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EFFECT OF DRINKING SALINE WATER AND FLAVOMYCIN SUPPLEMENTATION ON SOME PHYSIOLOGICAL RESPONSES, GROWTH PERFORMANCE AND CARCASS TRAITS OF BARKI RAM LAMBS

El-Sherif, M. M. A.

Department of Animal and Poultry Physiology, Desert Research Center, Mataria, Cairo, Egypt

ABSTRACT

The aim of the present study was to investigate the effect of using the antibiotic growth promoter flavomycin on physiological and productive performance of Barki ram lambs drinking saline water. Forty growing Barki ram lambs averaging 6 months old and 26.0 Kg live body weight were used. A 2x2 factorial arrangement was used consisting of two groups of drinking water, tap water, TW (505 ppm TDS) and diluted seawater, SW (12494 ppm TDS), two levels of flavomycin 0 and 20 mg/head and 10 animals as replicates. All groups were fed on a basal diet to cover requirements of 100 gm daily gain. Treatments continued until marketing age (12 months). Carcass traits were measured on three animals from each group.

Drinking SW reduced significantly the diurnal variation in rectal temperature, but increased skin and coat temperatures and the diurnal variation of respiration rate. Flavomycin increased skin and coat temperatures and morning respiration rate. The changes in these physiological responses indicated that drinking SW facilitated heat stability through increasing water vaporization. Flavomycin increased heat production and helped in increasing insulation properties of the superficial layers, which was the most efficient in protecting growing lambs from cold stress during winter.

Flavomycin addition increased packed cell volume and hemoglobin concentration. Drinking SW decreased packed cell volume, but stimulated increasing mean corpuscular hemoglobin concentration.

Flavomycin increased feed efficiency, while drinking SW decreased body daily gain, total body weight gain, nutrients intake, and feed efficiency. Adding flavomycin reduced these bad effects of drinking SW on growth performance.

Drinking SW resulted in decreasing empty body weight and hot carcass weight equaled to 2.642 kg and 2.400 kg, respectively, in addition to a significant decrease in dressing percentage by 2.954% in respect to the control group. Adding flavomycin to the animals that drank SW moderated that decrease to become 1.624 kg, 1.900 kg and 2.384%, respectively. Drinking SW increased the lean percentage in the best rib cut on the account of fat percentage. Flavomycin overcame the negative effects of SW on the spleen weight.

It was concluded that adding flavomycin to growing lambs under desert conditions could reduce some bad effects of drinking SW on growth performance and carcass traits. In addition, flavomycin protected growing animals from cold stress through increasing insulation properties of the superficial layers.

Keywords: Lambs, flavomycin, saline water, physiological responses, performance.

INTRODUCTION

Saline water may sometimes be the drinking water in desert and newly reclaimed areas in Egypt. The salinity of well water along these areas was found to vary from 360 to 30082 part per million total dissolved salts (Atwa, 1979 and Aggour, 1990). El-Sherif and El-Hassanein (1996) affirmed that long term administration of saline water decreased growth rate and final BW of

Barki ram lambs; in addition to increase cell contents of fluids hence muscle characteristics might be affected. Further more, sheep are exposed to harsh climatic conditions and feed shortage in this semi-arid area, which would affect badly their growth performance (Aboul-Naga and Aboul-Ela, 1986 and El-Sherif, 1991). Average litter size is 1.02 and lamb survival rate up to weaning is 0.77 (Ahmed, 1990). All these characteristics lead to low biological feed efficiency for meat production, which ranges between 22.7 and 27.0 kg DM / kg BW (Abd-El-Aziz, 1983). The vital need for animal protein in our developing country has created the interest towards increasing the growth efficiency by different methods in animal industry, including utilization of the growth promoters. The antibiotic growth promoter flavomycin was reported to increase daily gain in sheep (Murray *et al.*, 1992; Paltil *et al.*, 1996 and Martini *et al.*, 1996). In addition, significant improvement in feed conversion efficiency was found during the growth period of lambs (Rogers *et al.*, 1991, El-Basiony, 1994 and El-Sherif *et al.*, 2001). Moreover, it is not absorbed in the intestine due to its high molecular size so no metabolic side effects could happen after oral uses and no residues were found in meat and milk (Yassien *et al.*, 1996). In addition, flavomycin was proved to act as antistressor (Davey, 1980). According to these facts, the present study was designed to investigate the possibility of increasing meat production from Barki ram lambs drinking saline water by enhancing its growth rate with the use of growth promoter flavomycin. .

MATERIALS AND METHODS

This study was carried out at Maryout Research Station of the Desert Research Center, locates 35 km southwest of Alexandria (Latitude 31.02°N, longitude 29.80 °C). Forty ram lambs averaging 26.038 ± 0.798 kg live body weight and 186.1 + 2.102 days old were divided into 4 groups. Two groups drank fresh tap water; (TW; 505 part per million total dissolved salts, ppm TDS), and the other two drank saline water (SW; 12494 ppm TDS), which was obtained by diluting seawater with tap water in the ratio of 1:2, respectively. This level of salinity was considered as the salt tolerance level for sheep (Pierce, 1966). The electrolyte contents as ppm (Table 1) were measured by means of electrical conductivity apparatus (WTW, LF 538; Germany) and atomic absorption (UNICAM, 929 AA spectrometer; England). Seawater was collected weekly from El-Agamy shore, Alexandria in clean plastic tanks.

Table (1): Total dissolved solids and some elements (ppm) in different types of water

Type of water	TDS	Na^+	K^+	Mg^+	Cl^-
Tap water (TW)	505	180	11	19	220
Seawater	36480	12000	550	1312	13165
Diluted seawater (SW)	12494	4122	191.9	453	4532

From each water-type one group was offered flavomycin by drenching at the level of 20 mg/h/d (FL 20) while the other had no additive (FL 0). Hoechst, Western Germany, provided flavomycin. Water was available to the animals to drink *ad libitum* twice or 3 times daily. The levels of feeding were given according to Kearl (1982) to cover nutritional requirement of 100 g gain/day. The concentrate ration was offered at 8 a.m., while the roughage was offered. at 2 p.m. All groups were given the concentrate mixture and berseem hay (*Trifolium alexandrinum*) at a ratio of 1:1 of TDN. The concentrate portion consisted of barley grains and concentrate feed mixture (CFM) at the ratio of 1:3, respectively. The CFM consisted of cotton seed cake 50%, wheat bran 18%, yellow maize 15%, rice polish 11%, molasses 3%, limestone 2%, and common salt 1%. All feed stuffs were obtained from the local market. Actual feed intake was measured and samples of different diet ingredients were collected and analyzed according to A.O.A.C. (1980). Chemical composition of different diet ingredients is presented in Table (2). The level of requirements was adjusted continuously according to the changes in live body weight. Daily intake as dry matter (DM), total digestible nutrients (TDN) and digestible crude protein (DCP) was calculated and expressed either as absolute values (g/h/d) or relative to metabolic body weight (g / kg $BW^{0.75}$ / d). Live body weight (kg) to the nearest 0.1 kg of each animal was recorded biweekly throughout the experimental period. Feed efficiency (FE) were calculated biweekly according to the following equations:

FE1 = (average daily gain X 100) / average daily dry matter intake

FE2 = (average daily gain X 100) / average daily digestible nutrients intake

Table (2): Chemical composition of feed ingredients as fed to animals

Item	DM%	OM	CP	CF	EE	Ash	NFE
		% of DM					
CFM	84.85	92.40	13.91	12.11	2.99	7.60	63.39
Barley grains	87.65	9555	9.11	6.31	1.92	4.45	78.21
Berseem hay	90.65	85.57	12.31	28.31	2.19	14.43	42.76

CFM = concentrate feed mixture, DM% = dry matter percentage, OM = organic matter, CP = crude protein, CF = crude fibres, EE = ether extract, NFE = nitrogen free extract

Animals were housed in shaded pens (4 x 6 meters) roofed with asbestos sheets at the height of 5 meters. Ambient temperature (°C) and relative humidity percent at the level of the animals were recorded simultaneously with thermo-respiratory responses. Thermo-respiratory responses indoors were measured for all animals biweekly at both 7 am and 2 pm. These responses were rectal temperature (°C), skin temperature (°C), coat temperature (°C) and respiration rate per minute. Blood samples were withdrawn monthly from each animal from the jagular vein early in the morning before feeding, to measure some hematological parameters. Hemoglobin concentration in g/dl was measured using kits provided by Biocon Diagnosemittle GmbH & Co., Germany. Packed cell volume % was determined by means of hemofuge (Gallenkamp, England). Mean cell hemoglobin .concentration was calculated according to the equation MCHC (%) = (Hb X 100) / PCV. The treatments lasted from August 2000 to February 2001, when the animals became nearly 12 months old. Three animals from each experimental group were chosen representing the average live body weight of the group to evaluate carcass traits. Slaughter was performed after 12 hours fasting. Live body weight just before slaughter was recorded. Empty body weight (EBW) was calculated as slaughter weight without rumen contents. Hot carcass was weighed (HCW) without any attached offal. Dressing percentage (D%) was calculated as (HCW X 100) / EBW. Weights of neck, shoulders, racks, loin, flanks, legs, tail, pelt, liver, kidneys, spleen, and heart were expressed as a percentage of EBW. Physical characteristics of the 9^{th}, 10^{th} & 11^{th} rib cut were measured as weight, lean meat%, fat%, and bone%. SAS software (SAS, 1998) was used to perform statistical analysis to test the effect of saline water, flavomycin administration and their interaction. Arcsine values were used for statistical analysis of parameters calculated as percentages. The changes in the physiological responses with age were presented graphically.

RESULTS AND DISCUSSION

1- Climatic conditions:

At the start of the experiment, the animals were exposed to the hot conditions of summer, where air temperature under shade at the animal's level (microclimate) varied along the day between 26.5 °C and 32.3 °C, while relative humidity varied between 60% and 86% (Figure 1). Afterwards the weather changed towards the moderate conditions of autumn and winter, during which air temperature (AT) decreased gradually to reach in January 14 °C at morning and 15 °C at afternoon. Relative humidity (RH) showed reversed trend to that of the air temperature. Figure (1) shows that the majority of growth stage was faced by moderate climatic conditions.

2- Thermal responses:

Rectal temperature (RT) either at morning (m) or afternoon (a) was not affected either by saline water (SW) or flavomycin (FL) (Table 3). However, there was slight decline in RTa by drinking SW, which resulted in significant ($P<0.01$) reduction in diurnal variation of RT (DRT). This might be due to the higher intake of SW by lambs as reported by El-Sherif and El-Hassanein (1996), hence more water was available for evaporative cooling at afternoon. Nassar and Hamed (1980) and Salama (1993) reported that the rectal temperature decreased by increasing salinity level in drinking water.

In the present study, the highest DRT (0.465 °C) was found in the animals which drank TW without FL (Table 3), while those drank TW and had the additive exhibited lower DRT (0.338 °C). Flavomycin through increasing the energy of rumen volatile fatty acids due to high production of propionate (Flachowsky and Richter, 1991) might help in achieving thermal stability.

Terrill (1968) stated that low heat production interferes with the normal physiological mechanism for adjusting to temperature change resulting in impairment of heat regulation. The case was reversed in the animals which drank SW, where the DRT was lower in the group which had no FL (0.255 °C) than in that which had FL (0.318 °C). This resulted in significant ($P<0.05$) interaction SW X FL for DRT. Under salt load, the increased metabolic heat production by FL might delicate thermal stability of growing Barki ram lambs. However, this group still had lower DRT than the animals, which drank TW, indicating the role of drinking SW in providing more water for evaporation.

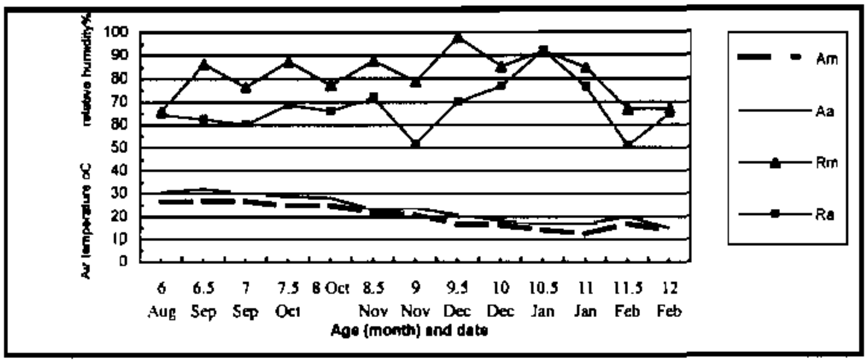

Figure 1: Changes in indoors climatic elements throughout the experimental period

Am: air temperature °C at morning (8 a.m.), Aa: air temperature °C at afternoon (2 p.m.), Rm: relative humidity % at morning, Ra: relative humidity % at afternoon

Table 3: Overall means + SE of physiological responses as affected by saline water (SW) and flavomycin (FL)

Parameter	Flavomycin level	Water type		SE		
		TW	SW	SW	FL	SW X FL
RTm	FL 0	39.31 + 0.03	39.37 + 0.03	0.023 ns	0.023 ns	0.033 ns
	FL 20	39.37 + 0.03	39.37 + 0.03			
RTa	FL 0	39.77 + 0.034	39.62 + 0.003	0.024 ns	0.024 ns	0.033 ns
	FL 20	39.71 + 0.033	39.68 + 0.003			
DRT	FL 0	0.465 + 0.045	0.255 + 0.043	0.030 **	0.030 ns	0.043 *
	FL 20	0.338 + 0.043	0.318 + 0.043			
STm	FL 0	30.64 + 0.12	30.97 + 0.12	0.084 *	0.084 **	0.118 ns
	FL 20	31.29 + 0.12	31.43 + 0.12			
STa	FL 0	33.73 + 0.105	34.39 + 0.100	0.071 **	0.071 **	0.101 *
	FL 20	33.40 + 0.100	34.41 + 0.100			
DST	FL 0	3.104 + 0.158	3.421 + 0.151	0.107 ns	0.107 ns	0.152 ns
	FL 20	3.103 + 0.151	2.978 + 0.151			
CTm	FL 0	28.39 + 0.12	29.14 + 0.11	0.081 **	0.081 **	0.115 ns
	FL 20	29.28 + 0.11	29.62 + 0.11			
CTa	FL 0	31.80 + 0.098	32.44 + 0.094	0.067 **	0.067 **	0.094 *
	FL 20	32.57 + 0.094	32.71 + 0.094			
DCT	FL 0	3.730 + 0.159	3.300 + 0.152	0.108 ns	0.108 ns	0.153 ns
	FL 20	3.228 + 0.152	3.085 + 0.152			
RRm	FL 0	38.04 + 0.98	36.81 + 0.94	0.668 ns	0.668 *	0.944 ns
	FL 20	40.25 + 0.94	40.78 + 0.94			
Rra	FL 0	46.57 + 1.261	51.57 + 1.205	0.857 ns	0.857 ns	1.212 ns
	FL 20	51.08 + 1.205	53.31 + 1.205			
DRR	FL 0	8.837 + 1.515	14.761 + 1.448	1.030 **	1.030 ns	1.457 ns
	FL 20	10.831 + 1.448	12.531 + 1.448			

TW: tap water; RT: rectal temperature m: morning; a: afternoon; D: diurnal variation ST: skin tepmerature; CT: coat temp.; RR: respiration rate; FL 0: no additive; FL 20: flavomycin 20mg/h/d; SE: standard error; * : $P<0.05$; ** : $P<0.01$, ns: not significant $P>0.05$

Both SW and FL had significant effects on skin temperatures (ST), which meant that ST was more sensitive than RT to these treatments. In the morning the increase ($P<0.05$) due to SW (0.23 °C) was of less magnitude than that due to FL (0.55 °C), indicating the role of that additive in increasing heat production during the temperate hours of the dey. Applying both treatments resulted in the highest ($P<0.05$) STm (31.43 °C) hence the lowest; but insignificant; diurnal variation (2.978 °C). During afternoon ST increased ($P<0.01$) due to SW by 0.83 °C, but showed negative change by FL (- 0.18 °C). The decrease by FL was more pronounced (-0.33 °C) in the groups drank TW than in those drank SW (-0.02 °C). This made the significant ($P<0.05$) interaction SW X FL. These results indicated that saline load was more powerful than FL administration in affecting STa. Increasing SW intake might stimulate sweating and perspiration during the hot hours of the day through increasing blood shift to the superficial tissues, carrying with it extra heat energy. Beakley and Findlay (1955) reported in calves an increase in the temperature of ear skin (18 °C) under environmental temperature of 15 - 20 °C, indicating a large increase in blood flow. However, ST in animals drank SW might decrease during the following hours of the day because of increased water vaporization. In contrast to the present results, Badawy (1999) reported that ST of rams was not significantly affected by drinking saline water, while Nassar and Hamed (1980) reported that sheep drinking SW (1.3%) showed tendency to have lower ST than that of sheep drinking TW. These conflicting results might reflect the differences in the time of recording ST, which indicates that this parameter, must be recorded over the whole day.

Coat temperature (CT) at both times of the day was significantly increased by SW and FL. The increase due to FL was more than that due to SW at both occasions. The temperature of the coat was affected by the sum of heat dissipated from the body and the heat load from the environment. Drinking SW increased the opportunity for evaporating water carrying extra heat from the skin surface, while FL increased heat production; hence much heat energy was transferred to the tip of wool. Diurnal variation (DCT) had reversed trend, where it decreased by treatments. Similar to DST, applying both treatments resulted in the lowest, but insignificant, DCT (3.085 °C). This was a result of increasing morning CT by both treatments.

Respiration rate at morning (RRm) increased significantly ($P<0.05$) by FL administration (Table 3), probably to dissipate by respiratory evaporation the extra heat production produced by this additive. This result confirmed the role of FL during the temperate hours of the day as demonstrated before in ST. Afternoon respiration rate (RRa) increased but insignificantly by both SW and FL. However, diurnal variation of respiration rate (DRR) showed significant ($P<0.01$) increase by drinking SW. Salama (1993) stated that drinking SW was of less effect on RR of sheep during winter. During summer, RR of adult sheep was found to decrease by drinking SW (Helal, 1984 and Badawy, 1999) which might be due to increased water available for evaporation throughout routes other than respiratory pathway. In camels, Ibrahim (2001) found no effect to drinking SW on RR. The increase in DRR in the present study was due to that the SW treatment was conducted under the temperate climatic conditions of autumn and winter. El-Sherif (1991) stated that age was the dominant factor dictating RR rather than environmental temperature under air temperature range of 7 - 22 °C. Growing lambs had higher metabolic rate and heat production than adults, because of growth stage and high surface to size ratio. Hence, the growing lambs were expected to increase evaporative cooling activities, especially as SW intake increased.

3- Temperature gradients:

Table (4) and Figure (2) demonstrates the effect of treatments and age on temperature gradients either at morning or afternoon. Temperature gradients included inner gradient; IG (RT – ST), middle gradient; MG (ST – CT) and outer gradient; OG (CT – AT).

Flavomycin administration resulted in decreasing ($P<0.01$) morning and afternoon IG and decreasing ($P<0.05$) afternoon MG, while did not affect morning MG (Table 4). This was due to the increase in metabolic heat production that transferred by blood to the superficial layers, then to the tip of wool, resulting in low difference between body core, skin and coat temperatures. The effects of FL were more obvious during afternoon time, which meant that the role of FL in increasing heat production was more effective after completion of feed digestion and absorption. Flavomycin administration increased significantly morning and afternoon OG (Table 4). As FL facilitated more heat production, much heat energy was transferred to the tip of wool resulting in significant high values of CT (Table 3), hence more difference between coat and air temperatures (OG).

Drinking SW had no effect on morning IG, but resulted in decreasing ($P<0.01$) afternoon IG. This effect was due to increased body fluids (El-Sherif and El-Hassanein, 1996), hence easy to shift heat energy from body core to superficial layers. The interaction FL X SW was significant ($P<0.01$) for afternoon IG, because of increasing IG by FL in the animals drank SW. This meant that FL helped in increasing insulation properties of the superficial layers might be through increasing fat deposition under skin. Flavomycin was found to improve rumen functions (Haimoud *et al.*, 1996 and Abdel-Rahman, 1998), nutrient utilization (Casey *et al.*, 1994; El-Basiony, 1994 and El-Feel *et al.*, 1997), and growth rate (Martini *et al.*, 1996, Paitil *et al.*, 1996 and El-Sherif *et al.*, 2001) in growing and adult sheep. Drinking SW resulted in decreasing both morning and afternoon MG. The decrease was significant ($P<0.01$) at morning (Table 4). This decrease could be a result of increasing water perspiration as water intake increased by saline load (El-Sherif and El-Hassanein, 1996). Perspired water spread with its latent heat energy within the coat fibres leading to homogenous temperature all over the wool staple. Consequently, CT became high and near to that of ST. As a result, the difference between CT and AT (OG) became high ($P<0.05$) at afternoon (Table 4).

Mean morning and afternoon IG increased with advancing age (Fig. 2) indicating the development of insulating properties of superficial layers probably by increasing under-skin fat thickness. However, these two parameters decreased during the last month of the experimental period (Fig.2) which coincided with the cold weather of February (Fig. 1).

Table 4: Changea In different temperature gradients (°C) as affected by saline water and falvomycin (Mean ± SE)

Gredient	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SW X Fl
Inner morning	FL 0	8.674 + 0.127	8.392 ± 0.121	8.533 ± 0.088	0.308 ns	0.308 **	0.436 ns
	FL 20	8.077 + 0.121	7.938 ± 0.121	8.008 ± 0.086			
Total		8.375 ± 0.087	8.185 ± 0.085				
Middle morning	FL 0	2.255 + 0.100	1.828 + 0.096	2.042 ± 0.069	0.244 **	0.244 ns	0.345 ns
	FL 20	2.008 + 0.096	1.806 + 0.096	1.907 ± 0.068			
Total		2.132 ± 0.069	1.817 ± 0.068				
Outer morning	FL 0	8.390 ± 0.119	8.891 ± 0.114	8.890 ± 0.083	0.291 ns	0.291 *	0.412 ns
	FL 20	9.285 ± 0.114	8.775 ± 0.114	9.03 ± 0.081			
Total		8.887 ± 0.083	8.733 ± 0.081				
Inner afternoon	FL 0	6.038 ± 0.110	5.227 ± 0.105	5.832 ± 0.078	0.268 **	0.288 *	0.379 **
	FL 20	5.312 ± 0.105	5.278 ± 0.105	5.295 + 0.078			
Total		5.674 ± 0.078	5.252 ± 0.074				
Middle afternoon	FL 0	1.932 + 0.078	1.949 ± 0.073	1.941± 0.053	0.186 ns	0.188 *	0.283 ns
	FL 20	1.823 ± 0.073	1.899 ± 0.073	1.781± 0.052			
Total		1.878 ± 0.053	1.824 ± 0.052				
Outer afternoon	FL 0	8.421 ± 0.099	8.875 ± 0.094	8.548 ± 0.068	0.241 *	0.241 **	0.341 ns
	FL 20	8.957 ± 0.094	9.245 + 0.094	9.101± 0.067			
Total		8.689 ± 0.066	8.980 ± 0.067				

TW: tap water; SW: saline watar; FL: flavomycin; FL 0: no additive; FL 20: flavomycin 20mg/h/d; SE: standard error; * : P<0.05; ** : P<0.01; ns: not significant p >0.05

This might indicate that a part of under-skin fat was used during cold months to produce heat energy for worming animals. Both morning and afternoon MG decreased (P<0.01) with advancing age and declining ambient temperature (Figures 1 and 2). Simultaneously, morning and afternoon OG increased significantly (P<0.01) with age. This meant that under cold climate heat energy flowed from skin to the tip of wool, resulting in small gradient within the coat with a big chance for large heat loss from the body surface to the surrounding environment. Under these circumstances, the insulating property of the superficial tissues was the most efficient in protecting growing lambs from cold stress, indicated by the high morning IG. The role of wool coat in protecting adult sheep against hot climate was proved by El-Ganaieny *et al.* (1992). El-Sherif (1991) stated that coat insulation properties of growing Barki lambs became effective after yearling age. The present results showed that the efficiency of wool coat in protecting growing Barki ram lambs from cold stress might appear later after enough development of fibre characteristics.

4- Some hematological responses:

Flavomycin administration resulted in increasing (P<0.05) packed cell volume % (PCV) in all animals apart from the type of drinking water (Table 5). Moreover, in animals drank TW there was a little increase in mean corpuscular hemoglobin concentration % (MCHC) by FL (30.60% vs. 30.36%), resulting in appreciable increase in blood hemoglobin (Hb) (from 9.95 to 10.17 g/dl).

A) Morning

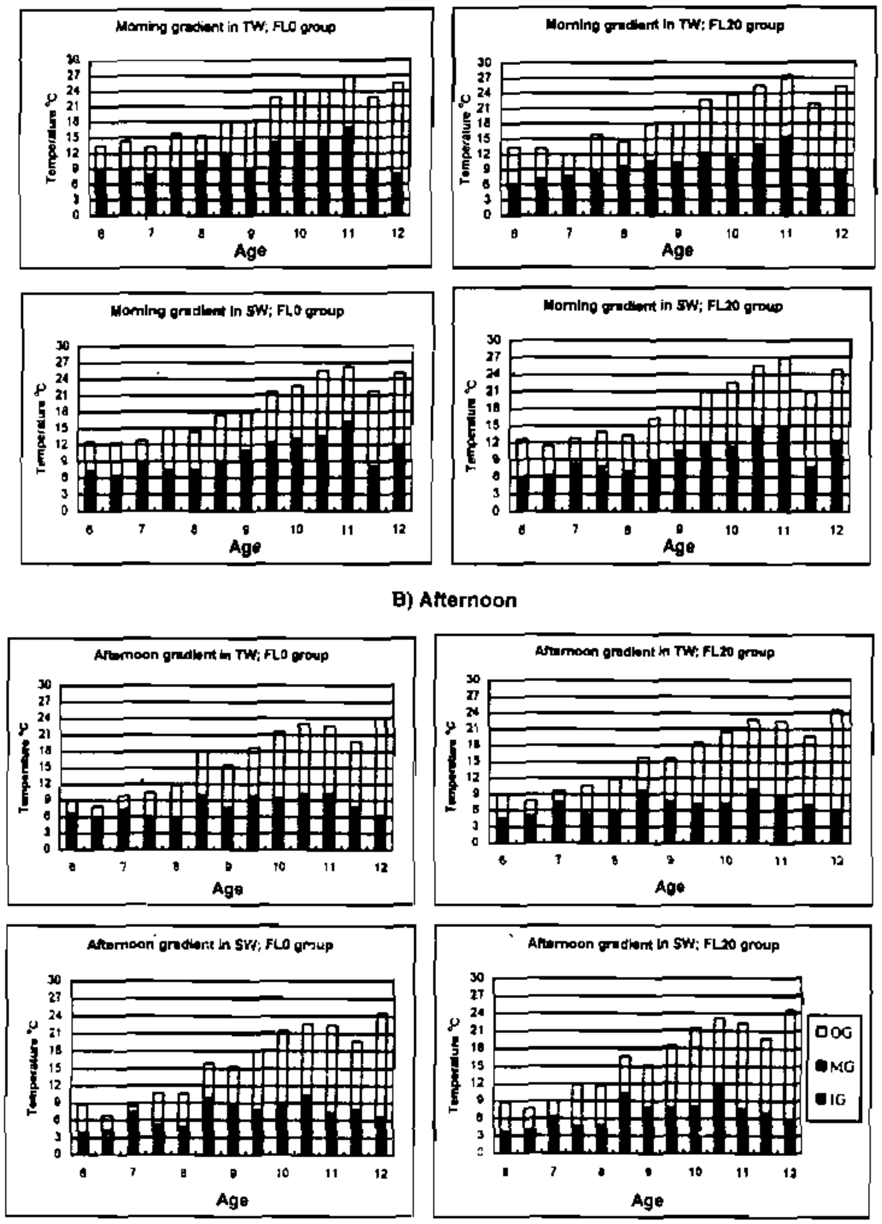

Figure 2: Changes in different temperature gradients (°C) throughout the experimental period in each experimental group

FW: fresh water, SW: saline water, F0: No flavomycin addition, F20: adding flavomycin 20 mg/h/d, IG: inner gradient (RT – ST), MG: middle gradient (ST – CT), OG: outer gradient (CT – AT).

Flavomycin seemed to help in biosyntheses of red corpuscles and hemoglobin due to its role in improving nutritional state of the animals through increasing the energy of VFA due to increased production of propionate (Flachowský and Richter, 1991). Additionally, increased propionate might spare amino acids normally used for gluconeogenesis (Leng *et al*, 1967) and stimulate body protein synthesis (Potter *et al.*, 1968).

Table 5: Overall means ± SE of some hematological parameters of growing ram lambs as affected by saline water and flavomycin

Parameter	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SWXFL
Hb g/dl	FL 0	9.95 ± 0.170	10.77 ± 0.170	10.36 ± 0.120	0.120 **	0.120 ns	0.170 *
	FL 20	10.17 ± 0.170	10.18 ± 0.174	10.18 ± 0.122			
Total		10.06 ± 0.120	10.47 ± 0.122				
PCV %	FL 0	32.88 ± 0.233	32.67 ± 0.233	32.78 ± 0.165	0.161 ns	0.161 *	0.227 *
	FL 20	33.45 ± 0.233	34.25 ± 0.239	33.85 ± 0.167			
Total		33.17 ± 0.165	33.46 ± 0.167				
MCHC %	FL 0	30.36 ± 0.526	33.36 ± 0.526	31.88 ± 0.372	0.339 *	0.339 **	0.479 **
	FL 20	30.60 ± 0.526	29.78 ± 0.539	30.19 ± 0.378			
Total		30.46 ± 0.372	31.57 ± 0.377				

Hb: hemoglobin concentration; PCV%: packed cell volume; MCHC: mean corpuscular hemoglobin concentration; FW: fresh water; SW: saline water; F 0: no additive; F 20: flavomycin 20mg/h/d; SE: standard error; * : $P<0.05$; ** : $P<0.01$; ns: not significant $P>0.05$

In animals that had no FL, drinking SW resulted in little decrease in PCV% (32.67% vs. 32.88%). This might reflect hemodilution due to increased water intake by saline load (El-Hassanein and El-Sherif, 1996 and Assad *et al.*, 1997). However, these animals compensated by increasing MCHC (from 30.36% to 33.36%), resulting in appreciable increase in blood Hb (from 9.95 to 10.77 g/dl). Hussein *et al.* (1990) and El-Hassanein and El-Sherif (1996) working on sheep recorded an elevation in the concentration of hemoglobin due to drinking saline water. Similarly, Ibrahim (2001) on camels and El-Sherif *et al.* (2002) on rabbits found similar results. However, other researchers found a decrease in Hb of different species of farm animals received SW (Badawy, 1999 in sheep; and Ibrahim, 1995 in goats) might be due to a greater phase of hemodilution especially under hot conditions and increased water intake. In the present study, the behavior of animals drinking SW in compensating by increasing MCHC obscured the advantage of increasing PCV% by FL, hence blood Hb in the animals drank SW did not show change by adding FL.

5- Growth performance:

Table (6) demonstrates that non of the growth performance parameters was affected by adding FL. Moreover, there was a little decrease in body daily gain (DG), total body gain (TBG), and the intake of different nutrients (dry matter; DMI, total digestible nutrients; TDNI and crude protein; CPI) either as absolute values (g/h/d) or as relative to metabolic body weight (g/BW0.75/d). However, the feed efficiency of DM (FE1) and TDN (FE2) increased but insignificantly by FL (Table 6). El-Sherif *et al.* (2001) reported that giving flavomycin at a level of 20 mg / h / d improved feed conversion efficiency in growing ewe lambs from 16.2 to 14.7 Kg DM / kg Gain. Flavomycin was reported to improve digestibility of dry matter, organic matter, crude protein, and crude fiber in Ossimi sheep, in addition to significant improvement in feed conversion efficiency during growing period (El-Basiony, 1994). Sadek *et al.* (1995) and El-Feel *et al.* (1997) found that flavomycin improved feed conversion efficiency and reduced finishing period and feed cost per kg gain in Friesian and buffalo calves.

Drinking SW resulted in significant decrease in TBG and DG. El-Sherif and El-Hassanein (1996) came to the same results in growing Barki ram lambs after prolonged administration of SW. Quite the opposite, Shwaket *et al.* (1988) and Abou El-Nasr *et al.* (1988) reported an increase in live body weight of sheep and camels by drinking SW as a result of increased water intake. In the present work, there was also minor decrease by SW in different nutrients intake, but more obvious in the absolute values (Table 6). These results of intake and body gain brought in significant ($P<0.01$) decrease in feed efficiency (FE1 and FE2) by drinking SW. However, introducing FL to the animals drinking SW reduced these bad effects on all nutrients intake, either absolutely or relatively, and the feed efficiency. That trend made the significant interaction SW X FL in DMI, TDNI, CPI, FE1 and FE2. This indicated the role of FL as antistressor the same as mentioned before by Davey (1980).

6- Carcass traits:

Data presented in Table (7) show that there were no significant effects due to SW or FL on empty body weight (EBW), hot carcass weight (HCW). Dressing percentage (D%) decreased ($P<0.05$) due to drinking SW. Fahmy (1998) reported that D% of sheep did not change by saline load through feeding silage of salt bushes as a basal diet. Abdel-Samee and El-Masry (1992), and Mohamed (1997) reported significant decrease in HCW and D% of both California and New-Zealand White rabbits by drinking SW. Ahmed (1996) suggested that the decrease in weights of carcass and its components by saline load could be due to depression in the final body weight and body solids content.

In cattle, Spires *et al.* (1990) noted that D% was greater when using FL 30 mg/h/day as compared to FL 45 mg/h/day (68.7% vs. 66.8%). However, Morris *et al.* (1990) reported that antibiotic growth promoters had no effect on D% and carcass composition.

Although the insignificant, there was a substantial decrease in EBW and HCW by drinking SW effects equaled to 2.642 kg and 2.400 kg, respectively, in addition to a significant decrease in dressing percentage by 2.954%. Adding FL to the animals' diet that drank SW moderated that decrease to become 1.624 kg, 1.900 kg and 2.384% in EBW, HCW and D%, respectively (Table 7).

Table (8) demonstrates the distribution of lean meat, fat and bone in the best rib cut (9th, 10th and 11th) as affected by SW and FL. Flavomycin administration had no effect on the physical composition of the best rib cut (Table 8). Drinking SW brought about significant ($P<0.01$) effects, where it caused an increase in lean meat percentage on the expense of fat percentage.

Table 6: Overall means ± SE of body weight, daily gain, feed intake and feed conversion efficiency as affected by saline water and flavomycin

Parameter	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SW X FL
Initial BW kg	FL 0	27.111 ± 1.741	25.850 + 1.851	26.481 ± 1.200	1.168 ns	1.168 ns	1 651 ns
	FL 20	25.700 ± 1.651	25.600 ± 1.651	25.650 ± 1.168			
Total		26.408 ± 1.200	25.725 ± 1.168				
Final BW kg	FL 0	46.944 ± 2.574	42.130 ± 2.441	44.663 ± 1.726	1.726 ns	1.728 ns	2.441 ns
	FL 20	44.150 ± 2.441	42.300 ± 2.441	43.225 ± 1.726			
Total		45.547 ± 1.774	42.215 ± 1.726				
Total BW gain kg	FL 0	19.833 + 1.482	16.280 + 1.406	18.057 + 1.021	0.994 *	0.944 ns	1.406 ns
	FL 20	18.450 ± 1.406	16.700 ± 1.406	17.575 ± 0.994			
Total		19.142 ± 1.021	16.490 ± 0.994				
DG g/h/d	FL 0	116.448 ± 5.734	92.507 ± 5.479	104.48 ± 3.966	3.697 **	3.897 ns	5.512 ns
	FL 20	112.307 + 5.479	100.145 ± 5.479	106.226 + 3.875			
Total		114.38 ± 3.966	96.33 ± 3.875				
DMI g/h/d	FL 0	1054.2 + 5.28	969.6 + 5.04	1012.0 ± 3.65	3.588 ns	3.566 ns	5.074 **
	FL 20	1017.2 + 5.04	981.9 + 5.04	999.6 ± 3.57			
Total		1035.7 ± 3.65	975.8 ± 3.57				
DMI g/kg $BW^{0.75}$/d	FL 0	70.788 + 0.319	69.739 + 0.305	70.263 + 0.221	0.148 ns	0.148 ns	0.210 *
	FL 20	70.227 + 0.305	70.460 + 0.305	70.354 + 0.218			
Total		70.507 + 0.221	70.110 + 0.216				
TDNI g/h/d	FL 0	699.03 + 3.505	643.15 + 3.349	671.09 ± 2.424	2.362 ns	2.382 ns	3.369 **
	FL 20	675.46 + 3.349	651.00 + 3.349	663.23 ± 2.368			
Total		687.25 + 2.424	647.08 + 2.368				
TDNI g/kg $BW^{0.75}$/d	FL 0	46.943 + 0.218	46.255 + 0.209	46.599 + 0.151	0.146 ns	0.148 ns	0.210 ns
	FL 20	46.688 + 0.209	46.734 + 0.209	46.711 + 0.148			
Total		46.616 + 0.151	46.494 + 0.148				
CPI g/h/d	FL 0	108.01 + 0.505	99.631 + 0.482	103.82 + 0.349	0.343 ns	0.343 ns	0.458 **
	FL 20	103.94 + 0.505	100.94 + 0.482	102.44 + 0.341			
Total		105.97 ± 0.349	100.275 ± 0.341				
CPI g/kg $BW^{0.75}$/d	FL 0	7.255 + 0.030	7.164 + 0.029	7.209 + 0.021	0.020 ns	0.020 ns	0.029 **
	FL 20	7.184 + 0.029	7.239 + 0.029	7.211 + 0.020			
Total		7.219 + 0.021	7.202 + 0.020				
DM conversion % (FE1)	FL 0	11.126 + 0.578	9.450 + 0.552	10.286 ± 0.399	0.393 **	0.393 ns	0.555 ns
	FL 20	11.356 + 0.552	10.312 + 0.552	10.834 ± 0.390			
Total		11.241 ± 0.400	9.861 ± 0.390				
TDN conversion % (FE2)	FL 0	16.775 + 0.671	14.255 + 0.832	15.515 ± 0.802	0.592 **	0.592 ns	0 837 ns
	FL 20	17.113 + 0.832	15.550 + 0.832	16.331 ± 0.588			
Total		16.944 ± 0.602	14.902 ± 0.688				

BW: body weight; DG: daily gain; DMI: dry matter intake; *TDNI: total digestible nutrients* intake; CPI: crude protein 20mg/h/d; intake; FE: feed efficiency percentage; FW: fresh water; SW: saline water; F 0: no additive; F 20: flavomycin BW: live SE: standard error; * : P<0.05; ** : P<0.01, ns: not significant P>0.05

Table 7: Carcass traits of Barki rams at the age of 12 months as ffected by saline water and flavomycin (Mean ± SE)

Parameter	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SW X FL
Empty BW kg	FL 0	37.707 ± 3.974	35.083 ± 3.974	36.395 + 2.810	2.810 ns	2.810 ns	3.974 ns
	FL 20	35.833 ± 3.974	36.083 ± 3.974	35.958 + 2.810			
Total		36.770 + 2.810	35.583 + 2.810				
Hot Carcass weight kg	FL 0	20.067 ± 2.229	17.667 ± 2.229	18.867 + 1.576	1.576 ns	1.576 ns	2.229 ns
	FL 20	18.967 ± 2.229	18.167 ± 2.229	18.567 + 1.576			
Total		19.517 + 1.576	17.917 + 1.576				
Dressing %	F 0	53.007 ± 1.775	50.053 ± 1.775	51.530 + 1.255	1.255 *	1.255 ns	1.775 ns
	F 20	52.920 ± 1.775	50.623 ± 1.775	51.772 + 1.255			
Total		52.563 + 1.255	50.338 + 1.255				

Dressing % : Hot carcass X100 / Empty BW; FW: fresh water; SW: saline water; F 0: no additive; F 20: flavomycin 20mg/h/d; SE: standard error; * : P<0.05; ** : P<0.01, ns: not significant P>0.05

Table 8: Physical characteristics of 9th -10th & 11th rib cut

Parameter	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SW X FL
Rib Cut weight kg	F 0	0.890 + 0.086	0.750 + 0.086	0.820 + 0.061	0.061 ns	0.061 ns	0.086 ns
	F 20	0.770 ± 0.086	0.803 + 0.086	0.787 + 0.061			
Total		0.830 + 0.061	0.777 + 0.061				
Lean meat %	F 0	52.547 + 1.829	63.350 ± 1.829	57.948 + 1.293	1.293 **	1.293 ns	1.829 ns
	F 20	52.920 + 1.829	62.090 + 1.829	57.505 + 1.293			
Total		52.733 + 1.293	62.720 + 1.293				
Fat %	F 0	21.480 + 2.090	9.663 + 2.090	15.572 + 1.478	1.478 **	1.478 ns	2.090 ns
	F 20	20.137 + 2.090	12.560 + 2.090	16.348 + 1.478			
Total		20.806 + 1.478	11.112 + 1.478				
Bone %	F 0	25.973 ± 1.627	26.983 ± 1.627	26.478 + 1.150	1.150 ns	1.150 ns	1.627 ns
	F 20	26.737 ± 1.627	25.083 ± 1.627	25.910 + 1.150			
Total		26.355 + 1.150	26.033 + 1.150				

FW: fresh water; SW: saline water; F 0: no additive; F 20: flavomycin 20mg/h/d; SE: standard error; * : P<0.05; ** : P<0.01, ns: not significant P>0.05

Mohamed (1997) found in rabbits an increase in carcass muscle % and a decrease in fat and bone percentages by drinking SW of tolerable concentration (3369 ppm TDS). In New Zealand White rabbits, Ayyat *et al.* (1991) reported that drinking saline water (3000, 4500 and 6000 ppm salt) caused a significant decrease in kidney fat. Fahmy (1998) reported in sheep an increase in the longissimus dorsi muscle area between 9th and 10th rib from 6.96 cm^2 to 20.7 cm^2 by feeding the silage of halophytic shrubs. However, he found that the lean percentages significantly decreased in leg and rack cuts, while the fat percentage significantly increased in all prime cuts.

Table (9) illustrates the effect of SW and FL on the different carcass parts expressed as a percentage of EBW.

Table 9: The percentage ± SE of different carcass parts from empty body weight (EBW) as affected by saline water and flavomycin

Parameter	FL level	Water type		Overall	SE		
		TW	SW		SW	FL	SW X FL
Neck %	F 0	8.413 ± 0.206	7.220 ± 0.206	7.817 + 0.145	0.145 **	0.145 **	0.206 **
	F 20	8.077 ± 0.206	6.100 ± 0.206	7.088 + 0.145			
Total		8.245 + 0.145	6.660 + 0.145				
Shoulder %	F 0	18.367 ± 0.441	18.780 ± 0 441	18.573 + 0.312	0.312 ns	0.312 **	0.441 ns
	F 20	19.867 ± 0.441	19.653 ± 0.441	19.760 + 0.312			
Total		19.117 + 0.312	19.217 + 0.312				
Racks %	F 0	25.227 ± 0.495	27.023 ± 0.495	26.125 + 0.350	0.350 **	0.350 ns	0.495 ns
	F 20	25.257 ± 0.495	26.633 ± 0.495	25.945 + 0.350			
Total		25.242 + 0.350	26.828 + 0.250				
Loin %	F 0	6.320 ± 0.468	5.647 ± 0.468	5.983 + 0.331	0.331 ns	0.331 ns	0.468 ns
	F 20	6.207 ± 0.466	6.373 ± 0.469	6.290 + 0.331			
Total		6.263 + 0.331	6.010 + 0.331				
Flanks %	F 0	4.713 ± 0.646	5.143 ± 0.646	4.928 + 0.457	0.457 ns	0.457 ns	0.646 ns
	F 20	5.463 ± 0.646	5.993 ± 0.646	6.728 + 0.457			
Total		5.088 + 0.457	6.568 + 0.457				
Legs %	F 0	31.663 ± 0.854	32.977 ± 0.854	32.320 + 0.604	0.604 **	0.604 ns	0.854 ns
	F 20	31 023 ± 0.654	32.793 ± 0.854	31.908 + 0.604			
Total		31.343 + 0.604	32.885 + 0.604				
Tail %	F 0	5.090 ± 0.905	3.220 ± 0.905	4.155 + 0.640	0.640 *	0.640 ns	0.905 ns
	F 20	4.110 ± 0.905	3.340 ± 0.905	3.725 + 0.640			
Total		4.600 + 0.640	3.260 + 0.640				
Pelt %	F 0	17.260 ± 0.910	18.423 ± 0.910	17.642 + 0.643	0.643 ns	0.643 *	0.910 ns
	F 20	18.177 ± 0.910	19.957 ± 0.910	18.067 + 0.643			
Total		17.718 + 0.643	19.190 + 0.643				
Edible offal % of EBW							
Liver %	F 0	1.267 ± 0 114	1.343 ± 0.114	1.305 0.081	0.081 ns	0.081 hs	0.114 ns
	F 20	1.363 ± 0.114	1.363 ± 0.114	1.363 + 0.081			
Total		1.318 + 0.081	1.353 + 0.081				
Kidnleys %	F 0	0.353 ± 0.021	0.393 ± 0.021	0.373 + 0.015	0.015 ns	0.015 ns	0.021 ns
	F 20	0.340 ± 0.021	0.373 ± 0.021	0.357 + 0.015			
Total		0.347 + 0.015	0.383 + 0.015				
Spleen %	F 0	0.187 ± 0.009	0.160 ± 0.009	0.173 + 0.006	0.006 *	0.006 **	0.009 **
	F 20	0.180 ± 0.009	0.193 ± 0.009	0.187 + 0.006			
Total		0.1883 + 0.006	0.177 + 0.006				
Heart %	F 0	0.517 ± 0.056	0.443 ± 0.056	0.480 + 0.040	0.029 **	0.039 ns	0.056 ns
	F 20	0.470 ± 0.056	0.390 ± 0.056	0.430 + 0.040			
Total		0.493 + 0.040	0.417 + 0.040				

FW: fresh water; SW: saline water; F 0: no additive; F 20: flavomycin 20mg/h/d; *SE:* standard error; * : P<0.05; ** : P<0.01, ns: not significant P>0.05

Saline load resulted in a significant decrease in neck and tail percentages, while caused significant increase in racks and legs percentages. Fahmy (1998) found a decrease in neck and flank percentages by salt load when feeding sheep on silage of salty plants. Flavomycin increased the percentage of shoulder and pelt, but decreased leg segment. Combining SW and FL yielded large decrease in neck %. Concerning edible offals, drinking SW decreased significantly spleen and heart percentage.

Drinking saline water was found to decrease most of the digestibility coefficients (Ismail, 2003). Flavomycin overcame the negative effect of SW on spleen %, hence there was significant interaction SW X FL on this part.

In conclusion, adding flavomycin to growing lambs raised under desert conditions could reduce some bad effects of drinking SW on growth performance and carcass traits. In addition, flavomycin protected growing animals from cold stress during winter through increasing insulation properties of the superficial layers. While drinking SW decreased packed cell volume, flavomycin increased biosyntheses of red blood corpuscles and hemoglobin.

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تأثير شرب الماء المالح مع إضافة الفلافوميسين على بعض الاستجابات الفسيولوجية و أداء النمو وصفات الذبيحة لحوالي البرقي

مجدى محمد أبوالعلا الشريف
قسم فسيولوجيا الحيوان والدواجن، مركز بحوث الصحراء، المطرية، القاهرة، مصر

هدفت الدراسة الى بحث تأثيرات استخدام منشط النمو الفلافوميسين (مضاد حيوى) بالتجريع على الاستجابات الفسيولوجية وإنتاجية حوالى البرقى النامية التى تشرب الماء المالح. استخدم ٤٠ حولى برقى متوسط عمر ستة أشهر ومتوسط وزن ٢٦,٠ كجم فى تصميم عاملى ٢ X ٢ يتكون من مجموعتين لنوع مياه الشرب (ماء صنبور ٥٠٥ جزء فى المليون أملاح كلية ذائبة و ماء بحر مخفف يحتوى على ١٢٤٩٤ جزء فى المليون لأملاح كلية ذائبة) و مجموعتين لمستوى الفلافوميسين (صفر و ٢٠ ملليجرام للرأس فى اليوم) ، ١٠ حيوانات كمكررات. غذيت جميع الحيوانات على مستوى يغطى معدل نمو ١٠٠ جم / اليوم. استمرت المعاملات لمدة ستة أشهر حتى وصلت الحوالى إلى عمر التسويق (١٢ شهر) حيث قدرت صفات الذبيحة على ثلاث حيوانات من كل مجموعة.

أدى شرب الماء المالح إلي انخفاض معنوى فى مقدار التغير اليومى لحرارة الشرج، بينما أدت إلي زيادة حرارة الجلد والصوف و مقدار التغير لمعدل التنفس بما يدل علي أن شرب الماء المالح ساعد على ثبات حرارة الجسم عن طريق توفير الماء اللازم لعمليات البخر. إضافة الفلافوميسين أدت الى زيادة انتاج الطاقة الحرارية ولكن ساعدت على زيادة كفاءة العزل الحرارى لطبقة تحت الجلد التى شكلت أهم وسيلة لحماية تلك الحوالى النامية من برودة الجو فى أشهر الشتاء.

أدت إضافة الفلافوميسين الى زيادة هيموجلوبين الدم ونسبة المكونات الخلوية، بينما أدى شرب الماء المالح الى نقص هذه النسبة، وقد استطاعت الحيوانات التغلب على ذلك بزيادة تركيز الهيموجلوبين داخل الخلايا.

بينما ساعد الفلافوميسين على زيادة كفاءة التحويل الغذائى، أدى شرب الماء المالح الى خفض معدل النمو وكمية الغذاء المأكول وكفاءة التحويل الغذائى. إضافة الفلافوميسين الى الحيوانات التى تشرب الماء المالح قلل من تلك التأثيرات السلبية.

أدى شرب الماء المالح إلى انخفاض وزن الجسم الفارغ و وزن الذبيحة بمقدار ٢,٦٤٢ و ٢,٤٠٠ كجم، على التوالى بالإضافة إلى نقص معنوى فى نسبة التصافى (٢,٩٥٤% بالنسبة لمجموعة المقارنة). إضافة الفلافوميسين الى الحيوانات التى تشرب الماء المالح قلل من هذه الآثار السلبية لتصبح قيم الانخفاض على التوالى ١,٦٢٤كجم، ١,٩٠٠كجم، ٢,٣٨٤% بالإضافة الى تقليل التأثير السلبى على وزن الطحال. شرب الماء المالح أدى لزيادة نسبة اللحم الأحمر على حساب الدهن فى الذبيحة ممثلة فى منطقة الضلوع التاسع الى الحادى عشر.

من النتائج أمكن استنتاج أن إضافة الفلافوميسين إلى الحوالى النامية تحت الظروف الصحراوية يقلل من التأثيرات السلبية لشرب الماء المالح على أداء النمو و بعض صفات الذبيحة ، بالإضافة إلى أن الفلافوميسين زاد من كفاءة العزل الحرارى لطبقة تحت الجلد بما يوفر الحماية ضد انخفاض حرارة المناخ المحيط بالحيوان.