# NUTRIENT UTILISATION AND VFA PRODUCTION ON BENTONITE SUPPLEMENTATION TO DIET CONTAINING UREA IN CATTLE

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Twelve crossbred rumen fistulated adult steers were divided into four groups of three animals each. The animals were provided with concentrate mixture and wheat straw as basal roughage. Animals of group I and II were fed concentrate mixture 1 and groups III and IV were fed concentrate mixture 2. Group II and IV were supplemented with sodium bentonite 4% of the concentrate mixture. Bentonite supplementation did not affect the DMI per day, per 100 kg b.wt and digestibility to coefficients at both the levels of urea. Bentonite supplementation had apparantly low Ca and P but the differences were not significant. Acetate percentage increased on bentonite supplementation at 1% urea while no difference was observed with 2% urea in the diet. However, TVFA concentration and butyrate (%) decreased in group II.

## INTRODUCTION

Urea, a commonly fed NPN source in ruminants can be used successfully replacing part of protein requirement in the diet. As it hydrolyses very fast, a part of it goes waste. In improving its utilisation, bentonite supplementation can be useful. Bentonite, a clay, has high ion exchange capacity and binds a wide range of inorganic and organic cations, including amino acids and proteins. In the rumen, the bentonite has been shown to increase the pH of ruminal fluid in sheep fed high grain diet (Bringe and Schultz. 1969) and increased feed: gain ratio (Huntington *et al.* 1977). Richter *et al.* (1990) observed increased daily gains on bentonite supplementation. Hence, in this study, effect of bentonite supplementation on nutrient utilisation in crossbred calves was estimated.

## MATERIALS AND METHODS

Twelve crossbred rumen fistulated adult (1.5-2 yr., 260-340 kg b.wt.) steers were divided into four groups of three animals each in a randomised block design. The animals were fed wheat straw *ad lib.* as basal roughage and concentrate mixture to meet maintenance requirements (Kearl, 1982). Animals in Group I and II were given concentrate mixture 1 and group III and IV animals were provided with concentrate mixture 2. Among these groups, II and IV group animals were supplemented with sodium bentonite @

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**Table 1**
**Ingredient and percent composition of experimental diets**

| Particulars | Concentrate Mixture 1 | Concentrate Mixture 2 | Wheat Straw |
|---|---|---|---|
| **Ingredient (%)** | | | |
| Maize | 35 | 40.8 | - |
| Wheat Straw | 42 | 43.0 | - |
| Groundnut cake | 19 | 11.2 | - |
| Urea | 1 | 2.0 | - |
| Mineral mixture | 2 | 2.0 | - |
| Salt | 1 | 1.0 | - |
| **Chemical composition (% DM basis)** | | | |
| Organic matter | 92.85 | 92.36 | 90.77 |
| Crude protein | 18.88 | 20.44 | 3.59 |
| Crude fibre | 4.58 | 3.54 | 34.82 |
| Ether extract | 4.47 | 3.97 | 1.29 |
| NFE | 64.93 | 64.41 | 51.07 |
| Total ash | 7.15 | 7.64 | 9.23 |

4% of their required concentrate mixture. Composition of the concentrate mixtures is given in Table 1. Vitablend in drinking water was given weekly to meet vitamin A requirement of the animals. Clean water was provided free of choice.

After preliminary feeding of 30 days, a 7 day metabolic trial was conducted. Daily samples of feed residue, feaces and urine were preserved for the proximate analysis (AOAC, 1984). Calcium was estimated by atomic absorption spectrophotometer using hollow cathode lamp for Ca and P was estimated by the method of AOAC (1984). After the trial, rumen liquor samples were collected for TVFA analysis on three consecutive days with the help of stainless steel probes having small holes and covered with fine nylon cloth. About 100 ml of rumen liquor was collected at 0, 2, 4, 6 and 8 h after feeding and were preserved in deep freeze. TVFA concentration (Chaturvedi *et al.* 1973) and VFA proportions (Erwin *et al.* 1961) were estimated in these samples. Data were analysed statistically (Snedecor and Cochran, 1968).

## RESULTS AND DISCUSSION

The chemical composition (Table 2) of the concentrate mixtures did not vary significantly except ether extract which was lower in concentrate 2 as compared to concentrate 1 (4.47). This may be because of decreased amount of GNC

**Table 2**
**Dry matter intake (DMI) of animals in different treatment groups**

| Parameters | Treatment groups I | II | III | IV |
|---|---|---|---|---|
| Body weight (Kg) | 282.50±40.35 | 278.17±19.54 | 281.42±30.20 | 282.08±21.67 |
| Metabolic body weight ($W^{0.75}$ kg) | 68.63±7.48 | 68.05±3.56 | 68.56±5.49 | 68.75±3.99 |
| Straw intake (kg/d) | 3.51±0.86 | 3.06±0.50 | 3.36±0.75 | 3.54±0.14 |
| Concentrate intake (kg/d) | 1.79±0.12 | 1.79±0.04 | 1.83±0.23 | 1.82±0.09 |
| Total DMI (kg/d) | 5.30±1.03 | 4.85±0.54 | 5.19±0.98 | 5.36±0.19 |
| Total DMI Kg/100 Kg b.wt. | 1.86±0.14 | 1.73±0.97 | 1.82±0.14 | 1.92±0.13 |
| Total DMI g/Kg $W^{0.75}$ | 75.98±7.43 | 70.92±4.72 | 74.53±7.75 | 78.32±3.78 |
| **Apparent digestibility (%)** | | | | |
| DM | 52.98±2.87 | 52.20±0.85 | 53.91±1.16 | 50.37±1.23 |
| OM | 55.72±2.96 | 56.93±1.11 | 56.54±1.10 | 54.74±1.13 |
| CP | 52.02±3.69 | 53.97±2.73 | 56.04±1.35 | 52.67±0.92 |
| EE | 75.59±2.92 | 74.41±0.93 | 74.93±1.22 | 70.34±1.57 |
| CF | 53.12±2.41 | 55.76±2.61 | 52.74±2.71 | 58.05±2.24 |
| NFE | 56.57±3.25 | 56.93±2.47 | 57.44±1.30 | 53.10±0.88 |

**Table 3**
**Calcium and phosphorus balances of animals under different treatments**

| | Treatment groups I | II | III | IV |
|---|---|---|---|---|
| | | **Ca balance** | | |
| Total intake (g/d) | 20.93±3.97 | 19.26±2.05 | 21.49±3.92 | 22.10±0.76 |
| Faecal loss (g/d) | 12.85±1.68 | 13.60±0.79 | 14.25±0.63 | 15.38±0.72 |
| Urine loss (g/d) | 0.69±0.11 | 0.49±0.12 | 0.49±0.16 | 0 69±0.20 |
| Balance (g/d) | 7.39±3.50 | 5.17±1.25 | 6.75±3.24 | 6.03±0.93 |
| | | **P Balance** | | |
| Total intake (g/d) | 17.47±2.23 | 17.09±0.76 | 17.67±2.51 | 17.72±0.78 |
| Faecal loss (g/d) | 13.08±1.20 | 13.92±0.43 | 12.58±1.94 | 14.38±1.50 |
| Urinary loss (g/d) | 0.19±0.06 | 0.14±0.05 | 0.33±0.09 | 0.15±0.05 |
| Balance | 4.20±1.15 | 3.03±1.15 | 4.76±0.75 | 3.19±1.14 |

The means are based on 3 values ± denotes SE in concentrate 2 which was the main source of oil in this ration. DMI value and digestibilities of various nutrients are depicted in Table 3. Total dry matter intake (kg/d) in the four groups did not differ significantly on bentonite supplementation at both the levels of urea. Dry matter intake per 100 kg, per kg $W^{0.75}$ body weight and digestibility co-efficient of various proximate principles did not differ significantly (P>0.05) in various treatment groups. No significant change in DM intake with high grain ration supplemented with 5 to 10% bentonite (Bringe and Schultz, 1969 and Rindsig *et al.* 1969) and on silage diet (Fisher and Mackay, 1983) was observed. Bentonite supplementation (3%) increased CF digestibility in steers (Erwin *et al.* 1957). Jacques *et al.* (1986) found low ADF, DM and CP digestibility, but OMD did not differ. Increased daily gains on bentonite supplementation were observed in bulls on high concentrate diet but performance of bulls fed high roughage diet was not affected (Richter *et al.* 1990). Bentonite supplementation did not improve the performance of steers in this study which may be due to the fact that urea-N does not bind with the bentonite (Ghoshal, 1994).

The Ca and P intake, excretion and balances of the various treatments (Table 4) did not differ significantly among various dietary treatments, however supplementation of bentonite at both the levels of urea resulted in apparently low balances of both Ca & P. The decrease may be attributed to adsorption property of bentonite. It was also observed in lactating cows at 5 and 10% level of bentonite (Rindsig *et al.* 1970). Huntington *et al.* (1977) also reported lower serum Ca level in one study and no significant difference in Ca, P and Mg level in another study. Other workers (Richter *et al.* 1990 and Schwarz and Werner, 1990) have estimated these minerals in serum but did not find any significant effect of bentonite supplementation in the diet.

**Total volatile fatty acids in rumen liquor**

Rumen fermentation indicates the ultimate effect of diet or any additive put into the diet. Among many parameters TVFAs reflect the availability of energy from a particular diet. Hence TVFA concentration and molar proportions of VFAs was studied and is presented in Table 4. Bentonite, apparently, decreased TVFA concentration at both the levels of urea, though the difference was not significant in group III and IV. Molar proportion of acetate increased and butyrate decreased significantly (P<0.01) in groups II, III and IV as compared to group I, however, these three groups did not differ significantly from eath other. Galyean and Chabot (1981) and Aitchison *et al.* (1987) reported increased acetate and A:P ratio with no change in TVFA concentration on bentonite supplementation to high grain diet. However, Jacques *et al.* (1986) and Madhu Mohini *et al.* (1993) did not find any significant difference on account of bentonite supplementation.

Hence, this study has indiated that

**Table 4**
**TVFA concentration (meq/100 ml SRL) in different treatments groups**

| Treatment groups | Periods (hour) 0 | 2 | 4 | 6 | 8 | Treatment average ± S.E. |
|---|---|---|---|---|---|---|
| I | 7.50±0.85 | 10.70±0.21 | 11.23±0.23 | 12.20±0.50 | 10.93±0.48 | 10.51±0.26[b] |
| II | 8.33±0.84 | 8.87±1.17 | 8.56±0.79 | 8.20±0.70 | 8.93±1.77 | 8.58±0.48[a] |
| III | 9.80±1.75 | 12.33±2.67 | 11.87±2.32 | 12.53±1.91 | 13.13±0.64 | 11.93±0.81[b] |
| IV | 8.40±0.60 | 10.00±1.40 | 10.27±0.85 | 12.20±0.70 | 10.70±1.16 | 10.19±0.49[b] |
| **Molar Proportion (%)** | | | | | | |
| | | | **ACETATE** | | | |
| I | 61.21±2.63 | 59.33±0.96 | 56.75±1.01 | 54.76±0.73 | 57.01±2.04 | 57.81±1.12[a] |
| II | 62.22±3.56 | 63.21±0.97 | 60.71±1.82 | 64.30±1.63 | 61.65±1.14 | 62.42±0.62[b] |
| III | 63.67±1.88 | 62.50±2.15 | 63.16±0.82 | 63.38±1.07 | 62.98±0.83 | 63.14±0.20[b] |
| IV | 62.92±1.78 | 62.14±0.52 | 60.55±1.72 | 59.77±2.19 | 59.13±1.65 | 60.91±0.71[b] |
| | | | **PROPIONATE** | | | |
| I | 27.33±1.56 | 28.24±1.25 | 29.55±0.19 | 24.67±2.13 | 28.82±1.92 | 27.72±0.84 |
| II | 26.23±1.11 | 26.32±0.61 | 29.40±1.11 | 26.46±0.53 | 27.22±1.13 | 27.13±0.45 |
| III | 27.41±0.55 | 26.65±0.26 | 26.91±0.27 | 26.27±0.69 | 27.24±1.07 | 26.90±0.20 |
| IV | 27.95±0.81 | 27.79±0.22 | 28.04±0.64 | 28.22±1.00 | 28.48±0.66 | 27.90±0.29 |
| | | | **BUTYRATE** | | | |
| I | 11.46±1.23 | 11.22±1.62 | 13.70±0.89 | 21.57±2.74 | 14.17±1.63 | 14.22±1.69[a] |
| II | 11.56±4.44 | 10.47±1.41 | 9.89±0.78 | 9.24±1.21 | 11.13±0.73 | 10.46±0.45[b] |
| III | 8.92±1.55 | 10.86±1.90 | 9.93±0.55 | 10.25±1.19 | 10.78±0.54 | 10.15±0.35[b] |
| IV | 9.13±1.00 | 11.08±0.42 | 11.41±1.56 | 11.99±1.20 | 12.39±1.07 | 11.20±0.56[b] |

Figures bearing different superscripts in a column differ significantly ($P<0.05$)

addition of bentonite to the diet containing urea as nitrogen source had neither improved the nutrient utilisation nor it has hampered mineral balances.

## REFERENCES


Aitchison, E. M., Rowe, J. B. and Rik, G. S. 1987. Effect of bentonite clays on rumen fermentation and diet digestibility. *Nutr. Abstr. and Rev.* 57:3945.

AOAC, 1984. Official methods of analysis. Association of official agricultural chemists,Washington, D.C.

Bringe, A. N. and Schultz, L. H. 1969. Effects of roughage type or added bentonite in maintaining fat test. *J. Dairy Sci.* 52:465.

Chaturvedi, M. L., Singh, U. B. and Ranjhan, S. K. 1973. Effect of alkali treatment of wheat straw on feed consumption, digestibility and VFA production in cattle and buffalo calves. *Indian J. Anim. Sci.* 43:677.

Erwin, E. S., Elam, C. J. and Dyer, I. A. 1957. The influence of sodium bentonite *in vitro* and in the ration of steers. *J. Anim. Sci.* 16:858.

Erwin, E. S., Macro, G. J. and Energy, E. M. 1961. Volatile fatty acid analysis of blood and rumen fluid by gas liquid chromatography. J. Dairy Sci. 44:1768.

Fisher, L. J. and Mackay, V. G. 1983. The investigation of sodium bicarbonate or bentonite as supplements in silages fed to lactating cows. *Canadian Journal of Animal Science.* **63**(4):939.

Galyean, M. L. and Chabot, R. C. 1981. Effects of sodium bentonite, buffer salts, cement kiln dust and clinoptilolite on rumen characteristics of beef steers fed a high roughage diet. *J. Anim. Sci.* **52**:1197.

Ghoshal, T. K. 1994. Utilisation of NPN in ruminants as affected by bentonite supplementation. M.Sc. Thesis. NDRI Deemed University, Karnal.

Huntington, G. B., Emerick, R. J. and Embry, L. B. 1977. Sodium bentonite effects when fed at various levels with high concentrate diets to lambs. *J. Anim. Sci.* **45**:119.

Jacques, K. A., Axe, D. E., Harrish, T. R., Harmon, D. L., Bolsen, K. K. and Johnson, D. E. 1986. Effect of sodium bicarbonate or sodium bentonite on digestion, solid and liquid flow, and ruminal fermentation characteristics of forage sorghum silage-based diets fed to steers. *J. Anim. Sci.* **63**:923.

Kearl, L. C. 1982. Nutrient requirements of ruminants in developing countries. International feedstuffs Institute, Utah Agricultural Experiment Station, Utah, USA.

Madhu Mohini, Singh, G. P. and Kewalramani, N. 1993. Influence of bentonite on the fermentation of protein supplements. Proceedings of the sixth Animal Nutrition Research Workers' conference (13th-16th Sept., 1993) held at Bhubaneswar. p. 36. Proc. of sixth Anim Nutr. Res. Workers Conf. p. 36.

Richter, G. H., Flachowsky, E., Ochrimenko, W. I. and Kractsch, D. 1990. Effect of bentonites on fatening performance, apparent digestibility and metabolic parameters in bulls. *Tierernahrung-Und-Futterung,* **16**:55. Cited in *Nutr. Abstr. Rev.* **61**:1320.

Rindsig, R. B., Schultz, L. H. and Shook, G. E. 1969. Effect of bentonite on nitrogen and mineral balances and ration digestibility of high-grain rations fed to lactating dairy cows. *J. Dairy Sci.* **52**:1770.

Rindsig, R. B., and Schultz, L. H. 1970. Effect of the addition of bentonite to high grain dairy rations which depress milk fat percentage. *J. Dairy Sci.* **53**:888.

Snedecor, G. W. and Cochran, W. G. 1968. Statistical Methods. Oxford and IBH Publishing Company, Calcutta, India.

Schwarz, T. and Werner, E. 1990. Effect of long term bentonite applications on the metabolism of major minerals in the dwarf goat. *Archiv-fur-experimentelle-Veterinar medizin.,* **44**(4):493. Cited in *Nutr. Abstr. Rev.* **61**:2247.