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NUTRITIONAL EVALUATION OF THE EFFECT OF FLAVOMYCIN AND SALINE WATER ON NUTRIENT DIGESTIBILITY COEFFICINTS, LAMB PERFORMANCE AND SOME CARCASS TRAITS.

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SUMMARY

Forty growing Barki lambs were randomly selected and divided into four equal groups of similar body weights (21.9 ±1.72, 22.0 ±1.68, 21.85 ±1.66 and 23.7 0±1.61 Kg). Animal groups were randomly assigned in 2x2 factorial design to experimental treatments (basal diet with or without 20 mg/h/d flavomycin in addition to either fresh water or diluted seawater for drinking). The basal diet consisted of 60% berseem hay and 40% concentrates (1: 3 for barley grains: concentrate feed mix, respectively). Sea water was diluted with fresh water at 1: 3 ratio for sea water : fresh water, respectively). A feeding trial was conducted for 179 days followed by a metabolism trial. Five lambs from each group were randomly selected and slaughtered to test for some carcass traits.

Most of the nutrient digestibility coefficients were not affected by either type of drinking water or flavomycin addition. Only crude protein and crude fiber digestibility coefficients were significantly (P<0.01) decreased when salty water was offered to animals. Feeding value (DCP%) was, thereafter, decreased significantly (P<0.01). Drinking salt water caused a lower body weight gain than fresh water. Body weight gain was lower in salt-water group than fresh water one. Flavomycin had no effect on body weight changes. Either type of water or flavomycin addition did not affect dry matter and DCP intake. Drinking fresh water caused higher feed conversion efficiencies than did salty water. Dressing percentage (hot carcass weight as related to either slaughter weight or empty body weight) were higher for fresh water than for salty water groups. Flavomycin showed no effect on carcass traits. Spleen weight (%) was significantly low for salt water without flavomycin.

Apparently, flavomycin does not have clear effects on nutrient digestibility, rather on nutrient metabolism in the rumen. Salt water may have caused certain shift in nutrient metabolism in the rumen. Therefore, it is recommended to further investigate the effect of both parameters (flavomycin and drinking salt water) on rumen metabolism.

Key words: *flavomycin, saltwater, lamb performance, carcass quality*

INTRODUCTION

The drinking water (free form of water), feed moisture (combined form) and water resulting from oxidative metabolic process (metabolic form) are the main sources of water intake available to animals. In desert and coastal areas, most of the water available for animals is well water. Well water has different salinity levels. Saline water surely affects the animals in different ways. The maximum safety level of salinity tolerated by animals differ according to several factors; of which are the environmental conditions under which the animals survive, breed, genus of animals, type of diet, etc. (Wilson, 1974, and Fahmy, 1993). Pierce (1963) noted that sheep that drank water containing up to 1.5% sodium chloride showed no ill effects, yet the 2% level was detrimental. Water balance, feed intake, and nutrient digestibility could all be greatly affected by drinking saline water (Fahmy, 1993). Water intake increases as the first reaction of animals to drinking salt water (Nassar and Mousa, 1981). Ahmed, (1984) reported that saline water (9100 ppm total dissolved salts) containing different salts, not only sodium chloride, promoted animal performance and feed utilization; probably because of the availability of different micro and macro elements that maybe needed for the host animal and its microbial population residing its rumen. Squires, (1973) found that water salinity negatively affected nutrient digestion. High salinity (13533 ppm) decreased the digestion coefficients of both crude protein and crude fiber (Sooud et al, 1988); which maybe due to that excess level of salts may counteract each other at higher concentrations leading to their unavailability for rumen microorganisms. However, drinking saline water within the tolerance level did not adversely affect live weight gain of sheep (Singh and Taneja, 1979).

Ionophores have been used at a large-scale worldwide as feed additives to improve feed conversion efficiency. Falvomycin is one of such a class. It can increase the efficiency of rumen fermentation through increasing propionate production (Flachowsky and Richter, 1991). Feeding flavomycin increased feed efficiency, and rate of gain of sheep (Murray et al, 1992). Bedo et al, (1984) advised to add flavomycin to diets rich in crude fiber .

This study was carried out in order to cast lights on the effect of flavomycin (a growth promoter) on animal performance and carcass quality under the stress of drinking saline water.

MATERIALS AND METHODS

Animals and management

Forty growing Barki lambs were randomly selected and divided into four groups of ten animals each. Average of live body weights of the experimental groups were 21.93 ±1.720, 22.00 ±1.677, 21.85 ±1.660 and 23.7 ±1.611 Kg for groups 1, 2, 3, and 4, respectively. Animal groups were randomly assigned to experimental treatments in a 2x2 factorial design. All animals were drenched to control internal parasites before the start of the experiment. The experiment lasted for 179 days as a feeding trial followed by a metabolism trial. During the feeding experiment, animal body weight changes were monitored every two weeks. Feed intakes and refusals were recorded.

Nutrient requirements were calculated according to Kearl, (1982). Rations were formulated as 60% roughage and 40% concentrates (basal diet). The roughage portion was berseem hay while the concentrate portion consisted of barley grains and concentrate feed mixture (CFM) at 1:3 ratio, respectively. Chemical composition of different diet ingredients is present in Table (1). Animal groups were randomly assigned to the following treatments:

1. Basal diet with 20 mg/h/d flavomycin and fresh tap water for drinking
2. Basal diet with 20 mg/h/d flavomycin and diluted sea water for drinking
3. Basal diet without flavomycin and fresh tap water for drinking
4. Basal diet without flavomycin and diluted sea water for drinking

Nutrient requirements were adjusted according to changes in average body weight. Flavomycin (a growth promoter) was given to animals at 20 ppm/h/d as a suspension through a drenching gun.

Salt water was brought from the sea and diluted with fresh water at 1:3 ratios for seawater: fresh tap water, respectively. Tap water had 505 ppm total dissolved salts (TDS), while sea water contained 36480 ppm TDS. The TDS was measured using electrical conductivity apparatus. The resulting diluted seawater for animals to drink contained 12494 ppm TDS (Table 2).

In the metabolism trial, three animals from each group were randomly selected. Animals were randomly and individually placed in metabolism cages designed for total collection of feces and urine. Fifteen days were allowed for animals to adapt to the metabolism crates. Animals were offered feeds on individual basis during the metabolism trial. The collection period was seven days. During the collection period, urine, feces, orts as well as samples of feeds offered and refused were collected. Drinking water was also sampled. Twenty-five milliliters of 9*M* H_2SO_4 solution were added daily to urine collection vessels as a preservative. A 10% aliquot of urine (by volume) was saved daily. Daily urine collections were composited, mixed thoroughly, and sampled and immediately frozen for later analysis. Dried feces were composited, daily, into sealed plastic bags. Fecal collections were weighed, sampled, and ground. The composite samples of feeds and orts were also sampled and ground for later analysis.

Five lambs of each group were slaughtered after they were prevented from feed and water for 16 hr, at the end of the feeding period. Dressing percentage was calculated according to Abou-Ammo, (1992) as follows:

Dressing %, 1 = Hot carcass weight/Slaughter weight%

Dressing %, 2 = Hot carcass weight/Empty BW%

1-Chemical analysis

Feeds, orts, feces and urine were chemically analyzed according to A.O.A.C. (1990).

2-Statistical analysis

The data were statistically analyzed according to 2x2 factorial design ((two water types (fresh and salt water) and two levels of the growth promoter (20 mg/h/d flavomycin and 0 mg/h/d flavomycin)). Live body weight and feed intake were analyzed according to repeated measurements model. The GLM procedures of SAS (1985) package was employed for that purpose.

RESULTS AND DISCUSSION

Digestibility and feeding values of rations offered to different animal groups of growing Barki lambs are present in Table (3). Diluted seawater had no effect on DM, OM, EE, and NFE digestibility coefficients. Barki sheep tolerate up to 1% sodium chloride in drinking water all year round and up to 1.5% sodium chloride only under moderate weather conditions (Badawi, 1969 and Abdel Mageed, 1969). Diluted seawater that the animals drank in the present study contained 4122 ppm of Na and 4532 ppm of Cl (Table 2). Saline water of that range of Na and Cl concentrations does not affect most of nutrient digestibility coefficients (Fahmy, 1993).

The CP and CF digestibility coefficients (Table 3) were significantly ($P<0.01$) affected by the drinking of diluted seawater. Average values of CP digestibility were higher for fresh water (68.73%) than those of saline water (64.4%) obtained under the effect of increased salt contents of drinking water. There was 4.3 units decrease in CP

Table (1) : Chemical composition of feed ingredients as fed to sheep

Item	DM	OM	CP	CF	EE	Ash	NFE
		DM basis, %					
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

Table (2) : Total dissolved solids and some elements (ppm) in different types of water.

Type of water	TDS	Na	K	Mg	Cl
Tap water	505	180	11	19	220
Sea water	36480	12000	550	1312	13165
Diluted water	12494	4122	191.9	453	4532

Table (3): Digestibility and feeding values of rations offered to sheep along with flavomycin and salt water

Item	SW		FW		WxFl	±SE		
	Fl	NFl	Fl	NFl		W	Fl	WxFl
DM	72.87	72.15	76.02	73.01	73.51	1.006ns	1.006ns	1.422ns
OM	74.00	73.26	76.81	74.36	74.61	1.000ns	1.000ns	1.415ns
CP	64.10	64.70	68.45	69.01	66.56	0.929*	0.929ns	1.314ns
CF	50.43	51.23	56.73	56.75	53.79	1.127*	1.127ns	1.594ns
EE	73.05	72.99	74.16	74.52	73.68	1.148ns	1.148ns	1.623ns
NFE	82.64	81.41	84.90	81.26	82.55	1.144ns	1.144ns	1.618ns
TDN	69.45	68.64	71.54	69.12	69.69	0.940ns	0.940ns	1.329ns
DCP	8.00	8.09	8.55	8.62	8.31	0.118*	0.118ns	0.167ns

SW=Salt water, FW=Fresh water, Fl=Flavomycin, NFl=No Flavomycin
Ns=not significant ** P<0.05, *=P<0.01

Table(4): Average daily gain (ADG) and intakes of growing sheep fed rations along with flavomycin and salt water

Item	SW		FW		WxFl	±SE		
	Fl	NFl	Fl	NFl		W	Fl	WxFl
No. of animals	10	10	10	10				
Initial BW, Kg	21.93 ±1.720	22.00 ±1.677	21.85 ±1.660	23.7 ±1.611				
Final BW, Kg	38.750	38.900	43.103	45.001	43.803	1.361*	1.225ns	2.031ns
Final $BW^{0.75}$, Kg	15.531	15.576	16.822	17.375	17.027			
Body wt changes, Kg	16.82	16.9	21.253	21.301	18.512	1.361*	1.225ns	2.031ns
ADG, g	93.966	94.413	118.732	119.00	99.20	0.008**	0.007*	0.011ns
DMI/h/d, g	1072.7	1059.5	1104.5	1142.5	1095.5	45.48ns	46.26ns	47.21ns
DMI/h/d, g/$BW^{0.75}$	69.07	68.02	65.66	65.76	62.36	1.482ns	1.482ns	2.210ns
TDNI/h/d, g	744.99	727.24	790.16	789.70	763.45	2.382ns	2.382ns	3.369ns
TDNI, g/$BW^{0.75}$/h/d	47.97	46.69	46.97	45.45	44.59	0.985ns	0.985ns	1.058ns
DCPI, g/h/d	85.82	85.71	94.43	98.48	91.04	1.338	1.338	1.875
DCPI, g/$BW^{0.75}$/h/d	5.53	5.50	5.61	5.67	5.35	0.167	0.167	0.358

* P<0.05 **P<0.01 ns= not significant

digestibility representing 6.7%. The coefficients of digestibility of CF were also decreased because of increasing salt concentrations in drinking water. The decrease in CF digestibility was highly significant (P<0.01). Drinking fresh water showed CF digestibility of 56.73%. There was 5.91 units decrease in CF digestibility representing 11.63% because of drinking saline water. It appears that the concentration of 12494 ppm of TDS has caused decrease to crude fiber and crude protein digestibility coefficients. Ahmed (1984) found that drinking well water that contained 9100 ppm TDS improved most of the nutrient digestion coefficients and feed utilization of sheep. Higher concentrations (~ 12500 ppm TDS) showed no effect on most nutrient digestibility coefficients.

Since EE and NFE make up more than 50% of TDN value of the rations and since they were not significantly affected by increasing salt concentrations in drinking water, the TDN values of the rations were not significantly different. Animal group drank salty water had 69.01% TDN value versus 70.33% for fresh water. Feeding values of rations expressed as DCP were significantly different since they were affected by drinking saline water. This was expected since the digestible CP (Table 3) was low for salt water group (8.05%) as compared with fresh water group (8.6%) treatments. Increasing salt intake increased the dilution rate of the rumen fluid phase and negatively affected the protozoal population (Shawkat et al, 1985). It, therefore, decreased the digestion in the fore stomach, which was later compensated for, at least partially, in the lower tract (Potter et al, 1972 and Hemsley et al, 1975). Furthermore, salt intake and the associated changes in the rumen dilution rate influenced the pattern of microbial fermentation (Hudgson and Thomas, 1975) where increasing the rate of flow was associated with the decrease in propionic acid proportion.

Flavomycin is supposed to enhance rumen fermentation. Flachowsky and Richter, (1991) found that flavomycin can increase the efficiency of rumen fermentation through increasing propionate production. The digestibility of all nutrients was not significantly affected by the addition of flavomycin to rations. It seems that flavomycin exerts its effect on metabolism pathways of different nutrients. Therefore, the anticipation of altered nutrient digestibility should not considered, rather the products of rumen fermentation that should be considered. Follows, the feeding values of rations (TDN and DCP %) were, therefore, not significantly affected (Table, 3). The effect of flavomycin would be to increase the efficiency by which nutrients are metabolized. Interaction between water effect and flavomycin effect on nutrient digestibility was not significant.

Initial as well as final body weights of different animal groups are present in Table (4). Body weight changes of the groups that drank fresh water were 21.25 and 21.30 Kg/h for flavomycin and no flavomycin fed groups, respectively. These values were higher (P<0.05) than those which drank salt water (16.82 and 16.90 Kg/h for flavomycin and no flavomycin fed groups, respectively). Expressing the body weight changes as average daily gains, (ADG) resulted in significant effect (P<0.05). However, the collective effect (interaction) of water and flavomycin was not significant. Wilson, (1974) and Singh and Taneja (1979) found that drinking salt water (within the tolerated levels) did not adversely affect the live weight of sheep. Shawkat, et al (1988) increased salt contents in the drinking water from 7650 to 13535 ppm of TDS and found that live weight losses were reduced. Ahmed,

Table (5): Feed efficiency per kilogram LBW gain of growing sheep fed rations along with flavomycin and salt water

	SW		FW			±SE		
Item	Fl	NFl	Fl	NFl	WxFl	W	Fl	WxFl
Kg DM/Kg gain	14.84	12.00	9.86	8.43	11.70	1.152ns	1.036ns	1.719ns
Kg TDN/Kg gain	9.84	7.96	6.54	5.59	7.76	0.746ns	0.688ns	1.141ns
Kg DCP/Kg gain	1.52	1.23	1.01	0.86	1.20	0.116ns	0.107ns	0.177ns

** P<0.001
ns= not significant

Table (6): Carcass traits of growing sheep fed rations along with flavomycin and wsalt w water

	SW		FW			±SE		
Item	Fl	NFl	Fl	NFl	WxFl	W	Fl	WxFl
Slaughter weight, Kg	45.00	44.83	43.33	45.67	44.708	2.894ns	2.894ns	4.093ns
Empty BW, Kg	36.08	35.08	35.83	37.71	36.177	2.810ns	2.810ns	3.974ns
Hot Carcass wt, Kg	18.17	17.67	18.97	20.07	18.717	1.576ns	1.576ns	2.229ns
Dressing% 1	40.28	39.05	43.73	43.65	41.678	1.312**	1.312ns	1.601ns
Dressing% 2	50.62	50.05	52.92	53.01	51.651	1.255*	1.255ns	1.775ns
Edible parts as percentage of empty BW								
Liver %	1.36	1.34	1.36	1.27	1.334	0.081ns	0.081ns	0.114ns
Kidneys %	0.373	0.393	0.340	0.353	0.365	0.015ns	0.15ns	0.21ns
Spleen %	0.193	0.160	0.180	01.87	0.180	0.006*	0.006**	0.009**
Heart %	0.390	0.443	0.470	0.517	0.455	0.039**	0.093ns	0.056ns
Physical characteristics of the 9th, 10th, and 11th rib cut								
Rib cut, Kg	0.803	0.750	0.770	0.890	0.803	0.061ns	0.061ns	0.086ns
Lean meat %	62.09	63.35	52.92	52.55	57.727	1.293**	1.293ns	1.829ns
Fat %	12.56	9.66	20.14	21.48	15.960	1.478**	1.478ns	2.090ns
Bone %	25.08	26.98	26.74	25.97	26.194	1.150ns	1.150ns	1.627ns

Dressing % 1 = Hot carcass weight/Slaughter weight%
Dressing % 2 = Hot carcass weight/Empty BW%
* P<0.05
** P<0.01

(1984) let sheep drink saline water (9100 ppm TDS) and obtained improved weight gain than that of fresh tap water. Meyer and Weir (1954) fed female sheep different levels of salt (0.5%, 4.8%, 9.1% and 13.1%) for 253 days during growth, finishing, breeding, gestation and early lactation. These levels did not cause any effect during growth, finishing, breeding or gestation. However, the 13.1% level did cause more weight loss during lactation. None of the salt levels affected the gain of the experimental lambs. Hammam, (2001) compared flavomycin at two doses (20 vs 40 mg/h/d) versus monensin at two doses (10 and 20 mg/h/d) when fed to growing female barki lambs. The results were inconsistent. The highest live body weight gain was for monensin groups (10 and 20 mg/h/d). Control and flavomycin (40 mg/h/d) group recorded the lowest ADG. Murray et al, (1990) obtained similar results when supplemented diets of Merino ewes with 40 mg/h/d flavomycin.

Dry matter intakes (either related to absolute weight or related to metabolic body size) of animal groups were not significantly affected by either flavomycin or type of water, and so were TDN intake values (Table 4).

The conversion of feeds into body weight gain (Table 5) expressed as Kg DM/Kg body weight gain, Kg TDN/Kg body weight gain or Kg DCP/Kg body weight gain were significantly ($P<0.05$) affected by the type of water. Feed efficiency values obtained under the circumstances of drinking diluted seawater were lower than those when fresh water was available. Flavomycin showed no effect on feed conversion, neither did the interaction effect of water and flavomycin. When Hammam, (2001) fed flavomycin at two different levels (20 and 40 mg/h/d), he found that flavomycin at 20 mg/h/d did not differ from control in respect with feed efficiency expressed either as Kg DM/Kg gain or Kg DCP/Kg gain. Flavomycin improved feed conversion ratios during the growth period of Ossimi sheep (El-Basiony, 1994).

The slaughter characteristics data are present in Table (6). Generally, most of the tested carcass parameters were affected by water significantly. Fresh water showed significantly ($P<0.05$) higher dressing percentage (hot carcass/ empty BW) and spleen weight (as a percentage of empty BW) than salty water. Higher significance level ($P<0.01$) for dressing percent (hot carcass/slaughter weight), heart weight (as a percentage of empty BW), lean meat percent and fat percent was detected for fresh water than for salty water. Slaughter weight, empty BW, liver and kidneys weight (as a percent of empty BW), rib cut (Kg) and bone percentages were not affected by either type of water or flavomycin addition (Table 6). Spleen weight (as a percent of empty body weight) was the only parameter that was affected by flavomycin addition ($P<0.01$) and the interaction between type of water and flavomycin ($P<0.01$). It seems that the effect of salt water caused shrinkage in spleen that made it less in weight. The relation between spleen and drinking salt water is not clear.

Offering saline water to sheep has significantly decreased CF and CP significantly, which may due to the inhibition and/or decreasing the numbers of rumen bacteria. Further studies are warranted to elucidate the actual effects of flavomycin on rumen metabolism.

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التقييم الغذائى لتأثير الفلافومايسين والماء المالح على قيم الهضم وأداء الحملان وصفات الذبيحة

صلاح عبد العاطى عطيه اسماعيل

مركز بحوث الصحراء – المطرية – القاهرة

تم اختيار ٤٠ حولى برقى نامى عشوائيا وقسمت الى اربعة مجاميع متماثلة فى الوزن (٢١,٩٣±١,٧٢ و ٢٢ ±١,٦٧٧ و ٢١,٨٥ ±١,٦٦ و ٢٣,٧ ±١,٦١١ كجم وتم توزيع المجاميع بشكل عشوائى على المعاملات فى تصميم عاملى ٢×٢ وكانت العليقة الاساسية مع او بدون فلافومايسين ومع او بدون ماء مالح للشرب (ماء بحر مخفف) تكونت العليقة الاساسية من ٦٠% دريس برسيم و ٤٠% مركزات (بنسبة ١:٣ للشعير والعلف المركز). تم تخفيف ماء البحر بالماء الطازج بنسبة ١:٣ وذلك فى تجربة تغذية استمرت ١٧٩ يوم تبعها تجربة تمثيل غذائى وقد تم اختيار خمسة حيوانات عشوائيا من كل مجموعة للذبح ودراسة صفات الذبيحة.

لم تتأثر معظم القيم الهضمية للعناصر الغذائية بالماء المالح او الفلافومايسين. فقط نسبة هضم كل من البروتين الخام والالياف الخام تأثرتا سلبيا كما تأثرت سلبيا ايضا قيمة البروتين المهضوم

شرب الماء المالح قلل الزيادة الوزنية ولم يؤثر الفلافومايسين على الوزن الحي للحيوانات ولم يتأثر كذلك المأكول من المادة الجافة او البروتين المهضوم بنوع ماء الشرب او الفلافومايسن وقد ارتفعت قيمة كفاءة تحويل العناصر الغذائية نتيجة شرب الماء الطازج اكثر من الماء المالح وكذلك نسبة التشافى فى الذبيحة بينما لم يظهر الفلافومايسين اى تأثير ولكن انخفض وزن الطحال نتيجة شرب الماء المالح والفلافومايسين.

يبدو ان الفلافومايسين ليس له تأثير واضح على نسب هضم العناصر الغذائية وقد يكون تأثيره على التمثيل الغذائى فى الكرش ويبدو ان الماء المالح قد تسبب فى تحول معين فى التمثيل الغذائى بالكرش.

ويوصى بعمل دراسات اخرى لدراسة تأثير الفلافومايسين والماء المالح على التمثيل الغذائى بالكرش