Research Article

Impact of Drinking Saline Water on Meat Production and Muscles Structures of Barki Lambs

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Abstract | In the desert and semi-desert lands, livestock usually drinks lowly or marginal quality water. Irregularly as water is excessive in salt, which could reason physiological dissatisfied or maybe a death in farm animals. Three major muscles *Triceps Brachii (TB), Longsimus Dorssi (LD) and Biceps Femoris (BF)* samples were collected at 24 h postmortem from the carcasses of Bakri lambs. Lambs were separated according on drinking water type into two groups, the 1st group (G1); lambs drank fresh water (274 ppm TDS) (control group). The 2nd group (G2); lambs drank saline water (5980 ppm TDS). The physical, chemical properties and histological structures of three muscles types from eight Barki lambs were analyzed to investigate the effect of drinking saline water on the previous traits. Both groups showed significant (P<0.05) differences in average daily gain, pre-slaughter weight, empty body weight, hot carcass weight, total fat, edible parts, and non-edible parts. Where the average daily gain increased by 50.68 % for lambs that drank fresh water group compared with those kept on saline water group. On the other hand, there no significant differences between two groups were observed on dressing percentages based on slaughter weight or empty weight. High significant differences were obtained for sensory evaluation (aroma, flavor, tenderness, juiciness, and palatability) for the three types of muscles for lambs kept on fresh water against to those drinking saline water. A micrograph of a section *BF* muscle of lambs that drinking fresh water showing intact muscle fibers, however the lambs that drinking saline water showing relative atrophy of muscle fibers. While *LD* muscle of lambs which drinking fresh water showing normal muscle fibers shape, but muscle of lambs that drinking saline water showing relative hypertrophy of muscle fibers. A micrograph of a section *TB* muscle of lambs drinking fresh water showing normal muscle fibers structure while, the lambs that drinking saline water showing an elongation of muscle fibers and narrow of the thickness as compared with the normal one that may be significant related to meat tenderness. Therefore, the results indicated that there was a bad influence of drinking saline water on meat yield, sensory evaluation, and histological structures of muscles type in Barki lambs in South Sinai Governorate, Egypt.

Keywords | Saline water, Meat production, Muscles structures, Muscles type, Barki lambs

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INTRODUCTION

In the desert and semi-desert lands of Egypt i.e., Ras Sudr, South Sinai Governorate, livestock usually drinks lowly or marginal quality water for several months of the year. These supplies originate from small wells. Irregularly as water is excessive in salt which could reason physiological dissatisfied or maybe death in farm animals, due to that concentration of salt ions be over water quality guide for livestock and poultry uses (National Academy of Sciences, 1974, 2007). The main target of our work was to explore the impact of the water sources in this area on the performance of local animals drinking such saline water which is usually caused death by a water imbalance. Reviewing the literature showed that the most common exception is water containing a high level of certain ions which may be induced caused scouring and diarrhea. Water availability for farm animals is often not secured in Ras Sidr and the growing water salinization has become an important restraint cooperating the efficiency and sustainability of livestock-based systems.

Abdelsattar et al. (2020) reported that, limited freshwater resources and climatic change are major challenge face animal production industry, especially in the arid and semi-arid regions. Moreover, climate changes are reflected in global warming and rainfall reduction, which in turn may increase the salinity of both soil and water (Buytaert et al., 2014). The groundwater has high saline, and the cost of desalination is expensive (FAO, 2004).

Upon the report of NRC (2007), drinking poor quality water can influence water and feed consumption, health, and the performance of production state of ruminants. Therefore, information of water requirements and responses of livestock to water levels and to its quality, mainly salinization, are highly needed to evaluate the efficiency of drinking practices at the farm level and to develop appropriate watering strategies that improve livestock performance while maintaining them healthy (Yousfi and Ben Salem, 2017). Concerning the reclamation strategy, groundwater will be the main source of used water in cultivated desert lands in Egypt (Abdelsattar et al., 2020).

Meat production is an economical trait in Barki sheep (Shehata et al., 2012). It is well known that muscle types play a major role in ultimate meat quality (Lawrie and Ledward, 2014). In addition, muscle fiber type is responsible for the variation in meat characters within and between muscles (Kirchofer et al., 2002).

In-order to acclimatize Barki sheep in Ras Seder, the present work aimed to increase the supply in the domestic meat market there, owing to the Barki meat has specific characters compared to other sheep breeds (Elshazly and Youngs, 2019). Since the difference in meat quality between fresh and saline water, this affected the muscle types. Thus, the purpose of this study was to investigate the effect of drinking saline water on the overall health status belonged to body weight, carcass characteristics, meat quality, histological structures of three muscles type, liver, and kidney histological structures of Barki lambs in South Sinai Governorate, Egypt.

MATERIALS AND METHODS

This experiment was carried out at South Sinai Research Station located at Ras Sudr, South Sinai Governorate, belongs to the Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt. The work was done during the period from March 2017 to March 2018. This study was designed to investigate the effects of drinking saline water on lambs performance, as well as meat production and quality of different three types of muscles of Barki lambs under the above fore-mention location area of the current study.

Study design

This experiment was divided into two stages, where this research experiment was planned, which depends on switching between the ewes that were drinking saline water by taking their offspring to drink fresh water, and on the contrary, the offspring of ewes that were drinking fresh water were taken to drink saline water, as follow:

First stage

Twenty adult Barki ewes of 2.0-3.0 years old with an average live body weight (33.53±1.40 and 34.91±1.41kg) were allocated into two groups for fresh and saline water groups, respectively, all ewes at the pregnant stage. The 1st group (G1); ewes drank fresh water (274 ppm TDS) (control group). The 2nd group (G2); ewes drank saline water (5980 ppm TDS). Chemical analysis of fresh and saline water is illustrated in (Table 1).

Table 1: Chemical analysis of fresh and saline water.

Items	Fresh water	Saline water	Saline water/ Fresh water
TDS (mg/L)	274 ppm	5980 ppm	21.82
Electric conductivity (μs.cm^{-1})	0.53	9.96	18.79
Sodium, Na (mg.L^{-1})	2.40	86.00	35.83
Chloride, Cl (mg.L^{-1})	2.47	61.34	24.83
Calcium, Ca (mg.L^{-1})	1.75	15.00	8.57
Magnesium, Mg (mg.L^{-1})	2.25	19.00	8.44
Potassium, K (mg.L^{-1})	0.15	0.36	2.40
Hardness* (mg.L^{-1})	4.00	34.00	8.50
Carbonate, $NaCo_3$ (mg.L^{-1})	0.40	0.20	0.50
Bicarbonate, $HNaCo_3$ (mg.L^{-1})	2.60	3.00	1.15
pH	7.63	7.23	0.95

TDS: Total dissolved solids; * Hardness is a measure of the amount of calcium and magnesium salts in water.

Second stage

Once lambing took place, the born lambs were ear tagged and weighed to record their birth weight and then biweekly until weaning. Eight Barki male lambs with an average live body weight at birth of (2.82±0.23 vs. 3.07±0.07 kg) for fresh and saline water groups, respectively, were used in the present study. Lambs were left with their dams till weaning that took place at 3 months and weaning weight was recorded and adjusted for 90 days. Then divided according to change their dam drinking water into two groups the 1st group (G1); lambs drank fresh water (274 ppm TDS) (control group). The 2nd group (G2); lambs drank saline water (5980 ppm TDS). To achieve the goal of the experimental which aimed to exchangeable processes of dam and their offspring between G1 and G2, to examine offspring performance, meat production and histological structures over generations of captive environmental effect such as drinking saline water.

Animals feeding regime

All animals were healthy and clinically free from internal and external parasites, they fed a commercial feed mixture has 12% crude protein. The diet consists of 43% yellow corn, 22% cotton seed meal, 20% wheat bran, 12% rice bran, 1.5% limestone, 1% sodium chloride and 0.5% minerals mixture, plus alfalfa hay (*Trifolium alexandrinum*) which offered *ad libitum.* However, the amounts of feed mixture were bi-weekly adjusted according to the changes in animal's body weight. Lambs were fed as per standard schedule (NRC, 2007) to cover their nutritional requirements. Animals were kept in semi open households and offered fresh or saline water were available all daytime to all groups.

Slaughter data

At the end of the experiment, all lambs aged one year were slaughtered after 24 h. fasting. Carcasses were chilled at an average temperature of $4^{o\,C}$ for 24 hours (Frild et al., 1963). Three muscles (*Triceps Brachii (TB), Longsimus Dorssi (LD) and Biceps Femoris BF)* samples were collected at 24 h postmortem. Samples of Barki lambs meat were collected from the carcass to evaluate the physical and chemical properties.

Physical traits of meat

Physical traits of meat including color and eye muscle area were determined. Meat color was measured using Chroma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer. Color was expressed using the CIE *L**, *a**, and *b** color system (CIE, 1976). A whole of three spectral analyses were taken for each sample on dissimilar locations of the muscle. Area of the cross section of *LD* muscle was measured by tracing the exact area of the exposed muscles on acetate paper among 11^{th} and 12^{th} rib using polar plane meter. The pH value of lamb's meat was resolute by a pH meter (Portable Digital Waterproof HANNA model HI 9025) later slaughter and 24 h from slaughter.

Chemical compositions of meat

Meat chemical compositions of three muscles were resolute by Food Scan™ Pro meat analyzer (Foss Analytical A/S, Model 78810, Denmark). Rendering to the manufacturer's instructions, about 50-100 g of fresh meat were minced and put in the meat analyzer cup. The cup was put into the meat analyzer for scanning sample with infra-red to determine the chemical components (moisture, protein, fat, and collagen).

Histological structure of muscles

Three muscles *TB, LD and BF* were prepared and stained with Hematoxylin and eosin stain giving to the method designated by Kiernan (1999). The morphometric analysis was performed using the Leica DM 3000 LED Image Analyzer (LEICA Imaging Systems LED, Germany). The examined slides were placed on the stage of the microscope, and selected magnification (μm).

The distances and the sum of fibers in each bundle, along with the thickness of the area of each bundle for two bundle of each muscle were taken by drawing a line beginning from one side to the opposite and from one side until the opposite, respectively. The outcomes seem automatically at the screen in the form of the distant measured in micron (μm) or square micron (μm^2) with the mean of each measured.

Sensory evaluation

Samples from different three muscles *LD*, *FB* and *TB* cuts of each lamb have been boiled in tap water for 45 minutes simply after chilling. After cooking, samples have been judged for sensory assessment by helping to 9 panelists in Ras Sidr Research Station to assess aroma, flavor, tenderness, juiciness, and palatability. Each trait turned into on a measure from 1 to 5 instead of the grades of very poor, poor, fair, good, and very good, respectively.

Statistical analysis

The data was subjected to one-way analysis of variance using the general linear model (GLM) of Statistics 22.0 software (SPSS, Inc., Somers, NY, USA). With level of saline as the main effect as follows:

$$Y_{ij} = \mu + d_i + e_{ij}$$

Where;

Y_{ij} = the observations; μ = the overall mean; d_j = the effect due to i^{th} type of drinking water, $_{i=}$ 1, 2; e_{ij} = random error associated with the $_{ij}{}^{th}$ observation.

The significant differences were tested according to Duncan's new multiple ranges test (Duncan, 1955).

RESULTS AND DISCUSSION

The mean values of birth weight, weaning weight, body weight gain, pre-slaughter weight, post-slaughter weight, empty body weight, hot carcass weight, dressing percentage, deposit fat, edible parts and non-edible parts for fresh and saline drinking water groups were presented in Table 2. Both groups showed significantly (P<0.05) differences

Table 2: Means and standard error values for growth performance and carcass traits of Barki lambs drank fresh and saline water.

Attribute	Overall mean± SE	Fresh± SE	Saline water± SE
Birth weight (kg)	2.91 ±0.15	2.82 ±0.23	3.07 ±0.07
Weaning weight (kg)	10.56 ±0.67	9.90 ±0.75	11.67±1.17
Average daily gain (g)	73.19 ±9.78	90.37^{a} ±7.39	44.57^{b} ±7.36
Pre-slaughter weight (kg)	30.33 ±2.45	34.30^{a} ±2.16	23.70^{b} ±2.31
Post-slaughter weight (kg)	29.09 ±2.35	32.90^{a} ±2.15	22.73^{b} ±1.99
Empty Body weight (kg)[1]	24.14 ±2.18	27.37^{a} ±2.32	18.74^{b} ±1.71
Hot carcass weight (kg)	12.72 ±1.05	13.72^{a} ±0.72	9.13^{b} ±0.91
Dressing % of slaughter weight	39.45 ±0.73	39.98 ±0.76	38.58 ±1.56
Dressing % of empty body weight	49.83 ±1.24	50.54 ±1.97	48.65 ±0.45
Deposit fat (kg)			
Abdominal fat	0.24 ±0.03	0.29^{a} ±0.02	0.15^{b} ±0.02
Heart fat	0.05 ±0.01	0.06^{a} ±0.02	0.03^{b} ±0.01
Kidney fat	0.17 ±0.02	0.20 ±0.02	0.13 ±0.01
Testes fat	0.12 ±0.01	0.13 ±0.01	0.11 ±0.01
Total fat	0.58 ±0.05	0.67^{a} ±0.03	0.43^{b} ±0.02
Edible parts[1]	2.56 ±0.30	2.12^{a} ±0.31	3.30^{b} ±0.27
Non- edible parts[2]	21.23 ±2.03	22.71^{b} ±3.94	28.56^{a} ±0.47
Blood	1.24 ±0.14	1.40 ±0.10	0.97 ±0.32

[1]Edible parts (Heart +liver + kidneys); [2]Non- edible parts (Head + feet +pelt), Means, within row with, different superscripts are significantly different (P <0.05).

in average daily gain (ADG), pre-slaughter weight, post-slaughter weight, empty body weight, hot carcass weight, total fat, edible parts, and non-edible parts. In the other hand, no significant differences were obtained between both two groups for dressing percentages based on slaughter weight or empty weight. No significant differences were obtained for the mean values of wholesale cuts as a weight in Barki lambs drank fresh and saline water were presented in Table 3.

Table 3: Means and standard error values for wholesale cuts (kg) of Barki lambs drank fresh and saline water.

Item	Overall mean± SE	Fresh water± SE	Saline water± SE
Neck	1.02 ±0.10	1.09 ±0.14	0.90 ±0.12
Shoulder	2.05 ±0.19	2.13 ±0.29	1.93 ±0.21
Rack	3.13 ±0.31	3.27 ±0.46	2.89 ±0.41
Loin	0.66 ±0.06	0.71 ±0.09	0.56 ±0.06
Flank	0.48 ±0.05	0.48 ±0.06	0.47 ±0.08
Leg	3.32 ±0.29	3.36 ±0.40	3.26 ±0.48
Tail	0.27 ±0.05	0.26 ±0.07	0.29 ±0.07

Same observations were recorded for the physical components of those drank fresh and saline water (Table 4). On top of that no significant differences were got for the mean values of chemical composition in different three types of Barki muscles kept on fresh and saline drinking water were presented in Table 5. Meat color was exhibited significantly no differences for the three types of sited fore-mentioned Barki muscles kept on fresh and saline water (Table 6).

Table 4: Means and standard error values for physical components in meat of Barki lambs drank fresh and saline water.

Item	Overall mean± SE	Fresh water± SE	Saline water± SE
Best ribs dissections (kg)			
Best ribs weight	0.702 ±0.05	0.724 ±0.07	0.665 ±0.06
Lean meat	0.245 ±0.02	0.258 ±0.04	0.223 ±0.01
Fat	0.078 ±0.01	0.084 ±0.02	0.068 ±0.03
Bone	0.179 ±0.02	0.182 ±0.02	0.174 ±0.05
LD area	12.78 ±0.67	12.58 ±0.54	13.10 ±1.76
pH (Temperature)	6.42±0.09 (39.64 °C)	6.42 ±0.14 (39.94 °C)	6.42±0.05 (39.13 °C)

LD: Longsimus Dorssi.

High Significant differences were obtained for sensory evaluation including aroma, flavor, tenderness, juiciness, and palatability in different three types of muscles for fresh opposed to saline drinking water were presented in Table 8.

Table 5: Means and standard error values for chemical composition of different three types in muscles of Barki lambs drank fresh and saline water.

Parameters	Fresh water± SE			Saline water± SE		
	FB	*LD*	*TB*	*FB*	*LD*	*TB*
Collagen	1.41±0.18	1.26±0.20	1.55±0.16	2.08±0.34	2.09±0.35	1.85±0.13
Fat	5.57±0.73	3.71±0.51	5.27±0.68	2.55±0.38	4.81±0.79	4.22±0.17
Moisture	74.69±0.71	74.00±0.98	74.10±0.66	75.36±0.55	72.59±0.66	75.65±0.62
Protein	18.84±0.22	19.55±0.34	19.00±0.28	19.98±0.12	20.06±0.45	19.23±0.22

LD: Longsimus Dorssi; TB: Triceps Brachii and BF: Biceps Femoris.

Table 6: Means and standard error values for meat color of different three types of muscles in Barki lambs drank fresh and saline water.

Color parameters	Fresh water± SE			Saline water± SE		
	FB	*LD*	*TB*	*FB*	*LD*	*TB*
*L**	42.45±0.77	43.51±0.82	44.89±1.03	42.96±0.80	40.04±0.33	44.10±0.62
a*	17.87±0.17	14.31±1.08	17.45±0.39	17.23±0.48	17.92±0.27	16.47±1.00
b*	7.46±0.39	9.47±0.60	7.25±0.44	8.95±0.44	7.21±0.61	5.53± 0.43

LD: Longsimus Dorssi, TB: Triceps Brachii and BF: Biceps Femoris

Table 7: Means and standard error values for histology traits of different three types in muscles of Barki lambs drank fresh and saline water.

Histology trait	Fresh water± SE			Saline water± SE		
	FB	*LD*	*TB*	*FB*	*LD*	*TB*
Number of muscle fibers	31.83[b]±3.64	31.43[b] ±2.71	37.87[b]±5.25	39.82[a] ±3.65	44.2[a] ±1.53	41.82[a] ±5.25
Muscle fiber thickness (µ)	133.69±3.96	134.01±15.65	128.36±0.78	119.13±14.71	117.86±15.78	147.27±32.22
Bundle area (µ^2)	928[b] ±59.14	870[b] ±45.20	953[b] ±72.10	1111[a] ±73.60	1110[a] ±57.94	1204[a] ±69.39

LD: Longsimus Dorssi, TB: Triceps Brachii and BF: Biceps Femoris; Means, within row with, different superscripts are significantly different ($P < 0.05$).

Table 8: Means and standard error values for sensory evaluation of different three types in muscles of Barki lambs drank fresh and saline water.

Parameters	Fresh water± SE			Saline water± SE		
	FB	*LD*	*TB*	*FB*	*LD*	*TB*
Aroma	3.63[a] ±0.18	4.40[a] ±0.16	3.60[a] ±0.16	1.17[b] ±0.17	1.50[b] ±0.22	1.00[b] ±0.0
Flavor	3.63[a] ±0.18	4.40[a] ±0.22	3.60[a] ±0.16	1.33[b] ±0.21	1.50[b] ±0.22	1.00[b] ±0.0
Tenderness	3.75[a] ±0.16	4.50[a] ±0.17	3.80[a] ±0.13	1.50[b] ±0.22	1.50[b] ±0.22	1.00[b] ±0.0
Juiciness	3.75[a] ±0.16	4.40[a] ±0.16	3.80[a] ±0.13	1.50[b] ±0.22	1.50[b] ±0.22	1.00[b] ±0.0
Palatability	3.63[a] ±0.18	4.70[a] ±0.15	3.70[a] ±0.15	1.17[b] ±0.17	1.50[b] ±0.22	1.00[b] ±0.0

LD: Longsimus Dorssi, TB: Triceps Brachii and BF: Biceps Femoris; Means, within row with, different superscripts are significantly different ($P < 0.05$).

Micrographs of a section liver from Barki lambs kept on fresh and saline drinking water were presented in (Figures 1-4). While Micrographs of a section kidney from Barki lambs kept on fresh and saline drinking water were presented in (Figures 5-8). Significant differences were obtained for histological investigation in different three types of muscles of Barki lambs kept on fresh and saline drinking water were presented in Figure 9. Significant differences were obtained for histology represented in three items. The first one was necrosis, however, the second one was atrophy while the third one was degeneration.

Histological investigation showed differences on level of bundle shape and composition of three types of muscles Barki lambs drank fresh and saline water were presented in Table 7 therefore a micrograph of a section *BF* from lamb drinking fresh water showing intact muscle fibers however *LD and TB* muscles from lamb drinking fresh water showing normal muscle fibers shape in the other hand A micrograph of a section *BF* muscle from lamb drinking saline water showing relative atrophy of muscle fibers while *LD* muscle from lamb drinking saline water exhibiting relative hypertrophy of muscle fibers, moreover *TB* muscle from lambs drinking saline water showing an elongation of muscle fibers and narrow of the thickness as compared with the control one of the experiment.

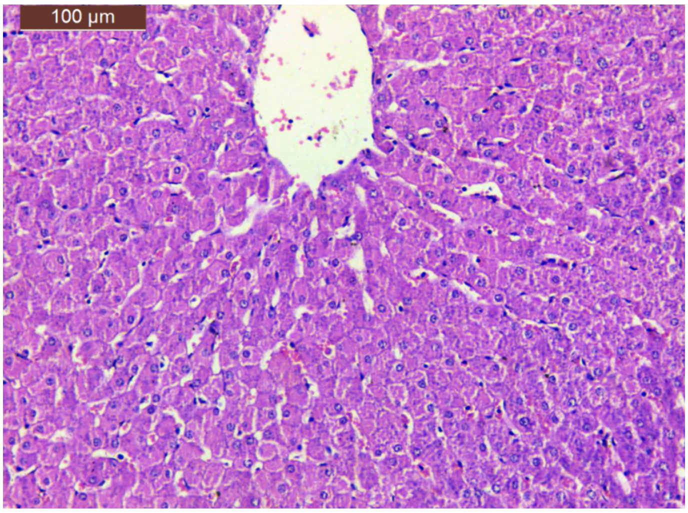

Figure 1: A micrograph of a section liver from lamb drinking fresh water showing the hepatic lobule. Notice the central vein (arrow), sinusoids (red arrow) and hepatocytes cords (yellow arrow) that associated with central nuclei (green arrow) (H and E stain, Scale Bar: 100 µm).

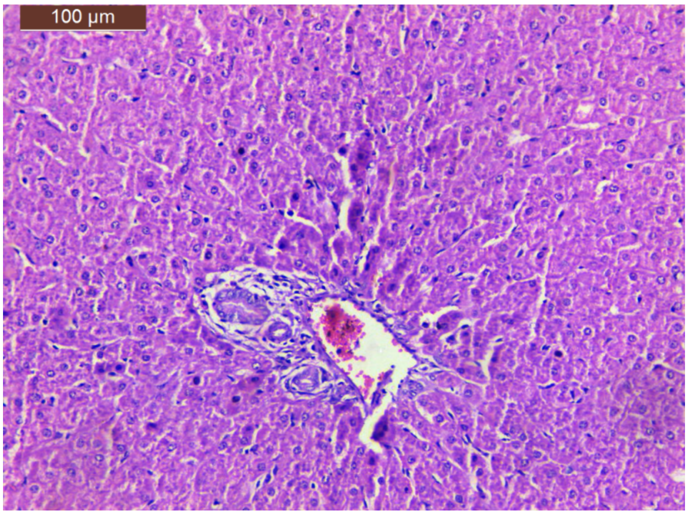

Figure 2: A micrograph of a section liver from lamb drinking fresh water showing collagen fibers around portal vein (red arrow), bile ductile (black arrow), hepatic artery (blue arrow) and lymphatics (arrowhead) (H and E stain, Scale Bar: 100 µm).

The present results of body weight are agreed with the results, reported by Peirce (1963) which presented that sheep drinking saline water (1.30% NaCl) reduced the body weight paralleled with groups drinking rain-water. In difference, Yousfi et al. (2016) indicated that Barbarine lambs drinking saline water having 7 g NaCl/l did not affect the last body weight.

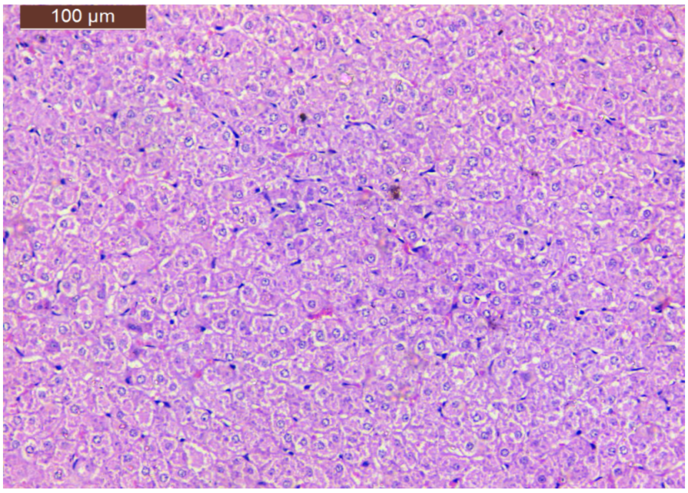

Figure 3: A micrograph of a section liver from lamb drinking saline water showing disturbance of the hepatic lobule. Notice hedropic degeneration in the hepatocytes (H and E stain, Scale Bar: 100 µm).

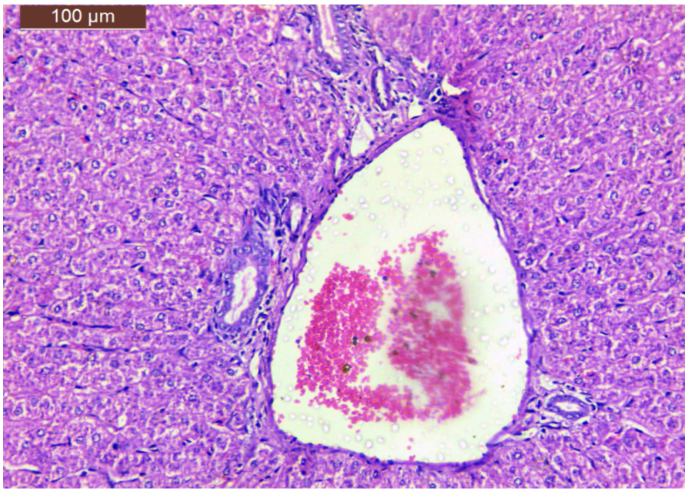

Figure 4: A micrograph of a section liver from lamb drinking saline water showing congested portal tract that associated with inflammatory infiltration (H and E stain, Scale Bar: 100 µm).

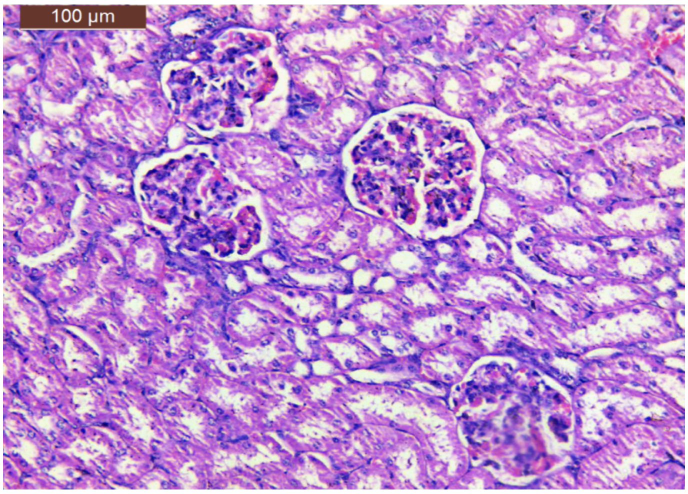

Figure 5: A micrograph of a section kidney from lamb drinking fresh water showing normal renal corpuscles and tubules (H and E stain, Scale Bar: 100 µm).

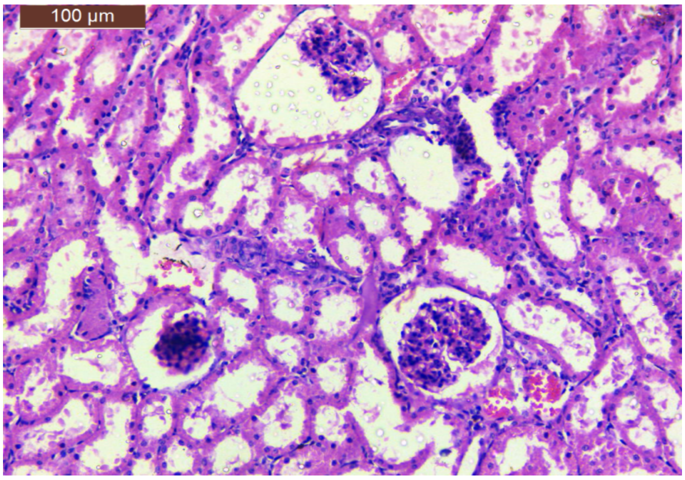

Figure 6: A micrograph of a section kidney from lamb drinking saline water showing partially degeneration of the glomeruli or atrophy (H and E stain, Scale Bar: 100 µm).

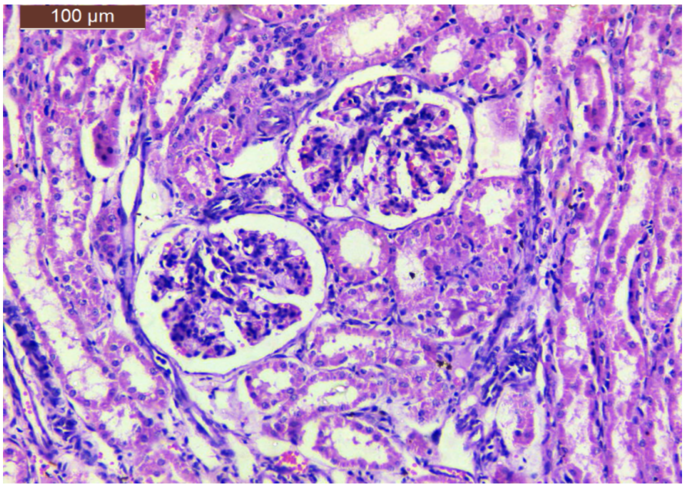

Figure 7: A micrograph of a section kidney from lamb drinking saline water showing lobuolated glomeruli associated with inflammatory infiltration. Note the degeneration of reanal tubules and an interstitial inflammation (H and E stain, Scale Bar: 100 µm).

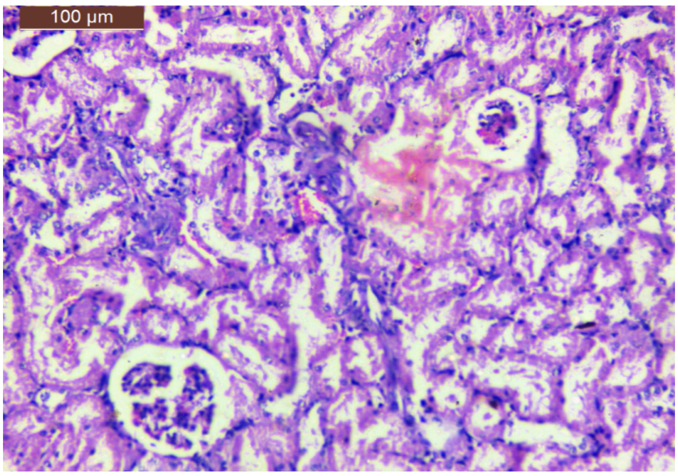

Figure 8: A micrograph of a section kidney from lamb drinking saline water showing interstitial hemorrhage. Notice the cell debris in the lumen of the renal tubules (H and E stain, Scale Bar: 100 µm).

Conversely, a lot of studies, it has been reported that the body weight was not affected at little saline level, however when it is gotten 2%, the body weight reduced. Peirce (1957) and Wilson (1966) found that 2% NaCl in drinking water decreased the body weight, while 1% NaCl in drinking water did not have an affected the body weight in lambs. Also, Wilson (1975) indicated that in Merino sheep 1.2 % soluble salts in drinking water did not affect the body weight. But, the growth in water saline from 1.2 % to 1.6 % or 2 % reduced the body weight.

The average daily gain increased by 50.68 % for fresh as compared with those kept on saline water groups, respectively (Table 2). These results are in good agreement with the results reported by Mdletshe et al. (2017) who found that the average daily gain was significantly reduced ($P < 0.05$) in goats with the upturn of TDS in drinking water from 5.5 to 11 g TDS/l likened with the freshwater group. Similarly, in developing steers, Patterson et al. (2003) concluded a decrease in the average daily gain by 27% while water TDS augmented from 1,019 to 4,835 ppm. Likewise, Patterson et al. (2004) noted a decrease in daily gain by 65% ($P<0.05$) in steers drinking saline water containing 7,268 ppm TDS compared with those drinking 1,226 ppm TDS.

Furthermore, Sharma et al. (2017) found that the average daily gain was reduced by 19.3% in Murrah buffalo calves drinking water with 8789 mg TDS/l likened with 557 mg TDS/l group. Alike results were found in goats (Eltayeb, 2006). Conversely, the body weight gain was not affected by saline water agreeing to few investigates. Yousfi et al. (2016) studied that offering water with 7 g NaCl/l to Barbarine lamb, did not affect the average daily gain. Alike results were shown in beef cattle (López et al., 2016), heifers (Alves et al., 2017).

On the opposing, some researchers stated that the body weight gain was improved by saline water at little TDS levels. Hekal (2015) indicated that in Barki lambs kept on saline water (2886 ppm TDS) was induced increased the average daily gain compared with the group of 275 ppm TDS, the average daily gain was 80 and 50 g, respectively, by 62.50 % for fresh and slain water, respectively.

Results of the carcass characteristics (Table 2) showed semi an agreement with the results reported by Hekal (2015) showed that in Barki lambs kept on water having 2886 ppm TDS were did not effect on the dressing percentage that means the little level of saline water might advance the carcass traits of lambs. On the contrary, it differs from the results of the current study on the hot carcass weight and the non-edible also edible parts weights that reduced by drinking saline water. However, Ahmed et al. (2015) studied that Atriplex significantly ($p<0.05$) in Barki lambs

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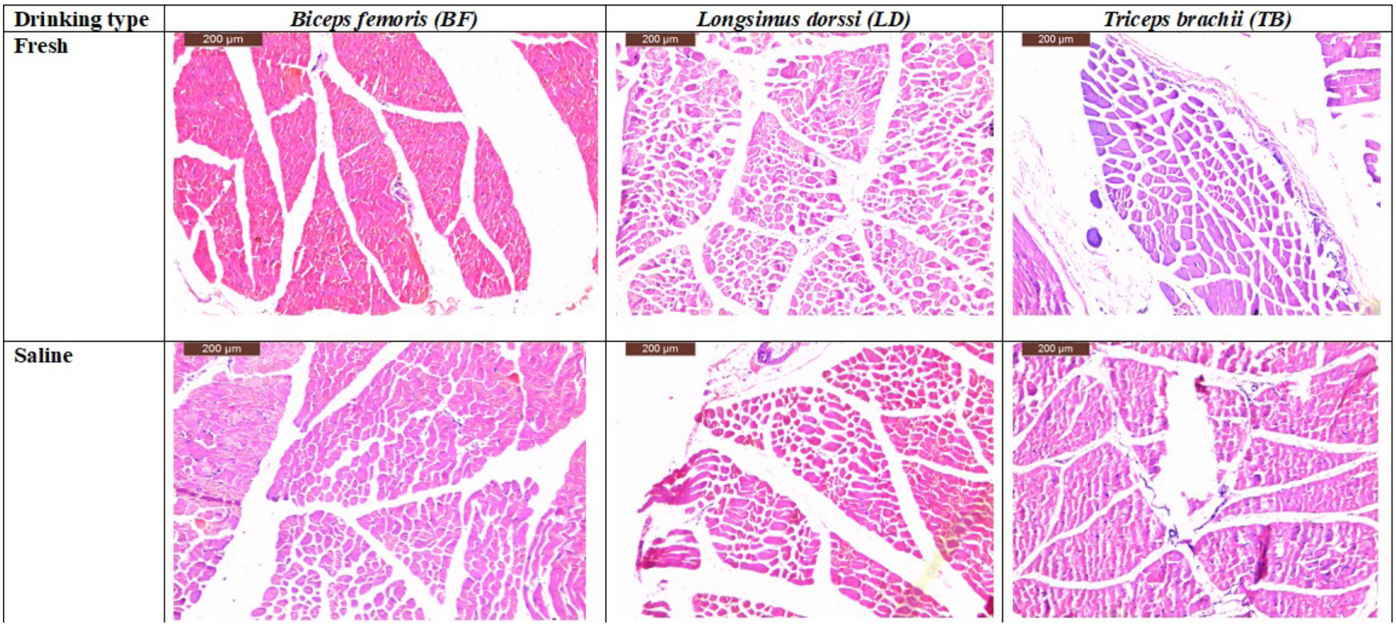

Figure 9: A micrograph of a section *Biceps Femoris (BF)* from lamb drinking fresh water showing intact muscle fibers however *Longsimus Dorssi (LD) and Triceps Brachii (TB)* muscles from lamb drinking fresh water showing normal muscle fibers shape in the other hand A micrograph of a section *Biceps Femoris* muscle from lamb drinking saline water showing relative atrophy of muscle fibers while *Longsimus Dorssi* muscle from lamb drinking saline water showing relative hypertrophy of muscle fibers moreover *Triceps Brachii* muscle from lamb drinking saline water showing an elongation of muscle fibers and narrow of the thickness as compared with the normal one (H and E stain, Scale Bar: 200 µm).

reduced dressing percentage however did not affect the slaughter lambs weight and carcass weight.

On the other hand, certain studies reported that saline water did not have affected the carcass traits. Walker et al. (1971) reported that the carcass weight didn't affect in Merino drinking saline or fresh water. Similarly, Yousfi et al. (2016) reported that in Barbarine lamb drinking saline water (7 g NaCl /l) wasn't affect weights for each slaughter, hot carcass and chilled carcass. Also, Castro et al. (2017) showed that in lambs drinking water with different saline levels (640, 3188, 5740 and 8326 mg TDS/l) didn't have affected on slaughter weight and together cold and hot carcass weights.

However, some research examined the title role of saline water in meat quality. Pearce et al. (2008) reported that in sheep salt load from fed halophytes for example saltbush had no effect on the pH of meat. Al-Owaimer et al. (2008) found that in Najdi lambs fed Atriplex species had no effect on the pH of meat. Likewise, Obeidat et al. (2016) showed that in Awassi lambs fed *Atriplex halimus* had no effect on the pH of meat.

Histological investigation also showed differences on level of bundle shape and composition of three types of muscles in Barki lambs drinking fresh and saline water are presented in Table 8 therefore A micrograph of a section *BF* from lamb drinking fresh water showing intact muscle fibers however *LD* and *TB* muscles from lamb drinking fresh water showing normal muscle fibers shape in the other hand A micrograph of a section *BF* muscle from lamb drinking saline water showing relative atrophy of muscle fibers while *LD* muscle from lamb drinking saline water showing relative hypertrophy of muscle fibers moreover *TB* muscle from lamb drinking saline water showing an elongation of muscle fibers and narrow of the thickness as compared with the normal one (control) the obtained results agree with thus determined by (Carpenter et al., 1996) which concluded that histology, fiber type percentages and mean muscle fiber diameters of the hypertrophy-responsive muscles varied between lambs. Relatively, site of muscles seems like to be the better predictor of hypertrophy, with muscles from the trunk and lumbar areas viewing a supplementary abundant hypertrophy than muscles from the thoracic limb (Jackson et al., 1993). Scientists have lengthy been conscious that muscle histology is related to meat quality (Cassens and Cooper, 1971; Ouali et al., 1988). Additional research required to estimate the influence of saline water through different levels and kinds of minerals in different livestock species to compare the mechanism of action of each that will service in the upcoming to investigate how to overcome these damaging effects (Abdelsattar et al., 2020).

CONCLUSIONS AND RECOMMENDATIONS

Commonly, it could be concluded that the influence of saline water depends on the level of salt ions, the type of minerals (salts) and the tolerance of animals. Low levels of saline water can be recommended for Barki sheep. While, using of high saline levels decreased Barki lambs performance and its health status. Regarding the significant differences observed in the study, the performance production, carcass traits and histological structures of Barki lambs drank fresh water are gaining more positive traits than Barki lambs drank saline water. Summing up it could be concluded that no significant effects of dams were drinking saline water on their offspring.

Despite the ability of the Barki lambs to adapt and its distinguished productive performance in the northwestern coast region, this distinction was not to the same degree at the level of adaptation and productive performance in the South Sinai region, especially under the reliance on put sheep drinking slain water in this region. This fact was drowned independent up on the recorded results, therefore it could be concluded finally that it is difficult to keep the Barki sheep under the environmental condition in Ras Sidr to exhibit their meat production where the saline water did not meet the physiological states of Barki lambs in other words such lambs cannot be adapted at South Sinai area (Ras Sudr).

NOVELTY STATEMENT

The purpose of this study was to investigate the effect of drinking saline water on the overall health status belonged to body weight, carcass characteristics, meat quality, histological structures of three muscles type, liver, and kidney histological structures of Barki lambs in South Sinai Governorate, Egypt.

Conflict of interest

The authors have declared no conflict of interest.

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