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Effect of the Mechanical Treatment of Hay and Sampling Time on the Ruminal Activity of Sheep

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THE EFFECT of the mechnical treatments of hay and sampling time on the ruminal activity of sheep was studied. Three forms of hay: long; chopped and ground were fed to 4 fistulated Rahmany rams. Rumen samples were taken before, 2,4 and 6 hr after feeding when long hay was fed, but when chopped and ground hay were fed samples were taken before, 2,4, 6 and 10 hr after feeding. The study included pH, buffering capacity, NH_3—N and total and individual VFA'S.

It was found that the physical form of hay as well as the sampling time after feeding affected rumen pH and buffering capacity in a similar way. The highest levels were observed with long hay and the lowest being with ground. The values decreased with advancing time after feeding in all forms of hay.

Both the physical form of hay and sampling time affected NH_3—N concentration ($P<0.01$). The highest level was with chopped hay. The concentration was low before feeding, increased 2 hr after feeding, and then decreased. The total VFA's increased after feeding, and remained nearly constant till 2 hr after feeding. The highest level was observed with ground hay and the lowest with long one. The effect of either the physical form of hay or sampling time was highly significant ($P<0.01$). The physical form of hay affected acetic acid ($P < 0.05$) but highly significant ($P < 0.01$) for propionic acid, butyric acid and valeric acids. Sampling time affected propionic acid ($P < 0.05$) and valeric acid ($P < 0.01$) and did not affect acetic and butyric acids.

Roughages represent an important source of nutrients to maintain ruminants and partly for production. Attention was directed to investigate the effect of the mechanical treatments on roughages. Qrskov *et al.* (1967) mentioned that the composition particle size of the diet and the feed intake were the principal factors affecting fermentation in the rumen. It was also recorded that the physical characteristics of the rumen and the metabolites produced during fermentation process are influenced by the mechanical treatment of hay (Thomas *et al.*, 1968; Steger *et al.*, 1970; Brasad *et al.*, 1972 and Alwash and Thomas, 1974).

Therefore a study was carried out on the effect of both the physical form of hay and sampling time on ruminal activity including pH, buffering capacity, NH_3—N, total and individual VFA's.

Experimental Methods

Four fistulated Rahmany rams were used, receiving hay *ad lib.* and unrestricted water. Feed was offered to the animals at 9 a.m. With long hay (*1st* exp.) rumen fluid samples were taken before feeding and 2, 4 and 6 hr, after the beginning of feeding. With chopped and ground hay (*2nd* and *3rd* exps), samples were taken before and 2,4,6 and 10 hr after the beginning of feeding. Rumen fluid was analysed immediately for NH_3 and as quickly as possible for pH, buffering capacity and total VFA's.

Samples were preserved in metaphosphoric acid for VFA's fractionation. Rumen fluid was collected in a syringe via a small rubber tube attached to a stainless steel strainer. Rumen fluid samples were filtered through cheese cloth and used for different determinations. Rumen pH was determined using Shanghai *2nd* Analytical Instruments Factory Model 25 pH-meter. Buffering capacity was determined as Nicholson *et al.* (1963) and expressed as milliequivalents of hydrochloric acid required to reduce the pH of 100 ml of rumen fluied to 4·5.

The concentration of ammonia in the rumen fluid was determined applying Conway methods. The total VFA's were determined by steam distillation of the distiliate as mentioned by Eadic *et al.* (1967). Determination of acetic, propionic, butyric and valeric acids was carried out according to Erwin(1961). A Pye Unicam 104 Gas Chromatograph was used in this investigation under the following conditions; column, (2 m 10% DAP 920 X on chromosorb W80 mesh.; Carrier gas (nitrogen) flow rate 80 ml/min., column) temp. 100°; detector temp. 200°; Attenuation 50×104; H_2 pressure inlet 25 ib/in². and air pressure inlet 10 Ib/in²., and chart speed I cm/min.

Results and Discussion

The results including the effect of mechanical treatments of hay and sampling time on ruminal activity are presented in Table.1.

1. *The Effect on ruminal pH*

The data in Table 1 indicated that feeding chopped hay was associated with the higher levels of pH, while ground hay produced the lowest values. pH values were higher before feeding and decreased with time, being 7·54, 6·53, 6·46 and 6·39 after 2,4 and 6 hr, respectively. Steger *et al.* (1970) found that peaks for different fermentation products including pH vary time depending on the type of feed and its physical consistency. The concentrration of each metabolite produced by ruminal fermentation was nearly the same before feeding and 7 hr, after.

ANOVA showed that the effect of sampling time and physical forms of hay affected ruminal pH highly significant ($P < 0.01$). The same general trend was found by several workers as Cottyn and Boucque (1960), Emmanuel *et al.*, (1969), Wheaton *et al.* (1970) and Tosev *et al.* (1974).

TABLE 1. Ruminal activity of sheep.

Time of Sampling	Form of hay	Ruminal pH	Rumen buffering capacity	Ammonia-N level (Mg/100ml)	Ruminal VFA'S
Before feeding	L.H.	7.89	11.14	13.85	4.00
	C.H.	7.92	7.48	18.15	4.60
	G.H.	6.81	6.34	13.08	6.83
2hr After feeding	L.H.	6.55	8.37	23.31	7.13
	C.H.	6.63	6.99	28.72	7.30
	G.H.	6.41	5.58	20.95	9.43
4hr After feeding	L.H.	6.60	8.40	13.95	8.11
	C.H.	6.67	7.36	23.22	8.85
	G.H.	6.13	4.98	18.52	10.73
6hr After feeding	L.H.	6.68	8.41	12.13	8.91
	C.H.	6.34	6.30	16.96	8.94
	G.H.	6.15	5.01	14.12	10.99
10hr After feeding	L.H.	—	—	—	—
	C.H.	6.61	5.65	—	7.71
	G.H.	6.04	4.84	—	11.03

* Each value represents an average of 12 observations.

2. *The Effect on the buffering capacity (B) of rumen liquor*

It was appeared from data in Table 1 that the (B) values were high before feeding then decreased after feeding. Also, it is evident that the (B) level with long hay was the highest, while it was the lowest with ground hay. These results may be explained by the difference found during the rumination cycle (12 hr, after feeding). With long hay, the rumination period was the longest and the shortest period observed with ground hay. So the animals required more time to rechew the long type of hay than the other two types. These phenomena which are associated with large secretion of saliva with long hay may clarify the higher values of (B) with long hay than with chopped or ground hay. The effect of the mechanical treatments and sampling time on the (B) values was highly significant ($P < 0.01$).

3. *The effect on ammonia-N concentration in rumen liquor*

Results are presented in Table 1. It is obvious with the three forms of hay that, the mean values of NH_3—N were lower before feeding and increased to their maximum levels 2 hr, after feeding. The results presented are in agreement with those of Yousri (1970) and Cottyn and Boucque (1968). Ammonia-N concentration appeared to be affected either by the mechanical treatments of hay or by sampling time ($P < 0.01$).

In addition Guglya *et al.* (1973) with heifers receiving diets containing long hay or chopped, found that NH_3-N in rumen was 16·4 and 18·4 before feeding and 20·0 and 21·7 mg/ 100 ml after feeding. Weston and Hogan (1967) and Hogan (1961) mentioned that/the low concentration of NH_3-N may be due to the mone rapid passage of ingesta through the digestive tract with ground hay than the other two forms.

4. *The effect on VFA patterns in the rumen*

a) Total VFA's

The levels of VFA's in the rumen are given in Table 1. It is obvious that the levels of VFA of sheep fed long hay were the lowest while ground hay caused the highest. Since the three forms of hay were taken from the same lot, so, the observed variations in the levels of VFA's should be due to the different physical characteristics of the hay. Because of the carbohydrates content of hay became more suitable and easily of fermented for chopped or ground hay, so, more VFA's production was observed. The variation in VFA levels with the three forms of hay can be explained as a result of the variation in the rumination rate and total time of rumination which were higher with long hay followed by chopped then by ground hay.

It was also found that VFA values for each hay form were lowest befor e feeding, then increased and reached the highest value 6 hr after feeding. These results agreed with those of Cottyn and Bouquce (1968). Emmanuel (1969), Steger *et al.* (1970) and Yousri (1975). The statistical analyses showed that VFA values were affected by the mechanical treatments of hay and sampling time ($P < 0.01$).

b) Individual VFA's

Data in Table 2 concern the effects of the physical form of hay on the molar proportions of acetic, propionic, butyric and valeric acids. It is evident that acetic acid varied between the three forms of hay at different sampling time. The effect of the mechanical treatments of hay was significant ($P < 0.05$); while that of sampling time was not.

With propionic acid the maximum mean value was observed 2 hr after long hay feeding, but 6 hr after chopped hay feeding. The molar proportion of propionic acid was high between 2 and 4 hr after feeding with ground hay. The effect of sampling time was significant ($P < 0.05$) but that of mechanical treatments was highly significant ($P < 0.01$).

Butyric acid appeared to be high before feeding, then decreased after feeding. The maximum value with every form was before feeding and the highest level was with long hay. The effect of sampling time was not significant, but that of the mechanical treatments was highly significant ($P < 0.01$).

TABLE 2. Effect of the physical form of hay and sampling time on the molar proportions of individual VFA's in the rumen liquor*.

Time of sampling	Long hay				Chopped hay				Ground hay			
	The molar proportion % of the acids											
	acetic	prop.	buty	val-eric	acetic	prop.	buty	val-eric	acetic	prop.	buty	val-eric
Before Feeding	62.92	22.76	13.45	0.83	63.33	22.40	11.46	1.85	58.16	28.94	9.41	3.52
After 2 hr	63.26	25.06	11.10	0.51	60.66	29.88	8.31	1.16	61.62	29.51	7.62	1.43
4 hr	62.53	24.41	12.55	0.51	56.38	34.43	8.10	1.08	59.29	29.81	9.18	1.98
6 hr	64.05	23.37	12.07	0.52	56.01	33.34	7.46	1.19	63.40	27.17	7.34	2.39
10 hr	—	—	—	—	55.30	34.96	9.49	0.33	66.85	23.37	8.97	0.82

* Each value represents an average of 12 observations.

Valeric acid was high before feeding and then decreased after feeding. The highest level was found with ground hay while the lowest value was with long hay. The effect of both sampling time and mechanical treatments was highly significant ($P < 0.001$). Results here were in harmony with those of Palmquist and Ronning (1961), Fener *et al.* (1967 a and b), and Thomas *et al.* (1968), but in contrast to those of Alwash and Thomas (1974).

The variation in a particular acid or any ruman metabolite concentration at any time is dependent on many factors. The rate of production in the rumen, rate of absorption from the rumen, rate of passage from the rumen to the omasum, rate of dilution with saliva, rate of utilization by rumen micro-organisms and the rate of conversion to other rumen metabolite (Gray and Pilgrim, 1951).

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تأثير المعاملة الميكانيكية للدريس وزمن أخذ العينة على وظائف الكرش فى الأغنام

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شملت هذه الدراسة تأثير المعاملة الميكانيكية للدريس وزمن أخذ العينه على وظائف الكرش فى الأغنام باستخدام ثلاثة صور للدريس : سيم ومقطع ومطحون ، وغذيت لأربعة كباش رحمانى مجهزة بفتحة كرش مستديمة . فى حالة الدريس السليم أخذت عينات الكرش قبل التغذية وبعدها بساعتين وأربعة وسته ساعات فقط أما فى حالة التغذية على الدريس المقطع أو المطحون فكانت عينات الكرش تؤخذ قبل التغذية وبعدها بساعتين وأربعة وسته وعشر ساعات . كما شملت الدراسة على الحموضة والفعل التنظيمى لسائل الكرش وتركيز نيتروجين الأمونيا والأحماض الدهنية الطيارة الكلية والمفردة .

وقد وجد أن كل من الشكل الطبيعى للدريس وزمن أخذ العينة بعد التغذية كان لهما نفس التأثير على الحموضة والفعل التنظيمى لسوائل الكرش . وقد وجد أن أعلى مستوى لأرقام الحموضة مع الدريس السليم وأقل مستوى مع الدريس المطحون . كما أن درجة الحموضة فى كل من صور الدريس الثلاثة قد انخفضت بمرور الوقت بعد التغذية .

وأظهرت النتائج أن تأثير كل من الشكل الطبيعى للدريس وزمن أخذ العينة على تركيز نيتروجين الأمونيا كان معنويا جدا (مستوى ١٪) وكان أعلى مستوى للدريس المقطع وكان التركيز منخفضا قبل التغذية ثم ارتفع بعد ساعتين من التغذية ثم انخفض بعد ذلك . أما الأحماض الدهنية الطيارة الكلية فقد ارتفعت بعد التغذية واستمرت تقريبا ثابتة خلال ساعتين بعد التغذية .