Egyptian J. Anim. Prod. (2003)40(1)55:-62.

THE MINERAL STATUS OF GRAZING AWASSI SHEEP IN NORTHERN PART OF JORDAN

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SUMMARY

The study was conducted to monitor the seasonal changes in mineral profile of grazing Awassi sheep in northern part of Jordan. About 10 - 15 blood samples were collected monthly from lambs and ewes from the local slaughterhouse throughout a complete one year. Samples were divided into four feeding seasons according to the traditional feeding calendar which are: season I, from June to Septmber; season II, from Octobor to Novmber; season III, from Dec. to Feb.; and season IV, from March to May. Serum samples were analyzed for Ca, P, Mg, Co, Cu, Zn and Mn. Data were analyzed for the effect of season, sex and season X sex interaction. The results indicated significant changes in concentrations of Mg ($P<0.001$), Mn and Co ($P<0.01$), Ca and Cu ($P<0.05$) by feeding season. Calcium levels during season III and IV were significantly lower compared to season II and I. Phosphorus, Mg and Co were normal range throughout the year with a little fluctuation from season to another. Zinc and Mn concentrations in blood serum were below the normal levels throughout the year. Moreover, sex only affected the Cu concentrations in the blood serum of sheep, otherwise no sex and seasonXsex effect were detected for other elements. In conclusion, Awassi sheep raised under the extensive system suffer from Ca deficiency from Dec. to May, Zn and Mn throughout the year.

Keywords: *Jordan, Awassi, minerals, grazing , season*

INTRODUCTION

Minerals play a substantial role in sheep nutrition. Feeding of minerals has extreme importance in the maintenance and production of healthy sheep and lambs (McDowell, 1985 and Kincaid, 1988). Mineral deficiencies and imbalances can result in poor growth, failure of reproduction, wasting diseases, skin disorder, non-infectious abortion, anemia, bone abnormalities, tetany, and many other disorders (Underwood, 1981). Low conception rates and high rates of fetal death also were reported by Mertz (1987) in ewes that grazed Cu deficient pastures. Grazing sheep in west Asia usually don`t receive mineral supplementation and must depend almost exclusively upon pasture, crop residues and grain since they are raised as an adjunct to crop production area (Thompson *et al.*, 1988). Only rarely, pasture can completely satisfy all minerals requirement by grazing sheep because of the effect of seasons on the quality and quantity of available grazing forage. According to the literature, there is very little information regarding the incidence of mineral deficiencies and

toxicities of Awassi sheep in west Asia. White *et al.* (1995) conducted a prelimainary survey of the mineral and vitamin status of grazing sheep in Jordan, Syria and Turkey. They reported that Awassi sheep are at risk from mineral and vitamin deficiencies in these countries and recommended further studies. Accordingly, this study was conducted to determine the seasonal changes in minerals (Ca, P, Mg, Cu, Zn, Mn and Co) concentrations in serum of grazing Awassi sheep at northern part of Jordan.

MATERIAL AND METHODS

A total of 150 blood samples from grazing Awassi (Extensive system) sheep were collected from Irbid slaughterhouse throughout the full year of 1997 with an average of 10 to 15 samples monthly. Approximately 60% of the blood samples were Awassi lambs (6-12 months old) and 40% of Awassi ewes (4 6 yrs old; dry). The blood samples were divided to four feeding seasons according to feeding calender as reported by FAO (1994; Table 1). The four feeding seasons were: season I, from June to Sept.; season II, from Oct. to Nov.; season III, from Dec. to Feb.; and season IV, from March to May. Feedstuff and herbage samples were collected randomly from different locations in northern part of Jordan and summary of the average chemical composition from this study and other studies (FAO, 1994; White *et al.*, 1995) are reported in table 2.The blood samples were centrifuged (1500 x g for 10 min.) to separate the serum. The serum were treated immediately with 10% trichloroacetic acid (TCA) (1 part serum : 4 parts TCA) and centrifuged (1500 x g for 10 min). The supernates were stored at room temperature until mineral analysis was performed.

Table 1. Feed calendar under extensive conditions

Period	Area	Main feed	Subsidiary
June-Sept.	- Agricultural land	- Cereal stubble	Vegetable crop residue
Oct-Nov.	- Agricultural land - Steppe	- Crop residues, straw	
Dec-Feb.	- Steppe	- Straw, barley grain	Barley Wheat bran Straw
March-May	- Steppe	- Natural pastures - In dry years Barley & Straw	Standing barley

FAO (1994).

Concentrations of Cu, Ca, Mg, Mn, Zn, Na, K, and Co in serum and feed samples were measured by atomic absorption spectrophotometry (AAS) (Perkin-Elmer, 1981). Phosphorus in serum and feed was determined colorimetrically. The

preparation of reagents and standard for P_i analysis were done according to Association of Official Analytical Chemists procedure (AOAC, 1990). Dry feed samples were analyzed for crude protein (CP) according to the procedure of the Association of Official Analytical Chemists (AOAC, 1990).

The general linear model procedure of SPSS version 10.0 was used to analyze the data for a complete randomized design with repeated measurements. Blood serum P, Ca, Mg, Co, Cu, Zn and Mn were used as dependent variables, and season, sex and seasonXsex were the independent variables. Means were compared using the protected least significant difference (LSD) test of SPSS. Significance was declared at ($P<0.05$) unless otherwise noted.

RESULTS AND DISCUSSION

The lack of adequate amounts of dietary nutrients most of the year, especially during the dry season, is the major constraint limiting livestock productivity. Grazing sheep in Jordan are dependent upon forages for most minerals and other nutrients, because no mineral supplements are provided. Because of that, mineral deficiencies in grazing sheep can be expected especially during the dry season. The dry season is the most difficult time in the life cycle of grazing sheep because of the poor quality and limited quantity of available forages. During the dry season, sheep are usually supplemented with such materials as crop residue, agroindustrial by-product, or vegatable crop residues (Tables 1 and 2). Even though supplementation is a common practice during the dry season, nutrient intakes are normally submaintenance.

Table 2. Chemical composition of available feed and supplements consumed by grazing sheep during the four seasons in Jordan

Ingredients	CP	P	Mg	Ca	Mn	Cu	Zn	Co
	g/100g				g/g			
Barley grain	12.0	0.35	0.20	0.23	40.0	8.0	34.0	-
Barley straw	4.1	0.07	0.25	1.70	100.0	5.1	16.0	-
Wheat bran	15.2	0.94	0.49	0.43	176.0	15	85.0	-
Wheat straw	3.5	0.13	0.22	0.66	63.0	4.0	19.0	-
Natural pasture	15.7	0.40	0.43	2.42	108.0	10.0	49.0	-
Lentile straw	5.0	0.04	0.52	3.20	24.0	10.0	24.1	-
Irrigated grass	25.0	0.47	0.52	3.14	88.0	11.0	63.0	-

- FAO (1994)
- White *et al.* (1995)

The macro and trace minerals concentrations in blood serum of grazing Awassi sheep at northern part of Jordan for different seasons Tables 3 and 4, respectively. The adequate levels (i.e., levels believed to represent dietary sufficiency) of minerals in serum of sheep are: P, 4-8 mg/dl; Ca, 8.5-11 mg/dl, Mg, 2-3.5 mg/dl, Co, 0.2-0.3

and Puls, 1988). Moreover, The chemical composition of available feeds (Pasture and feed supplements) that fed during the four seasons at northern part of Jordan are

shown in Table 2. The requirements levels of minerals in feeds used in this study are: P, 0.25%; Mg, 0.20%; Ca, 0.30%; Mn, 25 ppm; Cu, 10 μg/g; Zn, 30 μg/g ; and Co, 1 μg/g (ARC, 1980 and Underwood, 1981).

Table 3. The concentrations of macro-minerals in serum of grazing Awassi sheep during four feeding seasons

	I[1]	II[2]	III[3]	IV[4]	SE[5]	Significance of differences[6]		
						Season	Sex	season x Sex
P, mg/dl	7.83	7.48	7.43	8.10	0.14	NS	NS	NS
Ca, mg/dl	10.20[a]	8.40[a]	6.34[b]	6.89[b]	0.36	*	NS	NS
Mg, mg/dl	2.42[a]	3.66[a]	5.83[b]	6.28[b]	0.35	***	NS	NS

[1] Season I, from June to September..
[2] Season II, from October to November.
[3] Season III, from December to February.
[4] Season IV, from March to May.
[5] Standard error of means were computed from error mean square.
[6] NS not significantly different $P > 0.05$.
[abc] Mean values with superscripts within row are significantly different at $P < 0.05$
*, **, ***, Significantly different at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

Table 4. The concentrations of trace-minerals in serum of grazing Awassi sheep during four feeding seasons

	I[1]	II[2]	III[3]	IV[4]	SE[5]	Significance of differences[6]		
						Season	Sex	Season x Sex
Co, μg/dl	0.32[a]	0.17[ac]	0.46[b]	0.43[ab]	0.03	**	NS	NS
Cu,μg/ml	1.48[a]	1.50[a]	1.30[b]	1.44[ab]	0.04	*	*	NS
Zn, μg/ml	0.69	0.72	0.69	0.70	0.07	NS	NS	NS
Mn, μg/ml	0.14[a]	0.10[a]	0.38[b]	0.31[b]	0.03	**	NS	NS

[1] Season I, from June to September..
[2] Season II, from October to November.
[3] Season III, from December to February.
[4] Season IV, from March to May.
[5] Standard error of means were computed from error mean square.
[6] NS not significantly different $P > 0.05$.
[abc] Mean values with superscripts within row are significantly different at $P < 0.05$
*, **, ***, Significantly different at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

The results of this study indicate that there were significant changes in the concentrations of Mg ($P < 0.001$), Mn and Co ($P < 0.01$), Ca and Cu ($P < 0.05$) in

blood serum of grazing sheep with season was detected (Tables 3 and 4). No significant effect (P >0.05) of season on blood serum P and Zn (Tables 3 and 4).

Calcium concentration in the blood serum was significantly lower (P<0.05) and below the adequate level during season III and IV (6.34 vs 6.89 mg/dl, respectively) compared with season I and II (10.2 vs 8.4 mg/dl, respectively: Table 3). Albel *et al.* (1979) reported a very high concentration in the liver of Awassi sheep throughout the year especially during winter season.The problem with this result that liver Ca level isn't a perfect indication of the animal status compared with blood serum or bone. The only justification of the present finding that grazing sheep consumed very low dietary Ca during seasons III and IV (Table 2). Moreover, some feed supplements such as straw can contain very high level of oxalate which reduces Ca absorption (Ray, 1963).

Concentration of P in blood serum of sheep were adequate throughout the year. No significant effect (P >0.05) of season, sex and sexXseason were detected. The P content in the most available feedstuffs was adequate during the four seasons with higher concentration in natural pasture (Table 2.) which resulted in adequate serum P of grazing sheep. Albel *et al.*, (1979) confirmed such finding by reporting an adequate intake of P by grazing sheep at northern part of Jordan even during the dry season.

Magnesium concentration in blood serum of grazing sheep was adequate throughout the year, but was very high at season III and IV compared with season I and II (5.83 and 6.28 vs 2.42 and 3.66 mg/dl, respectively) This result disagreed with the findings of Albel *et al.*, (1979) who reported a lower concentration of Mg in blood serum of grazing sheep in winter and early spring because of occurance of newly grown green plants and high infection rate of internal parasites. On the other hand, all the feedstuffs that are available for sheep to be consumed during the four seasons contain very good levels of Mg which make this result expected (Table 2).

Season showed a significant effect (P <0.01) on Co concentration in the blood serum of the sheep. All the concentrations fall within the adequate level, but the levels in seasons III and IV were higher and significantly differ (P <0.01) from the levels in seasons I and II. No significant effect of sex or sex X season on Co concentration were detected in this study. No data were available in the literature regarding the Co status of grazing Awassi sheep in Jordan.

The serum Cu concentrations were adequate throughout the year, with a significantly (P <0.05) low concentration during season III (1.03 ug/g) compared with season I and II (1.48 and 1.50 ug/g, respectively: table 4). The low concentration of Cu in season III may be caused by the low Cu level in the main available feed at this season (Table 2). The little improvement during season IV was detected because of the availability of natural pasture which contain 10 ppm Cu. Moreover, Copper was the only element that was significantly affected by sex (P<0.05) with higher values for grazing lambs compared with the ewes (Table 4), otherwise no significant effect (P>0.05) of sex and sex X season on the concentrations of other trace elements (Table 4). The present findings agree with White *et al.* (1995) who detected an adequate levels of Cu in the blood serum of ewes grazed in Al-Khanasri during the spring season (Feb. to March). On the other hand, Albel *et al.* (1979) reported a possibility of Cu deficiecy throughout the year, because of the low concentration of Cu in the sheep liver, especially during the green

season. They explained this result by assuming a presence of high level of Molybdenum in the available feedstuffs.

In this study, Zn concentration in blood serum of sheep were below the adequate range (0.8- 1.2 ug/g) throughout the year and no significant effect (P>0.05) of season, sex or sexXseason were found. Albel *et al.* (1979) reported an adequate level of Zn in sheep liver throughout the year with a little nonsignificant fluctuation. The present findings disagree with Albel *et al.* (1979), but agree with the findings of White *et al.* (1995) who reported an adequate level of Zn in blood plasma of ewes grazed in Al-Khanasri during the spring season, but they reported a low plasma Zn concentration at other sites at northern part of Jordan, eventhough the dietary Zn intake were high and adequate. The only explaination of the low concentration of Zn in the blood serum in the present study is the interaction of Zn with other minerals. For example, high Fe and Ca in feedstuff can reduce the absorption of Zn in the small intestinal tract of ruminant animals (White *et al.*, 1995).

Mangenese concentration in the blood serum were considered deficient throughout the year (Table 4). A significant differences (P<0.01) were detected in serum Mn concentration between seasons which were higher at season III and IV (0.38 and 0.31 ug/dl, respectively) compared with season I and II (0.14 and 0.10 ug/dl, respectively: table 4). This differences may be caused by the complete replesion throughout season III and IV from the available feedstuffs. Albel *et al.* (1979) reported a low concentration of Mn in grazing sheep liver throughout the year, even during the availability of green forage, which agreed with our findings.

In general, adequate forage intake by grazing sheep is an essential factor for them to meet their dietary requirements for good health and production. Forage crude protein and energy contents have large effects on feed intake of ruminants (McDowell, 1985), thus affect mineral intake. This study demonstrated that most of the feedstuffs that available (Table 2) in northern part of Jordan throughout the year are deficient in the mean of the crude protein, except for the period from March to May. This low intake of crude protein may effect the feed intakes which would have contributed to low mineral consumption.

CONCLUSIONS

Awssi sheep raised under the grazing system, suffer from Ca deficiencies throughout the winter and spring seasons (Dec. to May). Moreover, Zn and Mn are deficienct throughout the year as indicated by low serum values. Thus, mineral supplementation is very crucial with subsidiary feedstuffs to overcome deficiencies and improve overall sheep health and production in the northern part of Jordan.

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تركيز بعض العناصر المعدنية بدم أغنام العواسى التى ترعى بشمال الأردن

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قسم الإنتاج الحيوانى – كلية الزراعة– جامعة مؤته– الأردن

تمـــت هـــذه الدراسة بغرض التعرف على التغير فى تركيز بعض المعادن بدماء أغنام العواسى المرباة بشمال الأردن مع تغير الموسم. تم جمع ١٠ إلى ١٥ عينة دم شهرياً من نعاج وحملان عواسى ربيت بشمال الأردن تحـــت الـــنظام الرعوي خلال عام كامل. تم توزيع العينات للمواسم التالية: موسم ١. من يونيو إلى سبتمبر؛ ٢. من أكتوبر إلى نوفمبر؛ ٣. من ديسمبر إلى فبراير؛ ٤. من مارس إلى مايو. حللت عينات الدم لـــتقدير تركـــيز الكالســـيوم، الفسفور، الماغنسيوم، النحاس، الزنك،الكوبالت، و المنجنيز. تم تحليل البيانات إحصـــائيا لدراســـة تأثير الموسم ، الجنس والجنس X الموسم. دلت النتائج على وجود تأثير معنوي للموسم على تركيز كل من الكالسيوم، الماغنسيوم، النحاس،الكوبالت، و المنجنيز. حدث نقص في عنصر الكالسيوم في الفترة مابين ديسمبر إلى مايو. أما تركيز الفسفور، الماغنسيوم و الكوبالت كانت طبيعية طوال العام بينما وجد نقص الزنك والمنجنيز طوال العام. أما الجنس فقد إقتصرتأثيره فقط على تركيز النحاس.