

EFFECT OF VARYING SEASONAL NUTRITIONAL VOLUNTARY INTAKE IN METABOLISM TRIALS WITH OSSIMI AND MERINO SHEEP

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ABSTRACT

Five Ossimi and five Merino rams were housed in semi-open pen with yard shaded. The animals were fed concentrate feed mixture (CFM) at the rate 1.5% of their live body weight (LBW) plus green berseem *ad-libitum* during the coldest (8.3 ± 0.3 °C) winter months (December-January). While during the hottest (29.7 ± 0.1 °C) summer months (July-August), animals were also fed CFM at the rate 1.5% of their LBW plus berseem hay *ad-libitum*. Metabolism trials were conducted (two trials in each season) with the two breeds (Ossimi and Merino sheep), using 3 rams from each breed fed on winter and summer rations. Digestibility of all nutrients and feeding values of winter ration were higher ($P < 0.05$) with Merino than Ossimi rams, the opposite trend was noted in summer ration. The daily DM and feed unit intakes were higher in winter than summer. Water intake increased in summer to more than double of that in winter with both breeds. Urine output in both breeds was higher in summer than in winter. The anions (Cl^- and P^{--}) and cations (Na^+ and K^+) in blood serum of both breed were almost similar under cold winter or hot summer months. The results showed clearly that there were significant differences between the tested breeds in winter and summer seasons concerning feeding values, daily intake and water balance.

Keywords: Sheep breeds, voluntary intake, ambient temperature

INTRODUCTION

Sheep are usually reared under extensive system. Thus sheep are more exposed to the direct nature conditions and varying seasonal and nutritional conditions. Egyptian local sheep are more adapted to these conditions than imported one's which suffer from these stressful conditions. Therefore, these conditions will affect productive and reproductive efficiency of imported sheep, due to expending more physiological efforts to maintain their body internal status and health within normal limits. On the other hand, the electrolyte balance as (Na+K-Cl) is an important characteristic for metabolic acid-base status, calcium and phosphorus balances and some other blood parameters (Carijn *et al.*, 1990).

The object of this study was to investigate the effect of seasonal variability of feeds with local (Ossimi) and exotic (Merino) breeds in particular digestibility, feeding values, water balance, some major ions (anion and cation) in blood serum and urine and response of these breed to seasonal Egyptian conditions, during the cold weather in winter and hot weather in summer .

MATERIALS AND METHODS

This work was carried out in Animal Physiological Research Laboratory, Animal Production Department, Faculty of Agriculture, Cairo University from December 1997 to August 1998.

During the coldest (8.2 ± 0.3 °C) winter months (December-January),

five Ossimi and five Merino rams with an average body weight of 61.0 kg and 62.4 kg respectively, were housed in semi-open pen with yard shaded by canvas sheets. The animals were fed in winter concentrate feed mixture (CFM) at the rate 1.5% of their live body weight (LBW) and green berseem (*Trifolium alexandrinum L.*) *ad-libitum*. During hottest (29.7 ± 0.1 °C) summer months (July- August), five Ossimi and five Merino rams with an average body weight of 62.7 and 64.3 kg, respectively, were kept in the same housing as in winter, the animals were fed in summer CFM at the rate 1.5% of their LBW and berseem hay (2nd cut) *ad libitum*. The CFM, was comprised of 36% yellow corn, 20% wheat bran, 15% rice bran, 14% undecortecated cotton seed meal, 7% soybean (44%), 5% molasses, 2% limestone and 1% common salt.

Four metabolism trials were conducted (two trials in each season) using the two breeds (Ossimi and Merino rams) fed on winter ration, while the same breeds fed the summer ration. Three rams from each breed were shifted to metabolic cages for each trial, which lasted for 21 days. The last 7 days were considered as a collection period for feces and urine. Daily dry matter (DM) and water intakes were recorded.

Composite samples of feed and feces were analyzed for nutrients according to (A.O.A.C.1980). Blood samples were obtained from Jugular vein at 08.00 h during winter and at 12.00 h during summer, from each animal in non heparinized tube, then centrifuged to obtain serum for determination of ions. Chloride in blood serum and urine was determined according to Davis (1932) and phosphorus according to Taussky and Shorr (1953). While sodium and potassium ions were determined using Shimatzu Atomic Absorption/Flame Emission Spectrophotometer (Model AA- 640-13). Data were statistically analyzed using general liner modle procedure (GLM) according SAS,(1988).

RESULTS AND DISCUSSION

Chemical analysis of berseem and berseem hay is presented in Table 1 indicated that CP, EE and NFE contents in berseem were higher and ash was lower than those found in berseem hay.

Table 1:Chemical analysis (%) of berseem, concentrate feed mixture and berseem hay during winter and summer seasons.

Item	Winter		Summer	
	Berseem	CFM	Breseem hay	CFM
OM	88.06	92.67	80.96	88.14
CP	15.72	15.86	12.05	16.18
CF	23.42	12.64	24.39	13.66
EE	3.82	4.73	2.13	3.66
NFE	45.10	59.44	42.39	54.64
Ash	11.94	7.33	19.04	11.86

Results of chemical composition in this study were similar with those found by Gabra *et al.* (1993 a); Etman *et al.* (1998); Mostafa *et al.* (1998) and Gabra and Hafez (2000). Chemical analysis of eaten rations by Ossimi and Merino sheep in winter and summer seasons (Table 2) showed that winter ration contained more CP, EE and NFE % than summer ration.

Table 2: Chemical analysis, digestibility, feeding values and daily intake of rations fed to Ossimi and Merino sheep during winter and summer.

Item	Effect of Winter ration		Effect of Summer ration		Effect of seasons		Effect of Breeds	
	Ossimi	Merino	Ossimi	Merino	Winter	Summer	Ossimi	Merino
Chemical analysis (%) of ration eaten								
OM	90.52	90.47	84.70	84.61	90.50	84.66	87.61	87.54
CP	15.79	15.79	14.20	14.15	15.79	14.18	15.00	14.97
CF	17.65	17.78	18.80	18.94	17.72	18.87	18.23	18.36
EE	4.30	4.30	2.92	2.91	4.30	2.92	3.61	3.61
NFE	52.78	52.61	48.78	48.61	52.70	48.70	50.78	50.61
Ash	9.48	9.53	15.30	15.39	9.51	15.35	12.39	12.46
Digestion coefficients (%)								
DM	71.02b	77.34a	64.18a	60.74b	74.18a	62.46b	67.60	69.04
OM	70.79b	74.94a	69.02a	66.88b	72.87a	67.95b	69.91	70.91
CP	71.88b	78.70a	68.78a	65.93b	75.29a	67.36b	70.33	72.32
CF	59.39b	66.52a	64.36a	61.09b	62.96a	62.73a	61.88	63.81
EE	71.67b	73.11a	61.76a	59.42b	72.39a	60.59b	66.72	66.27
NFE	74.21b	76.79a	72.16a	72.89b	75.50a	72.53b	73.19	74.84
Feeding values (%)								
TDN	67.93b	71.73a	61.12	60.22	69.83a	60.67b	64.53	65.98
SV	54.80b	58.36a	47.15	46.12	56.58a	46.64b	50.98	52.24
DCP	11.35b	12.43a	9.77	9.33	11.89a	9.55b	10.56	10.88
Daily intake (g/h/d)								
DM	1830.0b	1872.0a	1881.0	1930.0	1851.0a	1905.5b	1855.5b	1901.0a
TDN	1243.1b	1342.8a	1149.7	1162.2	1293.0a	1158.0b	1198.4b	1252.5a
SV	1002.8b	1092.5a	886.9	890.1	1047.7a	888.5b	944.9b	991.3a
DCP	207.7b	232.7a	183.8	180.1	220.2a	182.0b	195.8b	206.4a
Daily intake (g/kg W^{0.75})								
DM	83.83b	84.32a	84.43	84.98	84.08	84.71	84.13	84.65
TDN	56.94b	60.49a	51.60	51.18	58.72	51.39	54.27	55.84
SV	45.94b	49.21a	39.91	39.19	47.58	39.55	42.93	44.20
DCP	9.51b	10.48a	8.25	7.93	10.00	8.09	8.88	9.21

For each effect:

a and b: Means in the same row having different superscripts are significantly different (P<0.05).

This might be due to the higher CP, EE and NFE content in berseem than that of its hay. However, CF and ash contents in summer ration were higher than winter ration.

Chemical analysis of eaten rations either in winter or summer were in agreement with those found by Gabra *et al.* (1993 b) with berseem and concentrate mixture, by Etman *et al.* (1998), Mostafa *et al.* (1998) and Gabra and Hafez (2000) with berseem hay and concentrate feed mixture.

Differences between berseem and berseem hay in their nutrient content might be due to some factors such as the losses of nutrients during hay making, order of cuts, forage maturity, season of the year, weather condition.

Concerning digestibility coefficients (Table 2), digestibility of all nutrients with Merino in winter were significantly higher ($P < 0.05$) than those recorded by Ossimi sheep. In summer season, digestibility coefficients with Ossimi rams were significantly higher ($P < 0.05$) than the figures obtained by Merino rams. In this connection, Silanikove (1986), Morand-Fehr (1989) and Gabra *et al.* (1994) reported that there are differences among the type of animals and their breed in digestibility coefficients of nutrients especially when forages are given *ad-libitum* with a proportion concentrate in the diet. Average of digestibility coefficients of the nutrients in winter was higher ($P < 0.05$) than in summer. This might be due to the fact that winter ration contained green berseem which increased the digestibility coefficients than the summer ration which containing berseem hay, as those found by Gabra *et al.* (1993 b) with sheep fed berseem with CFM. On the other hand, the average of nutrients digestibility of the two seasons were almost similar by the two tested breeds. However, the values presented in Table 2 are higher than those found by Etman *et al.* (1998) with Suffolk lambs, Mostafa *et al.* (1998) with Barki lambs and Gabra and Hafez (2000) with Rahmany rams.

Feeding values as TDN, SV and DCP were significantly higher ($P < 0.05$) for the ration fed in winter especially with Merino rams. Results of feeding values of the two rations fed by Ossimi and Merino sheep were higher than those recorded by Gabra *et al.* (1993 b), Etman *et al.* (1998), Mostafa *et al.* (1998) and Gabra and Hafez (2000).

Regarding daily DM and feed unit intakes (Table 2) data showed that intakes either g/h/d or $\text{kg W}^{0.75}$ by Merino were higher than Ossimi in the two experimental seasons. However, averages intake of TDN, SV and DCP was higher in winter than in summer. Increasing the consumption in winter from energy may be due to the energy losses in winter to protect animals from cold weather. Dry matter intake/ $\text{kg W}^{0.75}$ by the two breeds of sheep for the two tested rations in this study (83.83-84.98 g DM/ $\text{kg W}^{0.75}$) was higher than the standard intake (80 g DM/ $\text{kg W}^{0.75}$) with lucerne hay as recorded by Abou-Raya *et al.* (1980) and also higher (65.86 g DM/ $\text{kg W}^{0.75}$) the value given by Gabra and Hafez (2000) with Rahmany sheep fed berseem hay and CFM. Moreover, Kume *et al.* (1987) reported that hay and concentrate intake tended to decrease at higher ambient temperature from 18 °C to 30 °C and mineral absorption of lactating cows may be affected by heat stress and decrease above 26 °C.

The calculated daily intake from berseem with CFM or hay with CFM for sheep (39.19-49.21 g SV and 7.93-10.48 g DCP/ $\text{kg W}^{0.75}$) were higher than the ranges (25 g SV and 2-4 g DCP / $\text{kg W}^{0.75}$) of the recommended allowance of NRC (1966) for maintenance requirements. Therefore, the intake from berseem and CFM or hay plus CFM for sheep could cover the energy and protein requirements for maintenance and beside surplus for production of adult sheep.

Water intake and balance (Table 3) increased in summer period

more than double of that in winter period in both bred. During summer period, the increase is a composite response to hot condition and to the dry feeding.

This trend showed by McGregore (1986) who found that goats and sheep drank more water in hottest days (25 °C) in summer than coldest days (13 °C) in winter, when the animals fed in summer on dry pasture and in winter on green pasture. On the other hand, water balances were affected by variations in urine and fecal water. Urine output in both breed during summer was slightly higher than in winter.

Table 3: Daily water balances (ml/h/d) of Ossimi and Merino sheep during winter and summer seasons. (Means ± SE).

Item	Ossimi			Merino		
	Winter	Summer	Change	Winter	Summer	Change
Water intake	298	8482	8184	211	8803	8592
Water in forage	3400	100	-3300	3373	106	-3267
Water in CFM.	120	120	0.0	120	120	0.0
Metabolic water.*	746±69	806±70	60.0	690 ± 82	697 ± 34	7.0
Total water intake	4564±59	9508±169	4944	4394 ± 94	9726±111	5332
Urinary water.	1454±78	2061±105	607	2260 ±274	3012±148	752
Fecal water.	540±19	19±19	-121	323 ±26	253±30	-70
Total excretion.	1994±97	2480±124	486	2583 ± 300	3265±178	682
Apparent balance	2570±19	7028±63	4458	1811 ±180	6461±35	4650
% of intake	56.31	73.92	17.61	41.22	66.43	25.21

*: Metabolic water: One gram TDNI yields 0.6 gram water (English 1966).

It is clear that the water output in urine did not cope with increase in water intake in summer due to the excessive water vaporization for control of body temperature. Fecal water decreased as ambient temperature increase. Water balance as a percentage of water intakes were in winter 41.22-56.31% and in summer 66.43-73.92%. These results are in harmony with those found by Saxena and Singh (1983) and Bergner *et al.* (1989) who found that water balance of Merino weather was increased by feeding animal lucerne pellets at the maintenance level with unrestricted water.

Concerning concentration of major anions and cations in blood serum and urine (Table 4) data showed that concentration of blood Cl⁻ of Ossimi declined by 4% in summer than winter, while it did not show any seasonal differences in Merino. The results of Merino agrees with those recorded by Pandy and Roy (1969). Phosphorus in blood serum for Ossimi increased by 26% in summer than winter, while in Merino it was decreased by 7%.

Data for Ossimi were in agreement with those found by Mandal *et al.* (1972) and Tenhumberg and Graf (1979). Sodium in blood serum of both breeds was higher in summer than in winter. The results agree with finding of Shiga *et al.*(1985) and Ashour (1990). Potassium in blood serum of Ossimi was increased by 2% and decreased by 8% with Merino during summer than winter. Results of Ossimi were similar to those reported by Singh *et al.* (1982) and Snmehta *et al.* (1990).

The total anions in blood serum during summer were decreased in Ossimi by 4% than in winter (Table 4) with no change in Merino, while the total cations were nearly the same in both breeds during the two seasons.

In urine, chloride concentration was decreased in both breed being

more pronounced in Merino. While, phosphorus excretion was decreased in summer than winter period and was equal in both breeds (20.0 mg /100 ml).

Table 4: Major anions and cations in blood serum and urine (mg/100 ml) of Ossimi and Merino sheep in winter and summer seasons (Mean±SE)

Item	Ossimi			Merino		
	Winter	Summer	Change (%)	Winter	Summer	Change (%)
Blood anions						
Cl ⁻	429.2±13.5	410.4±17.8	-4	436.7±2.8	437.7±14.9	0
P ⁻⁻⁻	5.3±0.2	6.7±0.2	26	5.9±0.3	5.5±0.2	-7
Total anions	434.7±13.7	417.1±18.0	-4	442.6±3.1	443.2±15.1	0
Blood cations						
Na ⁺	259.2±13.1	283.7±6.1	9	261.0±15.5	289.6±83.0	11
K ⁺	19.7±0.3	20.0±0.4	2	19.5±0.3	17.9±0.2	-8
Total cations	278.9±13.4	303.7±6.5	9	280.5±15.8	307.5±83.2	10
Urine anions						
Cl ⁻	650.4±31.9	527.9±35.5	-19	641.8±30.9	406.1±28.4	-37
P ⁻⁻⁻	40.0±10.0	20.0±2.0	-50	30.0±4.0	20.0±0.2	-33
Total anions	690.4±41.9	5487±37.5	-21	671.8±34.9	426.1±28.6	-37
Urine cations						
Na ⁺	137.9±8.5	150.7±5.4	9	150.9±8.9	109.8±6.9	-27
K ⁺	250.8±25.9	192.7±11.2	-23	1753±15.5	202.8±21.1	16
Total cations	388.7±34.4	343.4±16.6	-12	326.2±24.4	312.6±28.0	-4

Sodium output increased slightly in Ossimi in summer (9%) while it dropped severally in Merino (-27%) and K excreta showed opposite trend to that of Na, decreasing by (-23%) for Ossimi but increasing by 16% with Merino.

A fundamental fact should be taken into consideration that the seasonal differences between winter and summer involved climatic and nutritional differences. Thus, seasonal changes in the studies are brought out by the two factors. However, anyway seasonal variation in offered feeds was kept to minimum change as of green berseem in winter was substituted by its hay in summer. The differences of temperature during the experimental seasons affect clearly the concentration of mineral in blood serum and urine. In this connection, Kume *et al.* (1986) mentioned that P and Na absorption and retention decreased greatly at 32 °C. The same author (1987) attributed the decreased mineral excretion to decreased minerals intake. It could be concluded that the seasonal variations in mineral concentration in blood serum could be due to the feed quality, water turnover, excretion via urine, feces and sweat (Emanuele and Staples, 1990).

The results obtained from this study revealed significant differences among the two tested breeds in winter as well as in summer in respective to feeding values, daily intake, water balance and level of ions blood serum and urine. Feeding animals in winter on berseem and CFM was more efficient than feeding hay and CFM in summer. Further studies are needed with different types of animals under Egyptian weather condition to investigate the

effect of ambient temperature during winter and summer seasons on physiological status of animal, feeding values, water balance, and meat and dairy production.

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تأثير اختلاف التغذية الموسمية على المأكول الاختياري في تجارب تمثيل غذائي
على الأغنام الأوسيمي والمارينو
سامي إبراهيم حافظ
معهد بحوث الإنتاج الحيواني _ مركز البحوث الزراعية - وزارة الزراعة - الدقى- الجيزة

استخدم في هذه التجربة خمسة أغنام أوسيمي وخمسة أغنام مارينو غذيت في فصل الشتاء خلال شهري يناير وفبراير وكان متوسط درجات الحرارة ($8,3 \pm 0,3$ درجة مئوية) على علفه مكونة من برسيم للشعب + 1,5% من وزن الجسم علف مركز، بينما غذيت الحيوانات في الصيف خلال شهري يوليو وأغسطس بمتوسط درجات الحرارة ($29,7 \pm 0,1$ درجة مئوية) على علفه مكونة من دريس البرسيم للشعب + 1,5% من وزن الجسم علف مركز. بجانب ذلك أجريت أربعة تجارب تمثيل غذائي على كل نوع من الحيوانات (تجربتان صيفا و تجربتان شتاء)، استخدم في كل تجربة ثلاث حيوانات تامة النمو، غذيت الحيوانات بنفس العلائق السابقة وكانت المكونات الغذائية للعلائق خلال فترة التجربة متماثلة.

قدرت كمية الماء المتناول خلال فترة التجربة، كذلك الأنيونات (الكلور والفسفور) والكاتيونات (الصوديوم والبوتاسيوم) في الدم والبول. أظهرت نتائج تجارب التمثيل الغذائي اختلافات في معاملات هضم المركبات الغذائية والقيم الغذائية بين الأغنام المارينو والأوسيمي حيث كانت معاملات الهضم عالية مع أغنام المارينو عن الأغنام الأوسيمي في علفه الشتاء وكذلك كانت معاملات الهضم مرتفعة مع الأغنام الأوسيمي عن الأغنام المارينو في علفه الصيف. كان المأكول من المادة الجافة والوحدات الغذائية عاليا في الشتاء عن الصيف وزادت كمية الماء المتناول في الصيف أكثر من الشتاء وتقدر في الصيف بضعف الكمية المتناولة شتاء، وتأثر ميزان الماء بكمية الماء الخارج في الروث والبول حيث كان الماء الخارج في الصيف لكلا النوعين من الحيوانات أعلى عن الشتاء. وكان تركيز الأنيونات أو الكاتيونات في دم الحيوانات تقريبا متساويا خلال موسمي الصيف والشتاء.

الخلاصة أن تغذية الحيوانات في الشتاء على البرسيم للشعب والعلف المركز أكثر استفادة للحيوانات من تغذيتها في الصيف على دريس مع العلف المركز مع وجود اختلافات معنوية بين أنواع الحيوانات المختلفة في القيمة الغذائية والمأكول اليومي وميزان الماء.