Treatment of Acute Rumen Dilation With Oral Administration of Activated Charcoal

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Introduction

Even though cattle can utilize cellulosic feedstuffs, they are fed diets that contain high levels of cereal concentrates. In Japanese dairy cattle husbandry, controlled feeding is very popular. The feeding ration is profixed to fit the physiological state, to obtain maximum milk yield and to minimize the economical loss. Under this restricted feeding condition, the cattle escaping from the mooring may eat too much concentrates available for the cow. Ingestion of large amounts of cereal concentrates provides the substrate for rapid proliferation of rumen bacteria and leads to lactate accumulation, low ruminal pH and decreased fiber digestion. Intake of larger-than-normal quantities of highly fermentable carbohydrates leads to lactic acidosis, acute dehydration and depression in acute forms. Increased production of lactic acid also contributes to metabolic acidosis. Death sometimes happens in serious cases. Many investigations of accumulation in the rumen of lactic acid were documented (2,3).

Activated charcoal has been used in the treatment of many intoxications (1). The charcoal is administered orally to absorb the toxins or some materials and thus prevent them being absorbed and increasing. We have investigated the suitability of activated charcoal as an absorbent material for the treatment of acidosis in cattle.

Materials and Methods

Three Holstein steers averaging 250 kg with rumen fistulae were given 8kg of crushed barley. Eight hours after feeding, 400g activated charcoal was orally administered to a steer. Two others remained untreated for control. Changes in blood chemistry, rumen fluid and clinical signs were monitored for 24 hours. Steers were sampled, after feeding, from the rumen fistulae at 2 hour intervals for 24 hours. Rumen fluid was stored at -20°C for later analysis. Rumen fluid pH was determined by a pH electrode immediately after sampling. Blood sampling was facilitated by placing a polyvinyl catheter in the jugular vein and collected using a disposable syringe and transferred to tubes. Rumen fluid samples were analyzed for pH, lactic acid, VFA, osmotic pressure, NH_3-N. Blood samples were analyzed for packed cell volume (PCV), plasma glucose, blood urea nitrogen (BUN), serum glutamic-ozaloacetate transminase (GOT), Ca, Na. Rectal temperature and heart rate were checked.

In addition to the experimental animals, 20 dairy or beef cattle were clinically examined. Field examinations were conducted with cattle suffering from acute rumen dilation by overfeeding of the concentrates from a local dairy farm, Chiba, Japan. All of them in the field were orally administered charcoal after overfeeding and clinical courses were monitored following treatment.

Results and Conclusion

Table 1 and 2 show the changes in the clinical signs of three steers. The steers given only barley in the experiment developed signs affecting heart rate, temperature and PCV. In contrast, the steer given charcoal did not develop signs and especially packed cell volume did not increase. There was no significant treatment difference in plasma Ca, Na. One untreated cow was significantly higher in plasma glucose and GOT 24 hours after feeding. Though in treated steers ruminal pH dropped first below 5.0, it fell slightly and rose after the administration of charcoal. On the other hand, ruminal pH of control steers fell 4.07, 4.43 respectively 24 hours after feeding (Table 3). Lactic acid levels and osmotic pressure were significantly different between treated steer and untreated ones. The volatile fatty acid profile and NH_3 - H in rumen fluid are shown in Table 3.

Table 1. Changes in clinical signs of steers fed barley.

Time of sampling post feeding	No.	temperature (℃)	heart rate	No.	temperature (℃)	heart rate	No.	temperature (℃)	heart rate
(hr)									
0[a]		39.1	100		39.0	72		39.4	80
4		39.0	120		39.0	80		39.2	82
8[b]		39.1	106		39.1	95		38.8	71
12	1	※39.2	98	2	39.0	92	3	39.1	88
16		38.9	82		39.0	92		38.8	86
20		38.4	86		39.7	130		39.0	94
24		38.8	84		39.6	132		38.6	90

No. 1 was treated with charcoal. No. 2 and No. 3 were not treated

[a]First feeding of 5kg barley. [b]Second feeding of 3kg barley.
※400g charcoal given.

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Table 2. Changes in blood of steers fed barley.

No.	Time of sampling post feeding	PCV	glucose	BUN	GOT	Ca	Na
	(hr)	(%)	(mg/dl)	(mg/dl)	(IU/l)	(mg/dl)	(mEq/l)
	0[a]	28.0	55.5	7.5	68	11.9	141.1
	4	26.0	64.7	6.3	63	10.4	140.6
	8[b]	24.5	66.6	5.1	55	8.6	138.2
1	※12	26.0	74.1	4.7	71	11.1	137.3
	16	26.0	69.6	4.9	65	11.2	145.2
	20	27.0	63.5	5.3	94	11.1	149.9
	24	28.0	74.5	5.6	93	11.4	145.8
	0[a]	28.0	69.3	11.9	56	11.2	142.0
	4	29.0	89.9	10.7	47	10.2	144.1
	8[b]	28.5	87.3	6.4	61	10.2	144.1
2	12	28.5	87.5	8.0	64	12.1	146.9
	16	33.0	76.2	8.0	55	13.0	150.4
	20	38.0	72.9	8.8	103	12.3	150.6
	24	42.0	137.7	11.4	103	13.0	154.8
	0[a]	31.0	66.4	19.7	47	10.9	138.5
	4	28.0	70.4	17.1	31	10.1	138.6
	8[b]	28.0	68.9	13.5	40	9.0	141.4
3	12	28.0	70.9	12.1	37	10.9	140.9
	16	29.0	72.3	9.3	41	12.1	141.2
	20	30.0	82.6	9.6	67	11.6	142.2
	24	31.0	77.8	8.6	62	11.2	142.6

Table 3. Changes in rumen characteristics of steers fed barley.

No.	Time	pH		V F A ratio				rumen NH_3-N	lactic acid	osmotic pressure
			ToLal VFA	Acetate	Propionate	Butyrate	A/P			
	(hr)		(m mol/dl)	(%)	(%)	(%)	(%)	(mg/dl)	(m mol/kg)	(m osm/kg)
	0[a]	6.42	9.8	66	20	11	3.3	4.5	-	236
	4	5.20	10.8	60	23	15	2.6	11.7	0.1	245
	8[b]	5.22	14.6	56	27	15	2.1	2.5	-	294
1	※12	4.98	13.2	60	26	13	2.3	3.5	-	359
	16	4.81	10.8	66	22	11	3.0	7.6	-	346
	20	4.85	9.6	70	20	9	3.5	13.0	-	353
	24	5.12	6.0	77	7	5	4.5	17.4	-	276
	0[a]	7.29	7.9	65	21	10	3.1	14.8	-	240
	4	5.86	11.5	64	19	14	3.4	27.2	-	329
	8[b]	5.54	12.0	63	17	17	3.7	19.1	-	320
2	12	5.04	12.8	56	18	24	3.1	17.5	5.94	432
	16	4.63	8.5	59	15	24	3.9	22.5	12.39	504
	20	4.16	6.0	63	14	21	4.5	22.9	16.66	487
	24	4.20	3.1	68	10	17	6.8	21.8	16.27	490
	0[a]	7.26	7.0	66	18	12	3.7	15.4	-	248
	4	6.05	14.2	59	19	17	3.1	19.7	-	295
	8[b]	5.67	13.6	58	19	19	3.1	11.4	-	261
3	12	5.47	16.5	55	18	23	3.0	18.9	-	286
	16	5.16	16.0	58	14	25	4.1	16.7	1.39	369
	20	4.61	18.5	74	8	16	9.3	15.3	8.82	435
	24	4.43	18.4	76	7	15	10.8	20.2	12.99	486

No. 1 was treated with charcoal. No. 2 and No. 3 were not treated.
[a]First feeding of 5kg barley. [b]Second feeding of 3kg barley.
※400g charcoal given.

Oral administration of activated charcoal was applied to 20 cattle suffering from acute rumen dilation by overfeeding of concentrates. Of these, 19 cattle were cured. The recovery was prominent in severely affected cases, which had not been able to stand 24 hours after overfeeding.

In conclusion, activated charcoal treatment is effective to eliminate excess lactic acid from the rumen of a cow with rumen acidosis or rumen dilation caused by overfeeding of the concentrates.

Summary

Three Holstein steers averaging 250kg with rumen fistulae were given 8kg of crushed barley; 12 hours after feeding, activated charcoal was orally administered to a steer. Two others remained untreated for control. Changes in blood chemistry, rumen juice and clinical signs were monitored for 24 hours. The treated steer recovered without showing critical signs. There was no increase in osmotic pressure and no accumulation of lactic acid in the rumen juice. Two control steers rumen pH fell to less than 4.5 at the lowest and osmotic pressure in rumen juice suggested lactic acid acidosis. Finally, the control steers died.

Oral administration of activated charcoal was applied to 20 cattle suffering from acute rumen dilation by overfeeding of concentrates. Of these, 19 cattle were cured. The recovery was prominent in severely affected cases which had not been able to stand 24 hours after overfeeding.

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