milk's fat and protein concentrations in experiment 2

	C2	D2	SEM, Effect
Fat (g/l)			
up to 10 days	6.331	7.072	0.373 ns
up to 60 days	7.056	6.249	0.771 ns
Protein (g/l)			
up to 10 days	3.830	4.015	0.136 ns
up to 60 days	4.479	5.336	0.171 **

ns: non significant;** significant difference $P < 0.01$).

IV – Conclusion

This study showed that during late autumn – winter season, watering ewes once every three days during late pregnancy and lactation resulted in decrease in milk and colostrum yield at different stages of lactation. However, fat and protein contents were not affected by these conditions, except for the experience 2.

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