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# EFFECT OF PROLONGED DRINKING SALINE WATER ON THE BLOOD PICTURE OF GROWING LAMBS

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## SUMMARY

Twenty-four male Barki lambs, at an average 10.4 ± 0.1 months of age and 26.0 ± 0.8 kg. body weight, were equally divided into two groups: one of which was used as a control (fresh-water treated) group while the other one was used as a saline (13.1 g / TDS) treated group. Drinking salin water was prepared by daily dilution of sea water (39.3 g / TDS). The experiment extended from December 1992 to September 1994 (21 months). Anticoagulated blood samples were collected pretreatment (zero-time), thereafter at monthly intervals for six months and every three months during the rest period of treatment.

The results reflected that successive growth of fresh-water treated lambs was accompanied by a tendency of increasing in red blood cells (RBCs), segmented neutrophils (SN), eosinophils (EOS), basophils (BAS) and lymphocytes (LYM) counts. Packed cells volume (PCV) and hemoglobin concentration (HB) showed the same trend by advancing age. However, monocytes (Mon) counts showed a reverse trend where it tended to decline by advancing age.

Although saline-treated rams showed a haemodilution phase during the first six months of treatment, they could keep the concentration of HB relatively high due to its increased concentration within the cells. However, after six months of treatment, saline-treated rams showed higher rates of elevation in RBCs, PCV, HB, mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) than the control corresponding values and this trend predominated during the rest period of treatment. This coincided with a marked reduction in the mean corpuscular volume (MCV) of saline-treated rams than the control values from 6th month of treatment up to the 21st month. The results might reflect a haemoconcenration phase, in addition to the noticeable shrinkage in the red cells, following the long-term saline treatment of rams.

Saline-treated rams showed a marked reduction in WBCs, SN, EOS, BAS and LYM as compared with that of the control values from the 6th month of treatment up to the 21st month. This coincided with a marked increase in band neutrophils (BN) and MON than the control values. Reduction in EOS and LYM cells count might reflect that salt stress caused pituitary gland to release ACTH which in turn caused deptetion of these cells. The increase in BN counts of saline-treated rams coincided with marked reduction in SN counts, reflecting an alteration in the boneing marrow production of neutrophils under long-term salt stress. In addition, monocytosis might reflect a chronic infammatory process due to the accumulative salt load.

There were mild adverse effects on health of rams grown on drinking diluted sea water (13.1 g/l TDC)for about 21 months, as some alterations in their blood picture as an adaptive response under the accumulative salt stress.

## INTRODUCTION

Scarcity of fresh-water is one of the main stresses that adversely affect the animals raised in arid and semi-arid regions such as the North Western Coast of Egypt. Under such desert conditions, weaned lambs may be forced to grow on drinking salty underground water. Atwa (1979) found that the total dissolved salts (TDS) in wells along the northern coastal region of western desert of Egypt varied from 360 ppm to 10797 ppm. However, in wells of Wadi Araba at the eastern desert, TDS varied from 16210 ppm to 30082 ppm (Agour, 1990).

Many investigations have been conducted to study the performance and productivity of sheep raised on drinking natural or artificial saline water. It has been recommended that the tolerable salt concentration by sheep ranged from 1.1 to 1.3% of the chloride-type water (Pierce, 1966). However, most of previous studies were conducted for relatively short term and scarce informations can be found on the accumulative effect of drinking these salty ranges by growing animals for a long period.

The present investigation was conducted to study the influence of prolonged administration of the recommended tolerable salt concentration (1.3 % TDS) on haematological parameters of the growing lambs.

## MATERIAL AND METHODS

The experiment was conducted at Maryout Research Station, 35 Km, west of Alexandria. Twenty-four male Barki lambs, of an average 10.4 ± 0.1 months of age and 26.0 + 0.8 Kg. body weight, were equally divided into two groups. The first group was offered fresh-water (0.3 g/I TDS) and represented the control group. The second group was offered saline water (13.1 f/I TDS) and represented the saline treated group. Drinking saline water was prepared by daily dilution of sea water (39.3 g/ TDS). Experimental animals were offered maintenance and growth requirements according to the Agriculture. Research Council (A. R. C) (1965) allowances. Water and food were offered once daily at 08.00 o'clock. The experiment extended from December 1992 to September 1994 (21 months).

Anticoagulated jugular venous blood ramples (using ethylene diamine tetra acctic acid, EDTA) were collected pretreatment (zero-time), thereafter at monthly intervals for six months and every three months during the rest period of treatment. Red blood cells (CRCs) ($X10^6$ / cmm) and white blood cells (WBCs) ($X\ 10^3$ / cmm) counts were determined by using a haemocytometer slide (Kolmer et al., 1951). Packed cells volume (PCV) (percentage) (using Wintrob method) and haemoglobin (HB) concentration (g / dl) (Crosby et al., 1954) were also determined. Leukocytes differential counts ($X\ 10^3$ / cmm) were also made on blood smears stained with Leishman's stain Mean corpuscular volumes (MCV) (fl), mean corpuscular haemoglobin (MCH) (picogram) and mean corpuscular haemoglobin concentrations (MCHC) (g / dl) were also calculated.

Because of the wide range of individual variation, in addition to the growing status of the experimental animals, all the haematological data were adjusted to their zero-time values to measure the percentage change in each parameter for each individual animal. The trend of these changes is demontrated in figure (1) and (2). The mean zero-time values of all haematological parameters for the two experimental groups are illustrated in tables (1) and (1). The percentage changes in each haematological parameter for the control and saline-treated animals at each time of measurement were analyzed separately by using one-way analysis of variance between treatment using Stat Graphics (version 5.0).

## RESULTS AND DISCUSSION

The results in fig. (1) and (2) might reflect that the successive growth of fresh-water treated growing lambs was accompanied by a tendency of increasing RBCs WBCs, segmented neutrophils (SN), eosinophils (EOS), basophils (BAS) and lymphocytes (LYM) counts and PCV values. The rate of elevation in these haematological parameters closely followed the rate of change in the body weight gain where it was rapid during the first six months and relatively slow during the rest period of treatment. The average body weight of these animals was increased by about 14 kg. during the first six months (2.3 kg / month), however, it was increased by only about 26 kg. during the next fifteen months of treatment (El-Sherif and El-Hassanein, 1996) which reflects that blood of the control growing lambs concentrates by advancing age in a rate following that of their body weight gain. Contradictly, the results reflected that monocyte cells (MON) counts tended to decline by increasing age and weight of the control animals (Fig. 2).

During the first six months of treatment, saline-treated rams showed relatively low rates of elevation in RBCs counts and PCV values as compared with that of the control group (Fig 1). This may reflect a haemodilution phase due to marked increase in their water consumption under salt stress. Assed et al. (1994) found that water intake increased from fresh to low or high saline-treated sheep and this tolerance was an adaptation to ingest saline water and is due to physiological changes in their kidney function. The rate of change in RBCs / and PCV / coincided with slightly higher concentrations of HB than the control values. This was achieved by increasing MCH and MCHC values, keeping higher HB levels which seemed to be of physiological importance for the saline-treated rams. Georrgiev (1968) found that poisoning with sodium chloride may cause an elevation in haemoglobin concentration, reduction of oxyhaemoglobin in tissues and increase in venous blood. The present results were in agreement with those in cats, rabbits and hens (Georgiew, 1968), in rams (Hussein et al 1990) and in goats (Ibrahim, 1995).

After six months of treatment, saline-treated rams showed higher rates of elevation in RBCs counts, PCV values, HB concentration and MCHC than the control corresponding values (Fig. 1). This coincided with a marked reduction in MCV during the same period of treatment. Elevations in HB concentration during the 9th - 15th months period of saline-water treatment were significantly higher than those of the control group (Table 1). In addition, plasma volume of the same animals was significantly less than the corresponding control value during the same period of treatment (El-Sherif and El-Hassanein, 1996). These resuts might reflect a haemoconcentration phase, in addition to the noticeable shrinkage of the red cells, following the long-term saline treatment of rams. Similarly, Weeth et al. (1960) found that drinking water containing 1.0 % and 2.0 % salt caused varying degrees of anhydremia resulting in an elevation of specific gravity and haematocrit value in the blood of heifers. Elevation in RBCs count and PCV value of long-term saline-treated animals might reflect that they compensate, to a large extent, for red cells shrinkage by increasing these cells number to achieve a PCV value higher than that of the control corresponding values.

On the other hand, saline-treated rams showed a slight tendency of increasing WBCs, SN, EOS and LYM counts than the control corresponding values during the first three months of treatment (Fig. 2). It was found that gastroenteritis may

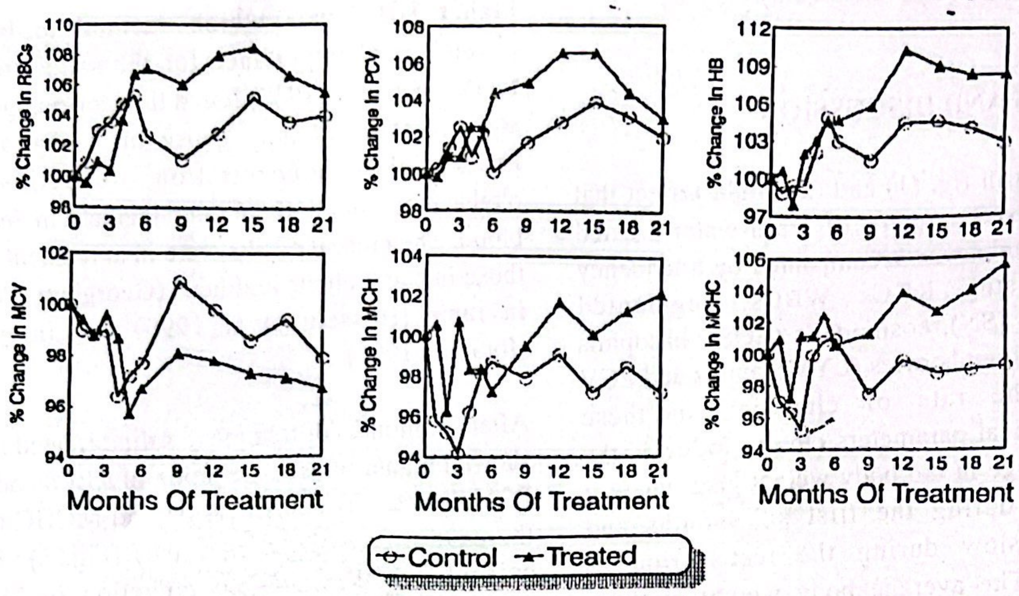


Fig. (1)- Percentage Change In Red Blood Cells Count And Red Cells Parameters (relative to zero-time values) For Control And Saline-treated (13.1 g/l TDS) Growing Rams.

( RBCs = Red Blood Cells count ; PCV = Packed Cells Volume ; HB = Haemoglobin Concentration ; MCV = Mean Corpuscular Volume; MCH = Mean Corpuscular Haemoglobin ; MCHC = Mean Corpuscular Haemoglobin Concentration.)

Table (1)- Mean absolute values of red blood cells count and red cells parameters of control and saline-treated rams at different times of measurements.

| Months Of Treatment | RBCs ($x10^6$/cmm) | | PCV (%) | | HB (g/100ml) | | MCV (fl) | | MCH (picogram) | | MCHC (g/dl) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FW | SW | FW | SW | FW | SW | FW | SW | FW | SW | FW | SW |
| Zero-time | 5.930 | 5.570 | 30.400 | 30.900 | 9.920 | 9.720 | 51.700 | 56.600 | 17.300 | 17.800 | 33.500 | 31.500 |
| 1st Month | 5.983 | 5.550 | 30.500 | 30.833 | 9.808 | 9.783 | 51.162 | 56.261 | 16.565 | 17.888 | 32.492 | 31.789 |
| 2nd Month | 6.108 | 5.625 | 30.833 | 31.167 | 9.875 | 9.525 | 51.090 | 55.903 | 16.468 | 17.118 | 32.244 | 30.628 |
| 3rd Month | 6.142 | 5.592 | 31.167 | 31.167 | 9.875 | 9.917 | 51.196 | 56.358 | 16.302 | 17.925 | 31.880 | 31.834 |
| 4th Month | 6.217 | 5.775 | 30.667 | 31.667 | 10.142 | 10.017 | 49.825 | 55.855 | 16.641 | 17.505 | 33.451 | 31.844 |
| 5th Month | 6.242 | 5.942 | 31.083 | 31.667 | 10.417 | 10.158 | 50.251 | 54.165 | 16.967 | 17.492 | 33.766 | 32.257 |
| 6th Month | 6.092 | 5.967 | 30.417 | 32.250 | 10.225 | 10.183 | 50.503 | 54.755 | 17.067 | 17.301 | 33.806 | 31.642 |
| 9th Month | 6.000 | 5.908 | 30.917 | 32.417 | 10.075 | 10.292* | 52.155 | 55.531 | 16.936 | 17.707 | 32.637 | 31.884 |
| 12th Month | 6.100 | 6.017 | 31.250 | 32.917 | 10.375 | 10.725* | 51.580 | 55.327 | 17.150 | 18.107 | 33.348 | 32.695 |
| 15th Month | 6.242 | 6.042 | 31.583 | 32.917 | 10.400 | 10.600* | 50.951 | 55.100 | 16.821 | 17.809 | 33.059 | 32.323 |
| 18th Month | 6.150 | 5.942 | 31.333 | 32.250 | 10.333 | 10.533 | 51.372 | 54.959 | 17.038 | 18.026 | 33.140 | 32.742 |
| 21th Month | 6.175 | 5.883 | 31.000 | 31.833 | 10.217 | 10.533 | 50.597 | 54.751 | 16.808 | 18.193 | 33.194 | 33.201 |

N.B.: RBCs= Red blood cells; PCV= Packed cells volume; HB= Haemoglobin concentration; MCV= Mean corpuscular volume; MCH= Mean corpuscular haemoglobin; MCHC= Mean corpuscular haemoglobin concentration; FW= Fresh-water treated; SW= Saline-water treated (13.1 g/l TDS).

* = Difference due to treatment in percentage change from zero-time value is significant ($p < 0.05$).

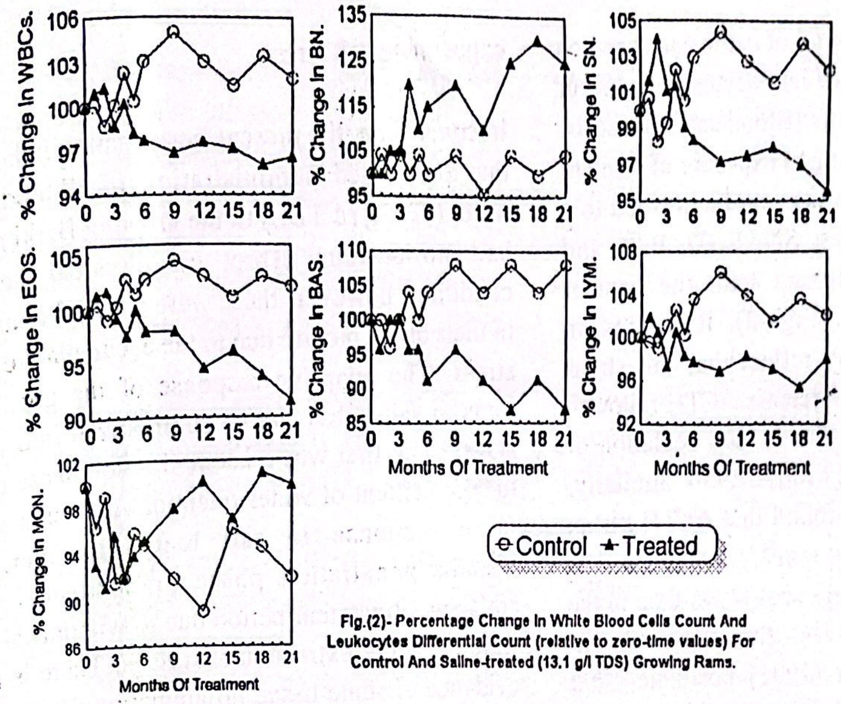


Fig.(2)- Percentage Change In White Blood Cells Count And Leukocytes Differential Count (relative to zero-time values) For Control And Saline-treated (13.1 g/l TDS) Growing Rams.

(WBCs=White blood cells; BN= Band neutrophils; SN= Segmented neutrophils; EOS= Eosinophils; BAS= Basophils; LYM= Lymphocytes; MON= Monocytes)

Table (2)- Mean absolute values of white blood cells and leukocyte differential counts of control and saline-treated rams at different times of measurements.

| Months Of Treatment | WBCs ($x10^3$/cmm) | | BN ($x10^3$/cmm) | | SN ($x10^3$/cmm) | | EOS ($x10^3$/cmm) | | BAS ($x10^3$/cmm) | | LYM ($x10^3$/cmm) | | MON ($x10^3$/cmm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FW | SW | FW | SW | FW | SW | FW | SW | FW | SW | FW | SW | FW | SW |
| Zero-time | 12.500 | 11.300 | 0.023 | 0.020 | 5.827 | 4.997 | 0.324 | 0.293 | 0.025 | 0.023 | 6.000 | 5.400 | 0.309 | 0.535 |
| 1st month | 12.517 | 11.417 | 0.024 | 0.021 | 5.868 | 5.080* | 0.326 | 0.297 | 0.025 | 0.021 | 5.975 | 5.500 | 0.298 | 0.498 |
| 2nd month | 12.342 | 11.450 | 0.023 | 0.020 | 5.727 | 5.196 | 0.321 | 0.298 | 0.024 | 0.023 | 5.942 | 5.425 | 0.306 | 0.488 |
| 3rd month | 12.508 | 11.158 | 0.024 | 0.021 | 5.785 | 5.054 | 0.325 | 0.291 | 0.025 | 0.023 | 6.067 | 5.258 | 0.283 | 0.512 |
| 4th month | 12.783 | 11.317 | 0.023 | 0.024** | 5.960 | 5.068 | 0.333 | 0.286 | 0.026 | 0.022 | 6.158 | 5.425 | 0.284 | 0.492 |
| 5th month | 12.550 | 11.100 | 0.024 | 0.022* | 5.860 | 4.953 | 0.329 | 0.293 | 0.025 | 0.022 | 6.017 | 5.308 | 0.296 | 0.502 |
| 6th month | 12.892 | 11.042 | 0.023 | 0.023* | 6.001 | 4.918 | 0.333 | 0.287 | 0.026 | 0.021 | 6.217 | 5.283 | 0.293 | 0.509 |
| 9th month | 13.125 | 10.950 | 0.024 | 0.024** | 6.084 | 4.859 | 0.339 | 0.287 | 0.027 | 0.022 | 6.367 | 5.233 | 0.284 | 0.524 |
| 12th month | 12.892 | 11.033 | 0.022 | 0.022* | 5.993 | 4.870 | 0.334 | 0.276 | 0.026 | 0.021 | 6.242 | 5.308 | 0.275 | 0.536** |
| 15th month | 12.683 | 10.983 | 0.024 | 0.025** | 5.918 | 4.896 | 0.328 | 0.282 | 0.027 | 0.020 | 6.092 | 5.242 | 0.297 | 0.519 |
| 18th month | 12.942 | 10.858 | 0.023 | 0.026** | 6.051 | 4.845 | 0.334 | 0.275 | 0.026 | 0.022 | 6.217 | 5.150 | 0.292 | 0.540 |
| 21th month | 12.750 | 10.917 | 0.024 | 0.025** | 5.959 | 4.771 | 0.331 | 0.268 | 0.027 | 0.020 | 6.125 | 5.300 | 0.284 | 0.534 |

N.B.: WBCs= White blood cells; BN= Band neutrophils; SN= Segmented neutrophils; EOS= Eosinophils; BAS= Basophils; LYM= Lymphocytes; MON= Monocytes; FW= Fresh-water treated; SW= Saline-water treated (13.1 g/l TDS).

*= Difference due to treatment in percentage change from zero-time value is significant ($p < 0.05$).

**= Difference due to treatment in percentage change from zero-time value is highly significant ($p < 0.01$).

occur due to salt poisoning of cattle and sheep on drinking saline water and leukocytosis may occur due to this gastroenteritis (Blood and Rodostitis, 1989). However, prolonged exposure of rams to the salt stress for more than six months led to a marked drop in WBCs, SN, EOD, BAS and LYM counts as compared with the control corresponding values (Fig. 2). Reduction in LYM cells counts may reflect that salt stress caused pituitary gland to release ACTH followed by cortisone which in turn caused depletion of this cell (De Groot and Morris, 1950. Similarly, Kawashti et al. (1983) found that ACTH serum activity in saline-treated rams (1.5 %) tended to be higher and eosinophil count lower than in the fresh-water group. On the other hand, Hutchnison and Boxer (1991) postulated that acute infection, particularly that associated with acute inflammation, may lead to decreased peripheral eosinophils count and this eosinopenia may be due either to sequestration at the inflammatory sites or to suppression of eosinophilopoiesis with gradual depletion of marrow eosinophil stores. In addition, Roth and Pintea (1977) found that eosinopenia and a relative increase in neutrophils occurred in sheep after intravenous infusion of 465 ml. sodium chloride solution. The present investigation reflected significant elevations in band neutrophil (BN) counts (Table 2) and marked increase in MON counts for the long-term saline - treated rams than the control values. Coates and Baehner (1991) stated that monocytosis is generally associated with chronic inflammatory processes, whether infectious or immunologic in nature. In addition, monocytosis has been noted with several primary neutropenic syndromes, including cyclic neutropenia (Lenge adn Jones, 1981). In the present investigation, the increased BN counts and decreased SN counts of the long-term saline-treated rams may reflect an alteration in the bone marrow production of neutrophils or an appropriate response to the demand of inflamed tissues under the prolonged exposure to salt stress.

In conclusion, the present investigation indicated that prolonged administration of diluted sea water (13.1 g / I TDS) to the growing Barki rams had no serious effect on physical health condition, however, there were some alterations in their blood picture due to the accumulative salt stress. The adaptive response of the growing rams to salt stress can be summarized into two stages. The first was a haemodilution phase due to some extent of water retention in plasma as a rapid response to salt load. However, a haemoconcentration phase predominated by advancing treatment period due to withdrawal of water into the extracellular tissues. There is an evidence of some tissue inflammation due to the prolonged administration of salt water.

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