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# Effects of water Salinity on milk Production and Several blood constituents of Barbarine Sheep in a Semi arid Climate

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## Abstract

Seventy lactating sheep were allotted into two groups (n=35). One group was offered potable water (5% NaCl) and another group was offered saline water containing 10% NaCl. Sheep were used to evaluate the influence of high drink salty water on milk yield, chemical and physical characteristics and metabolites blood concentrations. There are no significant effect of water salinity on milk yield, milk composition of fat and lactose and serum concentrations of glucose, total protein, uric acid, creatinine and γ-GT ($P>0.05$). Milk production on the 30 days of lactation for S-sheep was rich with protein, urea nitrogen concentrations ($P<0.05$) and low in mean somatic cells, pH, salinity and conductivity ($P<0.001$). Moreover, consuming saline water decreased serum triglyceride and cholesterol concentrations during the first month of lactation ($P<0.05$) and serum urea concentration during the second month ($P<0.01$).

**Keywords:** Salinity, sheep, milk, blood.

## Introduction

The importance of water quality has long been emphasized for cows, sows and sheep. One factor that influences water consumption is the salt. Water containing ≤ 13% of NaCl has been considered satisfactory for sheep[1]. Arjomandfar et *al.,*[2] showed that the saline water resulted in decreased milk production of the cows under heat stress. As well as, Jaster *et al.*,[3] noted a depression in the milk yield and a decline in the production persistency of the cows consuming tap water plus 2500 mg NaCl per L.

However, the available findings on the effect of water salinity on milk production of lactating sheep are limited and to some extent contradictory[4].

We investigated the effect of salinity water desalination on the milk yield, composition and physical characteristics and several blood constituents.

## Material and Methods

This study was carried during the period from November 2013 and March 2014 at Weslatia Research station, Kairoun governorate that belong to the National Institute of Agricultural research, Tunisia. Seventy lactating sheep, 5 years old with a mean body weight of 39.0 ±1.3 kg were assigned randomly into equal two groups (35 for each) to receive water containing either 0.5 (potable water; C) or 10 g per l of water (saline water; S). The mineral content of the water is shown in table 1.

**Table-1**
**Ionic Balance of potable water**

| Element | Content |
|---|---|
| Dry residue (mg/l) | 0.45 |
| pH | 7.22 |
| Sodium (mg/l) | 70.15 |
| Potassium (mg/l) | 1.64 |
| Calcium (mg/l) | 61.77 |
| Magnesium (mg/l) | 19.58 |
| Chlorure (mg/l) | 153.02 |
| Sulfate (mg/l) | 35.65 |
| Nitrate (mg/l) | 8.22 |
| Carbonate (mg/l) | 0.01 |
| Bicarbonate (mg/l) | 66.34 |

From the pregnancy to 120 days of lactation, all experimental animals received the different quality of water. On day 10, 30, 45, 60, 90 and 120th of lactation, milk and blood sampling were performed. Milk samples were obtained after injection of 1.5 ml of oxytocine in the auricular vein. At the time of milking, we noted the pH, conductivity and salinity. Milk fat, protein, lactose, urea nitrogen and mean somatic cells were analyzed by infrared spectrophotometer (Foss 4000 Milkscan; Foss Electric, Chemicals Analysis Laboratory, OEP, Tunisia).

Blood samples were obtained from the jugular vein. Serum was separated, after centrifugation of blood samples at 2000 rpm for 15 min, to determine the serum levels of triglyceride, cholesterol, glucose, total protein, uric acid, urea, creatinine and γ-GT using a commercial kits (BioSystem Costa Brava, 30 (Barcelone, Spain).

Milk yield, milk composition and physical characteristics and several blood constituents' data were analyzed by Proc Mixed of the SAS, using repeated measure ANOVA[5]. The data are reported as mean ± SE.

## Results and Discussion

**Results:** Increasing of salt level of the drinking did not significantly affect the milk production and composition in the present experiment (P>0.05), although the concentration of protein and urea nitrogen and the mean count cell on the 30 days of lactation were higher for S-sheep (P<0.05). The salinity, conductivity and pH of milk were high significantly affected by the water salinity used in the present experiment (P<0.01; Table 2). Although physical characteristics of milk were depleted following drinking saline water.

Serum concentrations of glucose, total protein, uric acid, creatinine and γ-GT were not influenced by the water salinity (P>0.05). While, serum concentrations of triglyceride and cholesterol on day 10 and 30 of lactation were lower in S-sheep than in control group. From day 45 to 90, serum urea levels tended (P<0.05) to be lower in lactating sheep on saline water (Table 3).

**Discussion:** We didn't noted a significant change in milk yield, composition and physical characteristics and several blood constituents for lactating sheep under salt stress. although the triglyceride, cholesterol and urea concentrations in the blood serum were significantly decreased. Homeostatic mechanisms control the level of minerals in body fluids; therefore, the concentrations of metabolites tend to stabilize after a period of saline water intake[5].Increased serum metabolites concentration in the sheep offered water containing a higher salt level may become detrimental to homeostasis in the long term. The inconsistencies observed on the effect of salt level on lactating sheep could partly be due to experimental protocols, such as the number of sheep, source of water, the level of salt used, the duration of the treatment, and the presence of minerals that may affect the performance but are not measured in such studies; usually, those minerals that are important in contributing to salt levels are measured[6].

**Table-2**
**Effects of water salinity on milk production chemical and physical characteristics of Barbarine sheep in a semi arid climate**

| **Day of lactation** | **C-sheep** | **S-sheep** | **SE** | **P** | **C-sheep** | **S-sheep** | **SE** | **P** | **C-sheep** | **S-sheep** | **SE** | **P** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Milk yield (ml)** | | | | **Fat (%)** | | | | **Proteine (%)** | | | |
| 0 | 84.43 | 76.68 | 0.31 | NS | 12.74 | 13.33 | 0.07 | NS | 15.31 | 19.25 | 1.22 | NS |
| 10 | 42.79 | 41.87 | 1.71 | NS | 4.29 | 4.18 | 0.03 | NS | 4.58 | 4.71 | 0.54 | NS |
| 30 | 33.90 | 29.75 | 1.24 | NS | 3.56 | 2.83 | 1.71 | NS | 4.10 | 4.61 | 0.18 | * |
| 45 | 29.60 | 27.4 | 2.07 | NS | 2.80 | 3.15 | 0.09 | NS | 2.36 | 2.22 | 0.01 | NS |
| 60 | 22.17 | 18.52 | 0.45 | NS | 3.10 | 3.18 | 0.01 | NS | 2.15 | 2.39 | 0.07 | NS |
| 90 | 16.82 | 14.27 | 0.29 | NS | 2.75 | 2.98 | 0.01 | NS | 1.95 | 2.11 | 0.21 | NS |
| | Lactose (%) | | | | Urea Nitrogen (mg/dl) | | | | Mean Somatic Cells | | | |
| 0 | 3.11 | 3.15 | 0.012 | NS | 11.40 | 9.24 | 0.72 | NS | 22.66 | 28.33 | 1.89 | NS |
| 10 | 2.96 | 2.66 | 0.03 | NS | 15.35 | 16.09 | 0.22 | NS | 32.85 | 35.68 | 0.94 | NS |
| 30 | 2.85 | 2.77 | 0.05 | NS | 17.32 | 20.42 | 1.02 | *** | 48.38 | 49.55 | 0.39 | *** |
| 45 | 2.73 | 2.66 | 0.02 | NS | 16.72 | 16.97 | 0.17 | NS | 56.72 | 56.55 | 0.05 | NS |
| 60 | 2.47 | 2.67 | 0.06 | NS | 12.51 | 13.22 | 0.12 | NS | 72.76 | 74.80 | 0.67 | NS |
| 90 | 2.35 | 2.48 | 0.05 | NS | 11.85 | 12.98 | 0.35 | NS | 82.60 | 78.80 | 0.88 | NS |
| | Conductivity (mS/cm) | | | | Salinity | | | | pH | | | |
| 0 | 4.05 | 3.01 | 0.12 | *** | 2.50 | 2.16 | 0.73 | *** | 7.05 | 6.94 | 0.34 | *** |
| 10 | 4.54 | 3.40 | 0.23 | ** | 2.57 | 2.35 | 0.48 | *** | 7.08 | 6.86 | 0.95 | *** |
| 30 | 4.67 | 3.59 | 0.08 | ** | 2.72 | 2.45 | 0.28 | *** | 7.01 | 6.94 | 0.37 | * |
| 45 | 4.19 | 3.17 | 0.60 | * | 2.47 | 1.92 | 0.66 | * | 7.02 | 7.03 | 0.08 | NS |
| 60 | 3.88 | 4.08 | 0.05 | NS | 2.41 | 2.62 | 0.105 | NS | 7.01 | 6.99 | 0.05 | NS |
| 90 | 3.64 | 3.68 | 0.01 | NS | 2.45 | 2.42 | 0.01 | NS | 6.74 | 6.80 | 0.15 | NS |

SE: standard error of means; NS: P > 0.05; *: P < 0.05; **: P < 0.01; ***: P<0.001

**Table-3**
**Effects of water salinity on several blood constituents of Barbarine sheep in a semi arid climate**

| Day of prgnancy | C-sheep | S-sheep | SE | P | C-sheep | S-sheep | SE | P | C-sheep | S-sheep | SE | P | C-sheep | S-sheep | SE | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Triglyceride (mg/dL)** | | | | **Cholesterol (mg/dL)** | | | | **Glucose (mg/dL)** | | | | **Total protein (g/l)** | | | |
| 30 | 17.53 | 14.91 | 0.16 | NS | 65.37 | 66.09 | 0.85 | NS | 53.48 | 61.83 | 0.11 | NS | 68.52 | 70.59 | 0.21 | NS |
| 60 | 17.34 | 15.01 | 0.28 | NS | 37.17 | 67.95 | 0.34 | NS | 63.46 | 59.06 | 0.48 | NS | 74.46 | 73.17 | 2.26 | NS |
| 90 | 54.62 | 52.73 | 0.83 | NS | 86.42 | 87.11 | 0.92 | NS | 82.38 | 63.64 | 0.02 | *** | 90.89 | 79.15 | 0.58 | NS |
| 120 | 83.28 | 67.86 | 0.64 | * | 89.86 | 100.08 | 0.3 | NS | 88.98 | 67.44 | 0.04 | *** | 27.26 | 23.35 | 1.03 | NS |
| 150 | 120.85 | 105.84 | 1.12 | * | 104.88 | 109.31 | 0.81 | NS | 115.42 | 95.11 | 1.74 | *** | 23.64 | 21.44 | 0.67 | NS |
| | Uric Acid (mg/dL) | | | | Urea (mg/dL) | | | | Creatinine (mg/dL) | | | | ɤ-glutantransferase (U/L) | | | |
| 30 | 1.58 | 1.18 | 0.13 | NS | 19.33 | 17.87 | 0.38 | NS | 1.5 | 1.37 | 0.57 | NS | 25.52 | 19.36 | 0.07 | NS |
| 60 | 1.55 | 1.31 | 0.72 | NS | 31.07 | 28.75 | 0.69 | NS | 1.87 | 1.68 | 0.58 | NS | 21.88 | 13.2 | 0.47 | NS |
| 90 | 2.12 | 1.98 | 0.71 | NS | 68.68 | 57.06 | 0.19 | NS | 1.05 | 1.7 | 0.22 | NS | 12.81 | 10.04 | 0.08 | NS |
| 120 | 2.70 | 2.57 | 0.48 | NS | 78.12 | 72.64 | 0.41 | NS | 1.19 | 1.07 | 1.34 | NS | 10.85 | 8.15 | 0.11 | NS |
| 150 | 6.15 | 5.60 | 0.89 | NS | 112.01 | 110.89 | 0.01 | NS | 1.65 | 1.80 | 0.5 | NS | 8.70 | 6.82 | 1.11 | NS |

SE: standard error of means; NS: $P > 0.05$; *: $P < 0.05$; ***: $P<0.001$

Saline water tended to increase the plasma levels of minerals and thyroid hormones[7]. Our results agree with Valtorta et *al.,*[9], who showed an insignificant effect of lactating grazing Holstein cows drinking water with 10,000mg/l of total dissolved solids. Jaster *et al.*[3] showed a milk production less than 2kg for cows on salt water, and stated that although the difference was small, it reflected a trend which, if extended over the entire lactation, could be dramatic. Solomon *et al.*[7] found increases in water intake, milk production, and milk composition (lactose, protein, fat), although dry matter intake was not influenced by the water type. According to Bahman *et al.*,[8], the quality of the water did not significantly affect the milk production and composition of cows. The indifferences on the milk yield in these experiments may reflect the indifferences in water consumption[2] or the indifference in mineral concentration in milk yield[3]. But, these two factors were not measured in our study. Under non-grazing conditions, Sánchez et *al.,*[10] also found that feeding high amounts of sodium does not reduce milk production or lactation performance. Milk protein and urea nitrogen presented high concentrations in S-sheep ($P<0.05$). Those results disagree with Revelli et *al.,*[11], Valtorta et *al.,*[9].

## Conclusion

These results indicate that consideration of salt alone would be not enough to characterize drinking water quality. More studies should be pointed out that, given the ability of lactating sheep to excrete high amounts of minerals waters that lead to elevated mineral excretion could induce environmental contamination problems.

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