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EFFECTS OF ADDING YEAST CULTURE OR SODIUM BICARBONATE TO LACTATING FRIESIAN COWS DIET CONTAINING FODDER BEET ROOT SILAGE ON RUMEN ACTIVITY AND BLOOD CONSTITUENTS

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SUMMARY

Twenty one multiparous lactating Friesian cows were used to study the effect of adding yeast culture or sodium bicarbonate on rumen activity and blood constituents.

Treatments were started three days post calving, cows were assigned randomly into three equal groups (7 cows each). Daily ration of G1 (control) contained concentrate mixture, wheat straw as well as fodder beet root silage (FBRS) represented 30% of the required TDN. While the daily ration of the G2 and G3 was supplemented with 15g/day/head yeast culture or 150 g/day/head sodium bicarbonate, respectively.

Results indicated that the supplementation with yeast culture improved ($P<0.05$) rumen pH, total VFA's, acetate production and rumen lactate. Blood analysis of G_2 indicated that cows had higher ($P<0.05$), T_3 hormone, total protein, albumin, A/G ratio, total lipids, and triglyceride, while it was not effected on level of (GOT).

Addition of sodium bicarbonate G_3 increased ($P<0.05$) rumen pH and acetate production as compared to G_1. Meanwhile, rumen pH, blood T_3, total protein and acetate concentration were lower as compared to G_2 but not significant.

***Keywords:** Sugar beet silage, lactating cows, rumen parameters, blood parameters, yeast culture, sodium bicarbonate*

INTRODUCTION

Fodder beet root may help for solving some of the problems of animal feeding during summer feeding period (Shalaby *et al.*, 1989) It may reduce feed cost and minimize the requirements for expensive concentrate mixture. Lactic acid as a strong acid produced during silage making and causes a reduction in rumen pH of dairy cows. Many studies had been carried out to control rumen acidity using some types of buffers as feed additives to improve rumen pH (West *et al.*, 1982, Cole *et al.*, 1992 and El-Ashry *et al.*, 1996).

The addition of sodium bicarbonate to ration of lactating dairy cows has been reported to have beneficial effects on rumen pH (El-Bedawy *et al.*, 1989), rumen acetate, and acetate to propionate ratio (Erdman *et al.*, 1982). Yeast culture is used to reduce rumen acidity throughout stimulation of lactic acid utilizing bacteria (Nisbet and Martin, 1991).

Therefore, objectives of this study are to measure the effects of sodium bicarbonate or yeast culture as additives to daily ration of dairy cattle containing fodder beet root silage on some characteristics of rumen liquor and blood constituents.

MATERIAL AND METHODS

The experiment was carried at Sakha Animal Production Research Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture. Twenty one lactating Friesian cows were used in this study. They were divided into three similar groups (7 cows in each group) according to their age (34–79 months), live body weight (average 440.3 kg), parity (2-5) and preceding lactation (average 2907 kg). The experiment started three days after calving, and extended five months postpartum The experiment started from July to the end of September 1998. All cows were fed a daily ration (DR) composed of concentrate feed mixture (CFM), wheat straw (WS) and fodder beet root silage which covered 30% of the total energy requirements/day/head. The intended ratio of roughage: concentrate was 40: 60.

The cows were fed individually according to NRC (1988) allowances. Experimental treatments were:- group1, (G1) fed daily ration (DR) without any buffer supplementation (control), group2 (G2), cows fed DR plus 15 gm./day/cow yeast culture (Saccharomyces cervisia, 5*109 c.f.u.Sc, Strain 1026/gm.), according to Yousef *et al.* (1996) and group3 (G_3), fed DR plus 150 gm./day/cow sodium

bicarbonate ($NaHCO_3$ as recommended by Orrego, *et al.* (1993) Yeast or $NaHco_3$ were added to beet root silage just before feeding. The chemical composition of ration samples were analyzed in the previous study (Ibrahim *et al.*, 2000), and the same experimental cows and rations were also used. The cows were maintained under similar conditions, they were fed CFM twice a day, at 8h. and 15h., silage at 11h., while wheat straw offered at 17h. Cows were machine milked twice a day at 7h. and 16h. All cows were kept under semi shaded yard, water offered freely along the day. Ruminal liquor samples were obtained from each cow every four weeks, just before morning feeding and 3hours post morning feeding.

Stomach tube with a vacum pump was used to get the rumen liquor. Each sample was divided into two portions, one for immediate measurements of pH by using digital pH- meter and ammonia-N according to Conway (1962) and the second portion, was treated with 1.0 ml of mercuric chloride added to stop microbial activity. Samples were covered with few drops of paraffin oil to determine volatile fatty acids (VFA) according to Warner (1964) and fractions of VFAs were estimated using gas liquid chromatography according to Stton and Johnsson (1969). Lactic acid was determined using Elsden and Gibson (1954) method. Blood samples were taken from the jugular vein simulataneously with rumen samples of the same cows in heparinized tubes and centrifuged at 3000 rpm for 15 minutes and the collected plasma was stored at –20°c until analyzed. Blood plasma was used for determination of total protein albumin, globulin, total lipids, cholesterol, glucose, triglycride, blood ammonia nitrogen, glutamic oxalate transaminase (GOT), creatinine and T_3 hormone. The biochemical determination of plasma total protein, cholesterol, GOT, albumin and globulin were carried out calometrically using commercial kits purchased from Biomericux Rains (France). Albumin: Globulin ratio was calculated. Plasma glucose, triglycerides, total lipids and creatinine were estimated using kits supplied by Scalvo (Italy). Direct Radioimmuneo Assay (R.I.A.) technique was performed for assessment of plasma T_3 ready antibody coated tube kits (Diagnostic products corporation, Los Angles, California, USA.) were used according to the procedure outlined by the manufacturer.

Data were subjected to the analysis of variance (ANOVA) procedures of the statistical analysis system (SAS,1990) for personal computer. The repeated measures model was:

$$Y_{ikj} = \mu + T_i + S_k + e_{ikj}$$

Where:

Y_{ikj} = the observation on the ikj^{th} animal.

μ = the overall mean.

T_i = the i^{th} treatment effect where ,i = (1,2).

S_k = the effect of k^{th} time of samples (before morning feeding and 3 hr after feeding).

e_{ikj} = the random residual term.

Significant differences among treatments were determined by Duncan's multiples range test (Duncan,1955).

RESULTS AND DISCUSSION

Rumen fermentation parameters

Table 1 shows that addition of yeast culture to daily diet in G_2 caused a significant increase ($P<0.05$) in rumen pH value (6.72) than that determined in rumen liqour of control group (G_1) (6.29). Similarly, addition of sodium bicarbonate in G_3 caused a significant increase ($P<0.05$) in pH value (6.66) compared with those obtained with rumen pH in control group. Williams *et al.* (1991) indicated the yeast culture supplement increases the initial rate of degradation of fibrous material in the rumen as a result of elevated ruminal pH via reduction in lactic concentration. El-Bedawy, *et al.*(1989) reported that $NaHCO_3$ supplement in rations raised rumen pH. Ruminal NH_3-N concentrations of all treated groups tended to be higher with cows fed yeast culture or buffered rations than the control, but differences were not significant (Table1). Beneficial effects of high level of ammonia might be due to indirect effect on ruminal pH (Church, 1988), or indirectly via increasing the amount of substrate available for microbial protein synthesis in the rumen. Despite these changes occurring within the rumen, there appear to be significant ($P<0.05$) effect of added yeast culture on altering VFA concentration compared with the control group or added buffers (Table1). However VFA tended to be slightly higher for buffered rations than control. Similar lack of response for added buffers on VFA were also reported by Solozano *et al.*(1989) and Wagner *et al.*(1993). El-Bedawy *et al.*(1989) and Tucker *et al.*(1992) found that added buffers altered ruminal VFA's. Kalashnikov *et al.*(1984), reported that added yeast culture to increase ruminal VFA's concentration as a result of increased fermentation rate. Results obtained in this study indicated that ruminal concentration of acetic acid was significantly ($P<0.05$) higher in rumen fluid of G_2 (55.36 ± 2.92 mmol/ml) than its concentration in G_1 (53.85 ± 4.41 mmol/ml) and G3 (54.83 ± 6.34 mmol/ml). However, there was insignificant affect for both buffer and yeast culture addition on ratio of acetate to propionate in the rumen. In contrast Harrison *et al.*(1988)

and Williams *et al.*(1991), found that feeding yeast culture decreased the ratio of acetate to propionate in the rumen. Table 1 shows that lactate rumen concentration in G2 detected a significant ($p<0.5$) reduction 3.4 mmol/ml) compared with those in G1 (4.8 mmol/ml) and G3 (4.1 mmol/ml).

Table 1. Effect of experimental treatment on rumen fermentation parameters

Item	Time (hours)	(G_1)	(G_2)	(G_3)
Rumen liquor pH value	0	6.81±0.31	7.01±0.52	6.93±0.47
	3	$6.29^b \pm 0.23$	$6.72^a \pm 0.61$	$6.66^a \pm 0.35$
Rumen liquor ammonia-N	0	13.5±1.10	13.22±1.53	13.61±1.76
(mg/100 ml)	3	19.3 ± 1.56	20.21 ± 1.9	19.81 ± 1.7
Total VFA's (mmol/ml)	0	84.25±4.81	85.37±5.33	84.89±6.22
	3	$90.32^b \pm 3.52$	$96.72^a \pm 4.64$	$92.67^b \pm 5.90$
VFA's proportion				
Acetic acid (mmol/ml)	0	47.23±4.80	46.86±5.11	47.42±5.63
	3	$53.85^b \pm 4.4$	$55.36^a \pm 2.9$	$54.83^a \pm 6.34$
Propionatic acid (mmol/ml)	0	16.29±1.21	15.12±1.61	15.81±1.95
	3	20. 12 ± 1.30	19.58 ± 1.74	20.30 ± 1.23
Acetic: Propionic	0	2.9	3.1	3.0
	3	2.6	2.8	2.7
Butyric acid (mmol/ml)	0	13.33±0.60	12.81±0.80	12.95±1.10
	3	11.71 ± 0.9	9.92 ± 1.0	10.42 ± 0.7
Lactic acid (mmol/ml)	0	3.65±0.09	3.14±0.04	3.79±0.02
	3	$4.86^a \pm 0.05$	$3.43^b \pm 0.03$	$4.17^a \pm 0.01$

Different superscripts at the same row means significant ($P<0.05$, differences).

Blood constituents

The albumin concentration in blood plasma was higher in G_2 followed by G_1 and the lowest was observed in G_3. The differences between G_2 and both G_1 and G_3 were statically significant ($P<0.05$).

Table 2 shows that T_3 concentration in blood plasma was significantly ($P<0.05$) lower in the control group (G_1) than those groups received yeast culture (G_2) or NaHCO3 (G_3). Those represent about 15.5% and 11.6%, respectively, over the T_3 blood plasma level in G_1.

The total plasma protein values showed the highest value with G_2, while the control group (G_1) had the lowest value. The differences between groups were significant ($P<0.05$). Results are almost similar with those obtained by Kluz *et al.*(1982) and Kalashnikov *et al.*(1984). Results are in harmony with Maynard *et al.* (1983). The globulin content in blood plasma had the highest value with G_2, while the control group(G_1) had the lowest value. No significant differences were found among the groups. Moreover, significant ($P<0.05$) differences were found among the experimental groups concerning albumin: globulin ratio. Blood plasma total lipids concentration and triglyceride show a significant ($P<0.05$) higher in cows received yeast culture (G_2) than those cows in control group (G_1), meanwhile, there were significant ($P<0.05$) differences among groups. The blood plasma glucose concentration was higher in the yeast culture group (G_2), but the differences between groups were not significant. Maynard *et al.*(1983) reported that yeast culture increased the cellulolytic bacteria that act on cellulose fibers degradation and produced more plasma glucose concentration. Plasma total cholesterol concentration was insignificantly lower in G_2 receiving yeast culture. Such effect may be due to that yeast culture may act as a source of chromium (Scwarz and Mertz, 1959). Recent evidences indicated that supplementation of chromium in lactating animals diet markedly decreased cholesterol (Bunting, *et al.*, 1994). The creatinine and GOT did not show distinct difference among groups. The levels were within the normal range in both treated and control cows.

Table 2. Effect of the experimental treatments on some blood plasma parameters

Item	Time (hours)	(G_1)	(G_2)	(G_3)
T_3 hormone (ng / ml)	0	71.22±6.33	72.33±10.25	71.85±10.18
	3	77.15^b ± 8.71	89.11^a ± 11.03	86.18^a ± 9.87
Total protein	0	4.65±0.41	5.01±0.62	5.12±0.73
(g./100ml)	3	6.71^b ± 0.33	8.10^a ±0.54	7.92^a ± 0.41
Albumin (g/100ml)	0	2.31±0.08	2.63±0.06	2.47±0.09
	3	3.54^b ± 0.33	4.61^a ±0.23	3.33^b ±0.30
Globulin (g/100ml)	0	2.02±0.03	2.31±0.04	2.11±0.03
	3	2.87±0.05	3.01±0.02	2.98±0.01
A : G ratio	0	1.14	1.23	1.17
	3	1.23^b	1.53^a	1.12^b
Total lipids	0	263.62±26.98	253.64±26.28	260.71±29.83
(mg/100ml)				
	3	321.72^b ± 23.33	339.81^a ± 25.72	331.56^a ± 27.61
Cholesterol	0	119.21±15.23	119.52±12.11	120.03±9.82
(mg/100ml)	3	133.11 ±14.59	127.93 ± 11.90	135.96 ±17.08
Triglycerids	0	98.6±9.61	95.21±11.25	97.32±8.33
(mg/100ml)	3	110.31^b ± 12.81	133.82^a ± 15.50	115.61^b ± 13.70
Glucose (mg /100ml)	0	31.20±7.81	30.62±10.25	31.35±9.28
	3	50.11 ± 2.74	55.31 ± 3.90	47.92 ± 2.98
Creatinine (mg /100ml)	0	1.63±0.04	1.59±0.08	1.45±0.10
	3	1.71 ±0.11	1.46 ± 0.38	1.35 ± 0.73
GOT (1u/l)	0	43.01±8.71	40.65±7.81	40.39±10.21
	3	43.29 ±3.6	41.6 ±2.80	42.6 ± 4.5
NH3-N (mg/100ml)	0	25.25±1.11	24.33±0.83	24.610.79
	3	29.6 ±0.71	28.9 ± 0.56	28.1± 0.13

Different superscripts at the same row means significant ($P<0.05$) differences

CONCLUSION

Results obtained in this study show that adding yeast culture to silage of fodder beet roots can improve rumen fermentation and some blood parameters. Results didn't show any negative effects on kidney or liver function.

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