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Blood parameters and feed intake in pregnant and lactating Barbarine ewes subjected to water deprivation

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Abstract. The effect of water restriction was assessed in Barbarine ewes: 24 adult ewes in the last 10 days of pregnancy were divided into two groups. Control ewes (C) had free access to water while deprived ewes (D) were *ad libitum* watered every 3 days during the last 10 days of pregnancy and the first 60 days of suckling. Body weight and score were measured every week, and feed and water intake were recorded daily for each animal. Venous blood was sampled during pregnancy, 2, 4 and 6 weeks of lactation and analyzed for electrolytes, glucose, urea, creatinine, total protein, triglycerides and cholesterol. A decrease in body weight was recorded at the end of the experiment in all ewes. However, the weight loss was significantly ($P<0.01$) greater in water-deprived animals as compared to the control. Feed intake was not affected by the treatment. Three days water deprivation induce changes in metabolism reactions which affected significantly ($P<0.01$) the level of the majority of electrolytes and metabolites measurers..

Keywords. Dehydration – Pregnancy – Lactation – Electrolytes – Metabolic – Sheep.

Métabolites sanguins et ingestion chez les brebis de race Barbarine en gestation ou allaitantes soumises à une privation d'eau

Résumé. *L'effet de la privation est évalué chez des brebis de race Barbarine: 24 brebis adultes gestantes (dans les derniers 10 jours de gestation) sont divisées en 2 lots. Un groupe témoin (C) qui a reçu de l'eau à volonté, et un groupe expérimental (D) qui n'a accès à l'eau qu'une fois tous les 3 jours. Le poids vif moyen a été mesuré chaque semaine et la prise alimentaire et de l'eau ont été enregistrées quotidiennement pour chaque animal. Les prélèvements sanguins sont effectués à partir de la veine jugulaire pendant la fin de la gestation, à 2, 4 et 6 semaines de lactation, pour analyse biochimique des électrolytes, glucose, urée, créatinine, protéines totales, triglycérides, cholestérol. Une diminution du poids corporel a été enregistrée à la fin de l'expérience. Cependant, la perte de poids était significativement (P <0,01) plus élevée chez les animaux du lot privé d'eau par rapport au lot témoin. La consommation d'aliments n'a pas été affectée par le traitement. La privation de 3 jours d'eau affecte significativement (P<0,01) la majorité des métabolites et des électrolytes mesurés*

Mots-clés. *Déshydratation – Fin de gestation – Lactation – Electrolytes – Métabolites – Brebis Barbarine.*

I – Introduction

Breeds of ruminants native to arid lands are able to withstand prolonged periods of water deprivation and graze far away from watering sites, sometimes 50 km or more far apart (Bayer and Feldmann, 2003). Within this context the largest population of the Barbarine sheep is raised in the Center and the South of Tunisia, a region that is characterized by arid conditions. Therefore, animals have to tolerate a stress environment due to high temperatures, and low food and water availability, especially during the dry season. Water deprivation was found to induce weight loss, hemoconcentration, increased serum protein, urea, creatinine, cholesterol and electrolytes concentration in sheep (Hamadeh *et al.*, 2006). On the other hand, the ewe's physiological status affects its biochemical responses to water deprivation (Aganga *et al.*, 1989). The process of milk synthesis imposes changes on almost all aspects of metabolism

(Annison *et al.*, 1984). The objective of this study is to determine whether water deprivation would change metabolic rate during late pregnancy and lactation in Barbarine ewes.

II – Materials and methods

The experiment was conducted in the experimental station of Bourbia of INRAT, Tunisia, from 10 December to 1 March. Twenty four adult ewes were divided into two groups balanced for age and weight. They were subjected to one of two treatments, Treatment C receiving water daily and Treatment D receiving water once every three days. Water restriction in Group D was imposed gradually first for one day, then for 2 days and thereafter for 3 days. Experimental ewes were kept in a single barn. The animals were fed a mixture of straw (1 kg/ewe/day) and barley (400 g/ewe/day) divided into two daily meals. Weight was recorded every 10 days. Throughout the experiment we recorded a daily feed and water intake for each animal. Blood samples were taken, every week, in the 3rd day of deprivation before watering and feeding, to determine plasma concentrations of glucose, urea, creatinine, total protein, cholesterol, triglycerides, sodium, potassium, calcium, magnesium, and phosphorus. Blood samples were collected in 10-ml vacuum tubes and centrifuged for 15 min at 3500 rpm. Blood metabolites and electrolytes were determined using electrolyte analyzer Genuis (Model GE200B; N.C: 300401101712). Data were subjected to statistical analysis using the ANOVA procedure of SAS program (SAS, 2005) with the water regime and time of measure as a source of variation.

III – Results and discussion

All the experimental animals lost weight by the end of the experiment. However, the weight loss was significantly greater in water-deprived animals as compared to the control, and in lactation stage as compared to the pregnancy (Table 1). this is thought to be due to deficient body liquids because water is requested for a correct rumination and digestion and the strong mobilization of fat for milk synthesis process. Li *et al*. (2000) found a decrease in body weight in winter (7%) and summer (11%) in sheep watered only in the evening (20:00 p.m.) as observed also by Cole (1995) in lactating sheep. Concerning food consumption, our results are in agreement with Mengistu *et al*. (2004) who did not find significant effects of water restriction on feed intake and that the loss of body weight is greatly influenced by the environmental temperature.

Table 1. Body weight and feed intake change (means±SD) under water deprivation on pregnant and lactating Barbarine ewes

Parameters	Treatment		Significance
	Once per 3 days watering	Daily watering	
Body weight (kg)			
Late pregnancy	60.17±7.59	58.46±5,37	ns
From birth up to 60 d in milk?	45.83±5.53	38.63±3.02	**
Feed intake (g)			
Last pregnancy	726.93±121.89	736.51±100.50	ns
From birth up to 60 d in milk?	1221.24±67.77	1203.06±76.61	ns

(ns) No Significant; **P<0.01.

Water deprivation had no significant effects on the blood levels of glucose. Hamadeh *et al.*, (2006) reported similar findings with respect to water restriction. The change in total protein, urea, creatinine, cholesterol, triglycerides, sodium and potassium was due to water deprivation because it causes hemoconcentration phenomena as result of a lower blood water level

(Casamassima *et al.*, 2008).Total protein concentration that often used to assess the level of hydration of the animal (Cork and Halliwell, 2002) was significantly affected by the treatment (P<0.001). In the study with Awassi sheep, Hamadeh *et al*., (2006) obtained the same results. Creatinine level, that was considered an indicator of reduced glomerular filtration rat (Keenan and Allardyce 1986), increased significantly under water deprivation hanging above the lactation. Similarly that Igbokwe, (1993) and Casamassima *et al.,* (2008) founded in different breeds. Contrarily results were previously reported in Aganga *et al.* (1989) obtained with Yankasa sheep. El-Shrif and Assad (2001) observed a sharp decrease in urea and creatinine in lactating ewes after parturition to approach those of the dry animals by the end of the first month. Water deprivation and lactation provoked a significant increase in cholesterol and triglycerides concentration as result of fat mobilization (Igbokwe, 1993). Similar results were detected by Hamadeh *et al.* (2006) in Awassi sheep.

Table 2. Metabolic changes provoked by water deprivation on pregnant and lactating Barbarine ewes

Parameters	Glucose (mmol/L)		Urea (mmol/L)		Creatinine (mmol/L)		Protein (g/L)		Triglyceride (mmol/L)		Cholesterol (mmol/L)	
Treatment	C	D	C	D	C	D	C	D	C	D	C	D
Pregnancy	2.80	2.90	9.24	9.08	87.80	82.00	74.00	67.80	0.16	0.16	1.62	1.60
Lactation	3.21	3.17	7.97	7.85	95.30	90.70	70.50	66.50	0.19	0.17	1.84	1.65
SE (p)	0.023	ns	0.079	ns	1.298	**	0.796	***	0.001	***	0.021	**

(ns) No Significant; (*)P < 0.05; (**) P < 0.01; (***) P < 0.001; SE (p): Standard error and significance.

Table 3. Electrolytes changes provoked by water deprivation on pregnant and lactating Barbarin ewes

Parameters	NA^+ (mmol/L)		K^+ (mmol/L)		Ca^{++} (mmol/L)		Mg^{++} (mmol/L)		P (mmol/L)	
Treatment	C	D	C	D	C	D	C	D	C	D
Pregnancy	138.20	136.60	4.00	3.99	1.74	2.04	0.62	0.69	1.45	1.22
Lactation	144.10	140.80	4.20	4.10	1.69	1.82	0.66	0.67	1.85	1.62
SE (p)	0.808	*	0.062	ns	0.043	**	0.009	**	0.018	***

(ns) No Significant; (*)P < 0.05; (**) P < 0.01; (***) P < 0.001; SE (p): Standard error and significance.

The effects of lactation on electrolytes reflect the mineral needs for milk production. Milk contains large amounts of Ca^{++} and K^+ (Collier, 1985) that would explain their decrease in plasma concentrations under lactation. Although Na^+ concentration is low in milk, the Na^+ requirements increase during lactation due to increased nutrient transport (Collier, 1985). On the other hand, concentration of plasma sodium was significantly higher under water deprivation according to results of Igbokwe (1993), while Ghosh *et al.* (1976) observed no significant effect of two-day water deprivation in Marwari sheep. This increase is probably the result of increased renal retention under the greater aldosterone activity. Water deprivation had no significant effects on the blood levels of K^+. Similar results are found By Igbokwe (1993) Hamadeh *et al*., (2006). However Aganga *et al.* (1989) indicated that plasma K^+ usually increases under dehydration in Yankasa sheep. Our result shown a significantly decrease in serum magnesium in the treated animals according Aganga *et al*. (1989). However, Parker *et al*. (2003) showed no effect of water deprivation on plasma magnesium.

IV – Conclusions

This study showed that during late autumn – winter, watering once every three days during late

pregnancy and lactation causes significant live weight loss especially in lactation and caused significant changes in many blood physiological indicators in lactating and pregnant Barbarine ewes. Despite these changes, we recorded a spectacular adaptive behavior which is developed by these ewes just after rehydration. Barbarine pregnant and lactating ewes can tolerate three successively days of water deprivation during 75 days between late pregnancy and the beginning of lactation without dramatic effect.

References

Aganga A.A., Umunna N.N., Oyedipe E.O. and Okoh P.N., 1989. Influence of water restriction on some serum components in Yankasa ewes. In: *Small Rumin. Res*., 2,. p. 19-26.

Annison E.F., Gooden J.M., Hough G.M. and McDowell G.H., 1984. Physiological cost of pregnancy and lactation in the ewe. In: Lindsay D.R. and Pearce D.T. (eds), *Reproduction in Sheep.* Cambridge University Press, UK, p. 174-181.

Bayer W. and Feldmann A., 2003. Diversity of animals adapted to smallholder system. Conservation and Sustainable Use of Agricultural Biodiversity. In: *Nat. Rev. Genet.,* 2, p. 130-138.

Casamassima D., Pizzo R. and Palazzo M., 2008. Effect of water restriction on productive performance and blood parameters in comisana sheep reared under intensive condition. In: *Small Rumin. Res.,* 78, p. 169-175.

Cole A.N., 1995. Influence of a three-day feed and water deprivation on gut fill, tissue weight and tissue composition in mature wethers. In: *J. Anim. Sci.,* 73, p. 2548-2557.

Collier R.J., 1985. Nutritional, metabolic, and environmental aspects of lactation. In: Larson B.L. (ed.), *Lactation*, Iowa State University Press, USA, p. 102-107.

Cork S.C. and Halliwell R.W., 2002. *The Veterinary Laboratory and Field Manual.* Nottingham University Press, UK, p. 302-314.

El-Sherif M.M.A. and Assad F., 2001. Changes in some blood constituents of Barki ewes during pregnancy and lactation under semi arid conditions. In: *Small Rumin. Res.,* 40, p. 269-277.

Ghosh P.K., Khan M.S. and Abichandani R.K., 1976. Effect of water deprivation in summer on Marwari sheep. In: *J. Agric. Sci. Cambridge,* 887, p. 221-223.

Hamadeh S.K., Rawda N., Jaber L.S., Habre A., Abi Said M. and Barbour E.K., 2006. Physiological responses to water restriction in dry and lactating Awassi ewes. In: *Livest. Sci.,* 101, p. 101-109.

Igbokwe, I.O. 1993. Haemoconcentration in Yankasa sheep exposed to prolonged water deprivation. In: *Small Rumin. Res*., 12, p. 99-105.

Keenan D.M. and Allardyce C.J., 1986. Changes of plasma creatinine levels of sheep during submaintenance feeding. In: *Aust. Vet. J*., 63, p. 29-30.

Li B.T., Christopherson R.J. and Cosgrove S.J., 2000. Effect of water restriction and environmental temperatures on metabolic rate and physiological parameters in sheep. In: *Can. J. Anim. Sci*., 80, p. 97-104.

Mengistu U., Dahlborn K., and Olsson K., 2004. Effect of intermittent watering on dry matter intake and body weight of male Ethiopian Somali goats. In: *J. Anim. Feed Sci*., 13 (Suppl. 1), p. 647-650.

Parker A.J., Hamlin G.P., Coleman C.J. and Titzpatrick L.A., 2003. Dehydration in stressed ruminants may be the result of acortisol-induced dieresis. In: *J. Anim. Sci.,* 81, p. 512-519.

Statistical Analysis Systems (SAS) Institute Inc., 2005. *User's Guide*, version 9.1. SAS 348 Institute, Inc., Cary, NC, USA.