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Mehdi W., Ben Salem H.

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Response of pregnant sheep to sadrinking water during early pregnancy

W. Mehdi* and H. Ben Salem

National Institute of Agronomy of Tunisia, Street Hédi Karray, 2049-Ariana, Tunis (Tunisia)
*e-mail: wiem_mehdi2000@yahoo.com

Abstract. Seventy Barbarine sheep aged 5 years were used to evaluate the influence of high intake of salty water of grazing ewes on growth performance, metabolites blood concentrations and physiological parameters. The two groups were randomly allotted a high-salt water (10 g NaCl / 1 l of water) or control water (potable fresh water, 0.5 g/l). Twice weekly body weight was recorded for each individual animal. Blood serum was collected at 30, 60 and 90 days of pregnancy for metabolites contents. Rectal temperatures, pulse rates, and respiration rates were recorded on day 45, 75 and 105 of pregnancy for measure of physiological test. Body weight differed during gestation (P<0.05), resulting in lower weight gain in the high-salt group in the first third of gestation until 75th day of pregnancy (-0.05 v. -0.01 kg/day) and higher weight gain in the final third of gestation (0.13 v. 0.07 kg/day). Glucose concentrations were high significantly lower (67.44 v. 82.38mg/dL P<0.001) in response to high-salt drinking as well as total protein concentration (97.15 v. 90.89 g/l P<0.05), presumably to achieve salt and water homeostasis. Triglycerides, cholesterol, albumin, urea, acid, creatinine and γ-GT concentration was not significantly affected by the water quality (P>0.05). Neither at the first month of the pregnancy, nor at days 75 and 105 during pregnancy, pulse rate, respiratory rate and rectal temperature were affected by the quality of water.

Keywords. Salty water – Sheep – Pregnancy – Metabolites Blood.

L'effet d'un stress salin sur des brebis gestantes pendant le début de la phase de gestation

Résumé. *Dans le but d'étudier l'effet d'un stress salin pendant le début de la phase de gestation sur les performances de croissance, la concentration en métabolites sanguins et les paramètres fœtaux, soixante-dix brebis de la race Barbarine âgées de 5 ans ont été utilisées. Les animaux ont été répartis de façon aléatoire en deux groupes et ont reçu soit de l'eau enrichie de sel (10 g NaCl / l d'eau) (S) soit de l'eau potable (0,5 g / l) (C). Le poids corporel a été enregistré toutes les deux semaines. A la fin de chaque mois de gestation, le sérum sanguin a été collecté afin d'analyser les métabolites sanguins (triglycérides, cholestérol, glucose, albumine, protéines totales, urée, acide urique, créatinine et Gamma glutantransferase). La température rectale, le rythme cardiaque et respiratoire ont également été notés. La consommation d'eau et les paramètres fœtaux n'ont été pas affectés par la qualité de l'eau. Les brebis recevant de l'eau enrichie de sel ont eu un gain de poids moyen quotidien supérieur après le jour 75 de gestation. La concentration de glucose et protéine totale ont été significativement diminuées sous l'effet de sel pendant le début de la phase de gestation.*

Mots-clés. *Sel – Brebis – Gestation – Métabolites Sanguines.*

I – Introduction

Salinity is an increasing problem in agriculture worldwide and the use of halophytic plants such as saltbush represents one of the few options available to revegetate salinised landscapes and re-establish grazing systems (Masters *et al*., 2007). Some landholders in Tunisia are grazing sheep on saltbush to fill a summer/autumn feed gap, a period that coincides with the greater demands of late pregnancy for autumn- or winter-lambing sheep. However, feeding saltbush or drinking salty water may possibly have a negative impact on growth performance of the sheep as high salt intake may reduce intake and cause physiological changes associated with adaptation to the

salt. High salt intake has been shown to reduce the efficiency of energy use for production (Blache *et al*., 2007) in sheep which is usually associated with a decrease in the concentration of metabolic hormones and metabolites blood (Chilliard *et al*., 2005). Thus, the objective of this work is to investigate the effect of drinking high-salt water during the first middle of pregnancy on the growth performance, the physiological parameters and the blood profiles in the pregnant-Barbarine sheep.

II – Materials and methods

Seventy Barbarine sheep, aged 5 years, and weighing on average 45 kg, were held at the Livestock Research Centre of National Institute of Agronomic Research at Ouslatia, Tunisia. After 15 days of adaptation from the day of mating, sheep were divided in two groups: experimental sheep drink high salt water (10 g/l NaCl; S- sheep; n = 35) or control sheep drink fresh potable water, normal salt (0.5 g/l NaCl; C-sheep; n = 35). About 0.4 kg barley grain per ewe was offered daily in the morning (09:00) and 0.8 kg hay was offered in the afternoon (18:00). During the day, sheep grazed pastures.

Animals were weighted twice weekly. Blood samples (9 ml) were collected from the jugular vein of each animal on days 30, 60 and 90 of pregnancy for metabolites blood analysis (triglyceride, cholesterol, glucose, albumin, total protein, uric acid, urea, creatinine and γ-GT). Plasma metabolites were analysed using BioSystem (Costa Brava, 30 Barcelone, Spain) kits. Rectal temperatures, pulse rates, and respiration rates were recorded on days 45, 75 and 105 between 9:00 and 11:00 h during data collection period.

Body weight, body condition score, metabolites blood concentrations and physiological parameters were arcsine-transformed prior to statistical analysis. All data were analysed by ANOVA. The C and S levels were regarded as fixed effect. Analysis of variance were undertaken using the proc GLM procedure of the SAS statistical package (SAS, 2004)

III – Results and discussion

Pregnant sheep that drunk high salty water during pregnancy show a difference in the daily live weight gain according to salt in water content especially on day 30 and 105 of pregnancy ($P<0.05$; Fig. 1).

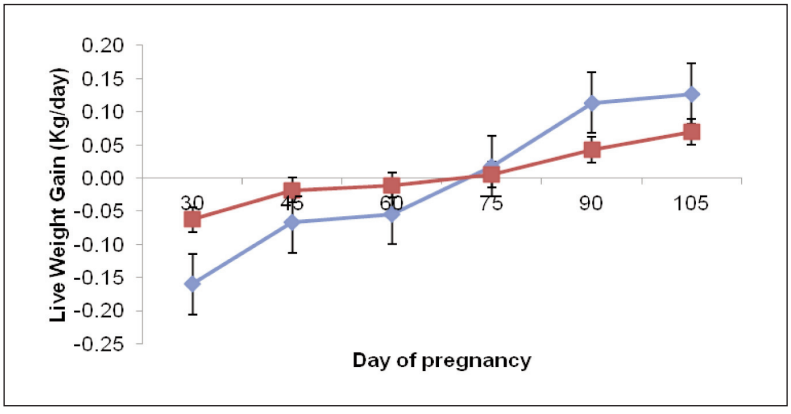

Fig. 1. Live weight gain of Barbarine ewes during the 105 days of pregnancy (Square shape: C-Sheep; Cubic shape: S-Sheep).

Sheep from the high-salt treatment showed an increased body weight elevated in ewes after day 90 of pregnancy. These results are similar to other studies in rats (Smriga *et al*., 2002) and humans (Curtis *et al*., 2004). Moreover, the high-salt sheep were 1 kg heavier than their control counterparts. Warren *et al*. (2001) found that by the end of pregnancy, an increase of 10 to 15% in total body water, which equates 3 to 5 kg more in weight when animals were fed saltbush.

Metabolites blood concentrations showed no significant change neither in C-Sheep nor in S-Sheep following either the water salt drinking until 90 days of pregnancy. Exceptionally for the glucose and γ-GT concentration which increased more after the salt drinking than the fresh water ($P<0.05$; Table 1).

Table 1. Metabolites blood levels of Barbarine ewe drinking potable water or salty water during early pregnancy

Metabolites blood	Day of pregnancy	Quality of water		SE	Effet of water
		Potable water	Salty water		
Triglyceride (mg/dL)	30	$17^{b} \pm 6$	$14^{b} \pm 6$	0.86	NS
	60	$17^{b} \pm 6$	$15^{b} \pm 8$	0.78	NS
	90	$54^{a} \pm 29$	$52^{a} \pm 35$	0.63	NS
Cholesterol (mg/dL)	30	$65^{b} \pm 12$	$66^{b} \pm 15$	0.25	NS
	60	$73^{b} \pm 15$	$67^{b} \pm 22$	1.34	NS
	90	86 ± 27	$87^{a} \pm 24$	0.22	NS
Glucose (mg/dL)	30	53 ± 17	53 ± 17	2.11	NS
	60	63 ± 23	59 ± 20	1.48	NS
	90	82 ± 45	67 ± 5	6.02	***
Albumin (g/l)	30	$32^{b} \pm 11$	$29^{b} \pm 11$	1.24	NS
	60	$34^{b} \pm 9$	$32^{b} \pm 10$	0.67	NS
	90	46 ± 16	$49^{a} \pm 18$	1.01	NS
Total protein (g/l)	30	$68^{b} \pm 20$	70 ± 19	0.69	NS
	60	$74^{b} \pm 13$	73 ± 20	0.45	NS
	90	$90^{a} \pm 9$	79 ± 15	3.02	*
Uric Acid (mg/dL)	30	1 ± 0	$1.1^{b} \pm 0.8$	0.13	NS
	60	1 ± 2	$1.3^{ab} \pm 1.2$	0.072	NS
	90	2 ± 1	$1.9^{a} \pm 1.3$	0.041	NS
Urea (mg/dL)	30	$19^{b} \pm 8$	$17^{c} \pm 10$	0.38	NS
	60	$31^{b} \pm 7$	$28^{b} \pm 11$	0.69	NS
	90	$68^{a} \pm 34$	$57^{a} \pm 26$	3.19	NS
Creatinine (mg/dL)	30	$1^{ab} \pm 0.9$	$1.3^{ab} \pm 0.7$	0.047	NS
	60	$1^{a} \pm 1$	$1.6^{a} \pm 0.7$	0.058	NS
	90	$1^{b} \pm 0.3$	$1.7^{b} \pm 0.3$	0.212	NS
Gamma glutantransferase (U/L)	30	$25^{a} \pm 14$	$19^{a} \pm 8$	2.07	NS
	60	$21^{a} \pm 15$	$13^{b} \pm 5$	2.47	NS
	90	$12^{b} \pm 5$	$10^{b} \pm 5$	0.98	*

SE, standard error of means; NS: $P>0.05$, *: $P<0.05$, ***: $P<0.001$; Data bearing the same superscript within a column are not different at $P<0.05$.

Balıkcı *et al*. (2005) showed that blood cholesterol and triglyceride levels increased with pregnancy compared to non-pregnant sheep. The plasma concentrations of glucose for both groups vary between 50 and 90 mg/dL which equal the normal values recorded for serum glucose found-

ed by Radostits *et al*., (2000). The total plasma protein concentration increased significantly with pregnancy (P<0.05). This increase in plasma total protein may be ascribed to the fact that the pregnant sheep divert more protein into their fetus which uses amino acids derived from the mother's body protein Albumin (Yildiz *et al.*, 2005). Creatinine, urea and γ-GT level increased in serum with pregnancy. These results were in general agreement with literature which quantify the biochemical indices in sheep during different stages of pregnancy (Khatun *et al*., 2011).

Neither at the first month of pregnancy, nor at days 75 and 105 during the pregnancy, pulse rate, respiratory rate and rectal temperature were affected by the salt content of drinking water (P>0.05; Table 2). Respiratory rates fluctuated throughout the study, ranging from 10 to 27 breaths per minute, and were higher than an average respiration rate of 19 breaths per minute in resting lambs (Tenney, 1977). Pulse rates fluctuated throughout the study, ranging from 26 to 38 beats per minute, and were lower than the expected range of 70 to 80 beats per minute (Dukes, 1964). Rectal temperatures were within the normal range (38.1 to 39.1) for S-sheep and C-Sheep (Anderson, 1977).

Table 2. Physiological parameters of Barbarine ewe drinking potable water or salty water during the early pregnancy

	Quality of water			
Day of pregnancy	**Potable water**	**Salty water**	**SE**	**Effet of water**
Pulse rate (Beats per min)				
45	27 ± 0.2	28 ± 0.1	0.26	NS
75	28 ± 1	29 ± 2	0.16	NS
105	35.5 ± 2	35.9 ± 1	0.21	NS
Respiratory rate (Respiration per min)				
45	18 ± 0.5	16 ± 0.4	0.55	NS
75	17 ± 2	16 ± 3	0.20	NS
105	18 ± 3	16 ± 2	0.43	NS
Rectal temperature (°C)				
45	38.3 ± 2	38 ± 1	0.025	NS
75	38.4 ± 0.1	38.5 ± 0.2	0.006	NS
105	38.5 ± 0.2	38.4 ± 0.2	0.029	NS

SE, standard error of means; NS, P>0.05.

IV – Conclusion

Barbarine ewes that drank high amounts of salt during early pregnancy did not show any adverse effects on metabolism, physiological parameters. It is most probable that ewes adapted to salted water by increasing gut water content to regulate osmolarity and may be to some extend their body protein mass.

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