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IMPACT OF WATER SALINITY (SODIUM AND SULFATE) ON DAIRY CATTLE AND ITS RELATION WITH OXIDATIVE STRESS IN BASRAH PROVINCE

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Key words: Water Salinity, Sodium, sulfate, dairy cattle

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ABSTRACT

Water salinity represents the most difficult challenge facing the livestock in Basrah province, therefore, twelve dairy cattle obtained from Farm of College of veterinary Medicine \University of Basrah. These animals were included and administrated salt water for 60 days with regular feed supplementation and then administrated pure water(R-O) for another 60 days. All clinical signs were recorded during the study period and the blood sample was collected from cows in both cases. Sodium, Sulphur and total antioxidant capacity values were measured. Four milking cows were dead during the period of study as a result of high water salinity. Serum sodium and sulfate values were rise significantly when compared with the period of drinking pure water while the effectiveness of total antioxidant capacity significantly decreased in dairy cows drink salt water. This study investigated the deleterious effect of sodium and sulfate rises on total anti-oxidant capacity in dairy cows.

INTRODUCTION

Water salinity is the most important threaten problem that faced Basrah city, especially at the last decade, as a part of regional conflicts that applied on Iraq, the first hand via restriction of water flowing from Turkey to Tigris and Euphrates, from other hand water restriction from Iran to pours in shat-arab . According to the agricultural date, there are hundreds of livestock's dead annually, especially through summer season in south cities of Basrah due to increase in

water salinity concentrations that extend a long distance shat-Alarab flow. Dairy cattle are different in their requirement for water from the animals due to its production of milk needed about (70-250 l/head/day) [1]. The common types of salts in water are mainly sodium chloride, calcium and magnesium bicarbonates, chlorides and sulfates [2]. Sodium sulfate is the primary salt causing elevated water total dissolved salts (TDS). Sulfates may be had greater an effect on water intake and performance than other salts [3]. Dissolved oxygen was not the single fluctuating variable in animals; variability in temperature and salinity interact with O2, and were also responsible for modulation of generation of endogenous reactive oxygen species (ROS), which affect the endogenous antioxidant response [4]. However, the effect of salinity variations on the total antioxidant system in animals has been investigated [5]. The changes in salinity (either increases or decreases) were affected on expression/activities of the antioxidant enzymes systems [6].

The aim of the study:

The present study aimed to evaluate the effect of water salinity mineral (especially sodium and sulfate) on animal performance and stresses in dairy cattle when compared with pure water given to same dairy cattle.

MATERIALS AND METHODS

This study was conducted at 11 /8 /2015 to 11 /1٢ /2015. Twelve adult dairy cattle obtained from Farm of Veterinary Medicine College \ University of Basrah were included in different ages, and administrated salt water for 60 days (Table 1) with regular feed supplementation and then given pure water for another 60 days (table 1). Blood samples were collected after each treatment period to evaluate sodium, sulfate and total antioxidants capacity and then centrifuged at 3000 rpm/ minute for 15 minutes to separate the serum for above measurements. The collected Serum was digested according to method described by Xueping and Reny (2002) by adding (2 ml) of Nitric acid and (1 ml) of Perochloric acid to (0.5ml) of serum as digesting agents in a Pyrex tube then heating with an oil path to 160Cº for 1 hour, then cooled and finally completed to 10 ml with (0.3) Hydrochloric acid to became ready for measureing the mineral values by using atomic absorption spectrophotometry. The total antioxidant capacity were measured by using (Total antioxidant capacity kit, Germany) that contain DPPH (2, 2-diphenyl-1-picrylhydrazyl) (0.6 Mm) and ascorbic acid 100 mg/100ML (control) with blank solution of

methanol. DPPH and ascorbic acid allowed reacting for sixty minutes in dark place and reading the samples at wave length 517 nm. An experimental blank solution (methanol) used for carrying out correction for the baseline [8].

RESULTS AND DISCUSSION

The present study designed to compare between the most important mineral that might be affected on animals when drinking salt water and other drink pure water these minerals were chosen (table 1) due to the symptoms observed on animals in the farm and showed the antioxidant defense system reflection depend on this cases.

Table (1) comparison between component of salinity water and pure water

sample	TDS mg/l	PH IU	Sal g/l	Cl mg/l	Na mg/l	So4 mg/l
Salt water	10872	7.15	16.9	7152	928.5	708.5
Pure water	833	6.8	1.22	441	171.3	254.4

***Data collected from Marine Science Center- University of Basrah**

The differences in salts concentration between salinity water and pure water showed in table (1) that appeared high TDS level in salt water (10872) which used in the first 60 days of trail compared with pure water (833) which used in the second 60 days of trail, also for Cl, Na, and SO_4 that recorded high concentration in salt water compared with pure water as collected from Marine science Center- University of Basrah.

The results revealed four dairy cattle were dead during the experiment and detected symptoms due to administration of salt water, these symptoms divided into two stages as in table (2).

Table (2) stages and symptoms of salinity water poisoning

early stage	Late stage
excessive thirst	general weakness
abdominal colic	muscular tremors
loss of appetite	rapid loss of condition
diarrhea	blindness
increased urination	eventual paralysis

The animal may be go into a coma and death within 6 to 24 hours.

The laboratory analysis showed significant increases ($p<0.05$) in serum Na & So4 in animals drinking salinity water when compared with animals drinking pure water (table 3). While the total antioxidant capacity showed a significant decrease ($p<0.05$) in values in animals drinking salinity water when compared with animal drinking pure water (table 3). Many studies indicated to the effect of water salinity on dairy cattle, one of these done by Curran [9],he observed the signs of salt poisoning represented by "Appear unwell , lack of appetite & reluctant to drink, Increased urination initially followed by small amounts of concentrated urine, nasal discharge, abdominal pain, lying down and nervous signs (such as star gazing, tremors, blindness, circling, walking backwards, head pressing, wobbly in the legs; knuckling at the fetlocks and convulsions) and death". The studies fixed previously that water high in salt content can be compromised performance and health of cattle viathree ways: 1) reduced water and feed intake; 2) toxic levels of sulfur ingestion; and 3) induced trace mineral deficiencies [10]. High concentrations of sulfates, especially sodium sulfate, produced a laxative effect in cattle, but normally within a short period of time cattle become acclimated to the water and diarrhea is no longer apparent [11]. Other research by Loneragan et al.[12] has shown a linear decrease in average daily gain of feedlot steers as sulfate concentration in the drinking water increased from 136 to 2,360 ppm and finally decreased feedlot cattle performance. In addition, ingestion of high levels of sulfate from water can be caused polioencephalomalacia (PEM). Symptoms noticed in animals with PEM included lethargy, anorexia, blindness, muscle tremors, gastrointestinal stasis, incoordination, staggering, weakness, convulsions, and death. Dietary sulfur levels of 0.9% of dry matter have been associated with PEM [13]. Indeed, increased water intake (i.e. during

periods of high temperature or lactation) results in elevated sulfur ingestion when sulfates are present in the water. Sulfate levels alone are rarely a problem as high sulfate concentrations usually occur only in waters with high general salinity. The direct effect of water salinity on antioxidant defense system was unclear, aspects relating of minerals to host immunity enzymes have been received importance in the recent past. Trace elements acted as cofactors of enzymes like superoxide dismutase. Oxidative stress are affected animals health by dismutase (SOD) [14], glutathione reductase, thioredoxin reductase [15] and catalase [16]. These enzymes are important to maintain the immunity of animals. They acted as antioxidants [17], but Sordillo and Aitken [18] suggested that oxidative stress during the transition period can be a major underlying cause of inflammatory and immune dysfunction in dairy cattle. Because of their antioxidant function, trace minerals can be contributed to counterbalancing oxidative stress, which could be reduced metabolic and immune problems during the transition period. The unbalanced of minerals in animals lead to impaired of immune functions of these animals and decreased the antioxidant enzymes activities [19].

Table (3) Serum level of Na, So4 and total antioxidant capacity of dairy cattle in salinity and regular water drink (Mean ± SD)

Sample/ parameters	Na mg/l	SO_4 mg/l	Antioxidant capacity
Salinity water	59.7±8.25*	3.87±0.30 *	0.08±0.016
pure water	41.7±6.42	1.73±0.83	0.17±0.010 *

***means a significant difference under p≥0.05**

تأثير ملوحة المياه (الصوديوم والكبريتات) على أبقار الحليب وعلاقتها بمضادات الاكسده في محافظة البصرة

الخلاصة

تمثل ملوحة المياه التحدي الاصعب الذي يواجه تربية الماشية في محافظة البصرة . استخدمت اثناعشر بقرة حلوب والتي شملت الحيوانات في حقل كلية الطب البيطري – جامعة البصرة .اعطيت الماء المالح لمدة ٦٠ يوم مع تقديم عليقة قياسية ، ثم تم تقديم الماء النقي الصالح للشرب لمدة ٦٠ يوم اخرى . سجلت جميع العلامات السريرية التي ظهرت على الابقار خلال فترة الدراسة و جمع الدم من الابقار في كلا الحالتين ليتم قياس قيمة الصوديوم ، الكبريتات وفعالية انزيمات الاكسدة . اظهرت النتائج نفوق اربعة من الابقار الحلوب نتيجة ملوحة المياه بعد تسجيل العلامات السريرية عليها وسجلت قيم الصوديوم والكبريتات ارتفاعا معنويا عند مقارنتها مع فترة شرب المياه العذبة فيما كانت فعالية الانزيمات مضادة للاكسدة منخفضة معنويا عند تقديم الماء المالح للابقار الحلوب. تشير الدراسة الحالية الى تاثير الصوديوم والكبريتات الضار على الابقار الحلوب وتثبيط نظام المضاد للاكسدة نتيجة زيادة تراكيزها في الماء المالح.

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