

Post-Prandial Changes of Rumen and Blood Osmolality in Sheep

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FOLLOWING feeding Rahmani sheep on clover hay, changes in ruminal osmolality, VFA and ammonia-N were examined. The osmotic pressure of rumen fluid was not constant and being changed with duration of time after feeding. The rumen fluid was hyposmolar with respect to serum before feeding while it was hyperosmolar 1, 2, 3, 4, 5, 6, 7 hrs after feeding. Results showed a relationship between ruminal osmolality and the concentration of VFA and ammonia-N.

Recent research has suggested a relationship between ruminal osmolality and metabolic processes in the rumen. The osmotic pressure in rumen affects transport of metabolites such as VFA, urea and NH_3 through the rumen wall. Bergen (1969) studied the role of rumen osmolality on feed intake and cellulose digestion and indicated that both characters were affected by changes in ruminal osmolality.

Information of such area of research on ruminants in Egypt is almost unavailable.

The objectives of this research were to study the post-prandial changes of rumen and blood osmolality and to find the relationship between rumen osmotic pressure and concentrations of VF and NH_3 in the rumen fluid.

Experimental

The investigation was carried out on four one year old Rahmani sheep. They were fitted with permanent rumen fistulae and maintained on cloverhay (1.5 kg/day), with unrestricted water. Samples of rumen fluid were obtained for two successive days from each animal. The samples were taken before feeding, 1, 2, 3, 4, 5, 6, and 7 hours after feeding. Rumen fluid were collected in a syringe via a small rubber tube attached to a stainless steel strainer.

Samples were filtered through 4 layers cheese cloth and immediately analysed for VFA and ammonia.

The samples were then treated with an equal volume of ION-H₂ SO₄ saturated with MgSO₄, the total VFA content was determined by steam distillation using all glass micro steam distillation apparatus (Fina and Simcher, 1959). Blood samples were taken from the jugular vein using bleeding needle, they were immediately centrifuged at 3,000 r.p.m. for 20 min. Ammonia in rumen liquor was determined by the method of Aeration into boric acid and titration (Abou-akkada and El-Sayed, 1967). The depression in freezing point was an indirect method to measure the osmolality of ruminal fluids.

The osmotic pressure was calculated using the relationship of Parthasarath and Phillipson (1953) $\Delta T_f 0.575 = 169 \text{ mM NaCl}$.

Results and Discussion

Changes in Rumen osmolality

The changes in rumen osmolality for the 7 intervals post-feeding are illustrated in Fig. 1. The ruminal osmolality rose considerably high 2hr. After the beginning of feeding and then showed a gradual decline. The magnitude of the rumen osmotic pressure values rose from 189 mM NaCl before feeding to 232 mM NaCl 2 hr after . Some individual cases showed when were different with range of 189-231. Some individual cases showed when the osmotic pressure increased to a very high level (260 mM NaCl). It was always followed by a sudden decrease.

Changes in serum osmolality

The mean values osmotic pressure for blood serum at different time of sampling varied slightly (Table 2), this would indicate smaller changes in serum osmolality. The maximum value of serum osmolality under the present experimental conditions has been that of after 2 hr post feeding. The corresponding figure for rumen osmolality was also after 2 hr. The decrease in serum osmolality was associated with a decrease in rumen osmolality. The rumen fluid was hyperosmotic to serum. The only case in which rumen hyposmotic has been before feeding (Fig. 2).

Warner and Stacy (1965) recorded that ruminal liquor was hypersmolar with respect to plasma for 5hr after feeding but, in the post-absorptive state (*i.e.* prior to the daily feeding). The ruminal liquor was hyposmolar. Ternouth (1967) reported the same results.

VFA NH₃ patterns

The concentration of VFA reached its maximum about 2hr after feeding and stayed nearly constant for the following 4 hr (Table 1). These changes in VFA concentration were in accordance with those of Ternouth (1967).

The pattern of total ruminal NOH₃ concentrations before feeding plotted against time were illustrated in (Fig. 1). Ammonia concentration showed general low value in rumen fluid before feeding, with the highest concentration at 2 hr after feeding. The ammonia concentration 7 hr after feeding was quite similar for its concentration before feeding.

TABLE 1. Average osmotic pressure, VFA and ammonia - N in the rumen fluid of Rahmani sheep.

Time after feeding (hr)	Osmotic pressure mM NaCl	VFA mEq./100 ml	Ammonia - N mg/100 ml
0	189.57 ± 3.00	8.07 ± 1.26	14.52 ± 1.00
1	225.21 ± 9.40	10.67 ± 0.63	21.74 ± 2.00
2	231.46 ± 11.79	13.51 ± 1.60	31.67 ± 1.87
3	226.31 ± 9.48	14.21 ± 1.10	29.66 ± 2.36
4	222.76 ± 7.60	14.23 ± 0.90	25.81 ± 1.20
5	214.55 ± 7.80	14.28 ± 1.00	23.14 ± 1.48
6	210.29 ± 4.80	14.29 ± 1.10	21.72 ± 2.42
7	206.10 ± 3.70	13.75 ± 0.79	15.11 ± 2.66

* Each value represents the average of eight observations.

TABLE 2. Osmolality of serum of Rahmani sheep after feeding.

	Hours after feeding							
	0	1	2	3	4	5	6	7
*Osmolality	201.33	197.19	207.21	205.74	201.33	200.95	199.86	197.65
mM	± 2.50	± 6.10	± 2.50	± 3.16	± 1.90	± 2.50	± 3.10	± 3.46

* Osmolality expressed as mM NaCl. Each value represents the average of four observations.

The relationship of osmolality, VFA and NH₃ patterns

It is known that beside Na, Ca, K, Mg, Cl, P and VFA S₂ cooperates in producing the phenomenon of osmotic pressure. Kaphlan and Sviridenko (1970) concluded that VFA contribute about 20—30% to the rumen osmotic pressure. In our experiment results showed that the increase in VFA concentrations in the first 2 hr after feeding was associated with the increase of ruminal osmotic pressure. In these data some samples showed that when the osmotic pressure reached 267 mM NaCl the concentration of VFA was 18 mEq/100 ml. On the other hand when the value was 173 mM NaCl the concentration of VFA was 6.6 mEq/100 ml.

The changes in osmotic pressure were consistently correlated with VFA concentration. The correlation coefficient (r) between VFA and osmotic pressure was 0.54. This value was significant ($p < 0.01$).

This result indicates that the concentration of VFA affects to a large extent the osmotic pressure in the rumen. The estimated correlation coefficient between ammonia and osmotic pressure was significant $P < 0.01$ ($r=0.47$).

This also indicated the highly association between the above two traits. Also it was observed that, the concentration of ammonia showed high sensitivity to changes of osmotic pressure.

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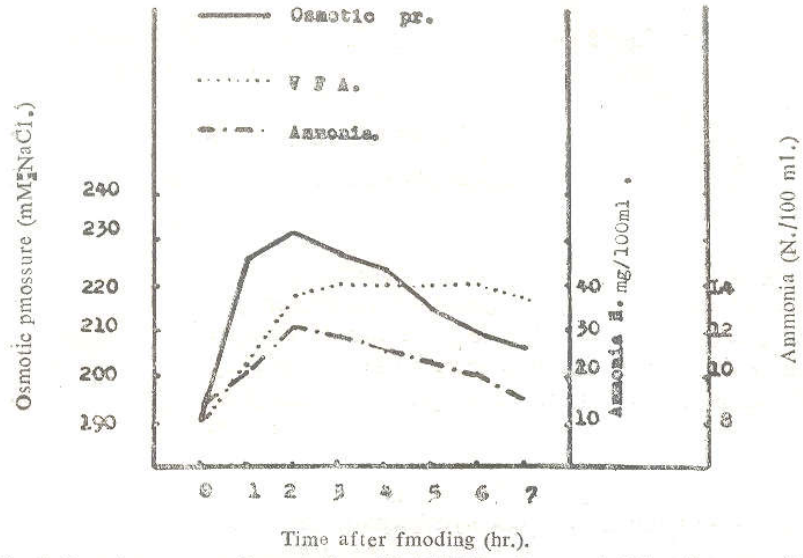


Fig. 1. Osmotic pressure, Concentration of total VFA and ammonia-N in the rumen fluid of Rahmani sheep at intervals after feeding.

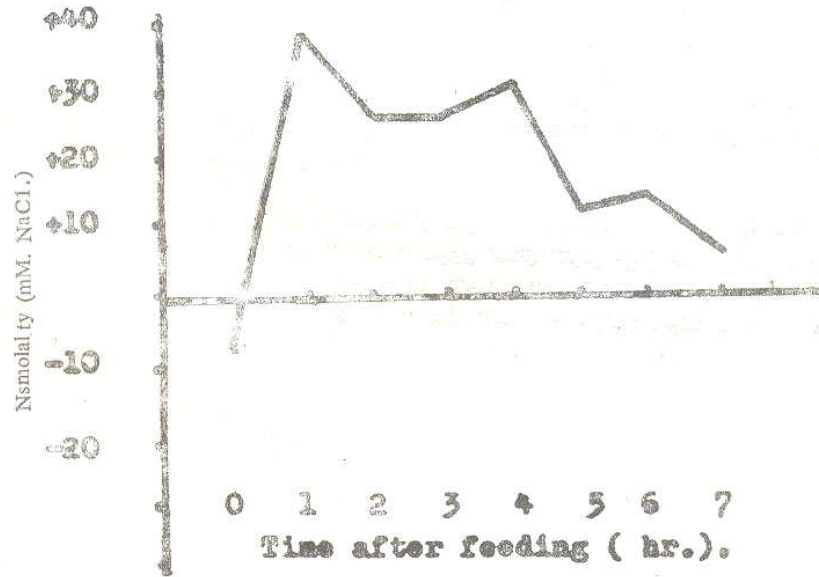


Fig.2. Gradient rumen osmolality with regard to serum.

تغيرات الضغط الأسموزى فى سائل الكرش وسيرم الدم بعد التغذية فى الأغنام

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أوضحت بعض الدراسات أن الضغط الأسموزى لسائل الكرش يؤثر على معدل انتقال الماء ونواتج التمثيل خلال جدار الكرش ، وقد أجريت هذه الدراسة لمعرفة التغيرات التى تحدث فى الضغط الأسموزى فى سائل الكرش وسيرم الدم بعد التغذية وكذلك معرفة علاقة الضغط الأسموزى لسائل الكرش بمستويات الأحماض الدهنية الطيارة والأمونيا . وتوضح النتائج ما يلى :

١ - الضغط الأسموزى لسائل الكرش يصل الى أقل مستوى له قبل التغذية (١٨٩,٥٧ ملليمول كلوريد صوديوم) ويعقب التغذية ارتفاع سريع يصل الى الحد الأعلى (٢٣١,٤٦ ملليمول كلوريد صوديوم) بعد ساعتين من بدء التغذية ويلي ذلك انخفاض تدريجى فى قيم الضغط الأسموزى .

٢ - الضغط الأسموزى للسيرم لا يكون ثابتا ويختلف باختلاف الوقت بعد التغذية وكان الضغط الأسموزى للكرش زائد الأسموزية بالنسبة للدم فى جميع العينات المأخوذة بعد التغذية ويتراوح الفرق من + ٣٧,٤٧ ملليمول كلوريد صوديوم الى + ٨٨,٥ ملليمول كلوريد صوديوم . أما العينة المأخوذة قبل التغذية فكانت ناقصة الأسموزية وكان الفرق - ٧,٢٥ ملليمول كلوريد صوديوم .

٣ - أوضحت الدراسة أن تغير تركيز الأحماض الدهنية الطيارة يصاحبه تغير فى قيم الضغط الأسموزى لسائل الكرش ويبلغ معامل الارتباط بين الضغط الأسموزى وتركيز الأحماض الدهنية الطيارة + ٥٤ بينما يبلغ معامل الارتباط بين الضغط الأسموزى وتركيز الأمونيا + ٤٧ وكلا التقديرين معنوى على مستوى ١٪ .