

Original Research Article

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Effect of Sodium Bicarbonate as a Buffer Feeding on Milk Yield and Fat Percent of Dairy Crossbred Cows

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ABSTRACT

The dairy farming in our country is entirely different from other developed countries. The reason is that small and marginal farmers feeding of dairy animals produce the bulk of production in our country. In terms of buffer use in nutrition, it has been defined as a salt of a weak acid which neutralizes acids that occur in feeds or acids produced during digestion and metabolism of nutrients. The experiment was carried out on 16 healthy crossbred cows nearly similar age and in late stage lactation to study the effect of feeding buffer on milk yield and fat per cent of raw milk. Four groups of buffer feeding were adopted in the study *viz.*, concentrate mixture (control), concentrate mixture with 1%, 1.5% and 2% of NaHCO₃ (Sodium bicarbonate). All cows were kept under same feeding schedule for 9 days under preliminary period to adapt the test diet followed by 28 days experimental period for records, and fed ration wheat straw and concentrate. The data on milk yield and composition of milk were analyzed through statistics using, analysis of variance technique. The data on mean value of Total solids, Fat per cent and Solid not fat per cent were significantly ($P<0.05$) higher in Group IV followed by Groups III, II and I, however specific gravity and milk yield (kg) were not significantly different between the groups. Based on these finding 2% of NaHCO₃ was significantly at the level of ($P<0.05$) superior compared to control, 1% and 1.5% of NaHCO₃.

Keywords

Buffer feeding (NaHCO₃), Dairy cattle, Milk composition, Milk yield

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Introduction

Animal husbandry culture in India initiated long back since medieval times which determines the status of family and prosperity of nation representing the particular civilization. In terms of buffer use in nutrition, it has been defined as a salt of a weak acid/hydroxide/oxide which neutralizes acids

that occur in feeds or acids produced during digestion and metabolism of nutrients (Chalupa and Schneider, 1985). For a compound to be effective as a buffer under physiological conditions, it must be water soluble, be a weak acid, base or salt thereof have a pKa value near the physiological pH of the system to be buffered (Murphy, 1992). The buffering capacity of carbonates, such as

sodium bicarbonate, is based on equilibrium between HCO_3^- , H^+ , H_2CO_3 , CO_2 and H_2O as follow: $\text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^-$

Bicarbonate ion (HCO_3^-) is a normal constituent of the blood and it's produced by the reaction of carbon dioxide (CO_2) with water (H_2O) to produce carbonic acid (H_2CO_3), which dissociates to a bicarbonate ion (HCO_3^-) and a proton (H^+). When the concentration of H^+ increases, the equilibrium shifts towards the right, which results in a buffering effect. It is generally recognized that milk fat depression is the result of a reduction in the ratio of lipogenic to glucogenic volatile fatty acids (VFA), promoted by the fermentation of such diets. Characteristics of this fermentation pattern include a reduction in the molar proportion of acetate and an increase in the molar proportion of propionate and rumen acidity, and a simultaneous lowering of the buffering capacity of the rumen fluid (Counotte *et al.*, 1979). It is now generally accepted that the addition of buffers, such as sodium bicarbonate (NaHCO_3), to low fibre diets will help prevent or alleviate milk fat depression (Staples and Lough 1989). Furthermore, while the systemic buffering properties of NaHCO_3 have been investigated (Erdman *et al.*, 1982), few studies have attempted to contrast acid-base metabolism and milk production in cows fed NaHCO_3 to those maintained in a state of metabolic acidosis. Such work is required to demonstrate the value of NaHCO_3 , as a systemic buffer and to document any potential benefits such buffering properties may have on production and productivity. The objective of present study was to compare separate level of NaHCO_3 of roughage and concentrate *i.e.* concentrate mixture (control), concentrate mixture along with 1%, 1.5% and 2% of lactating crossbred cattle in India and to examine the effect of NaHCO_3 on productive performance such as milk fat, total solids and SNF of lactating crossbred cow.

Materials and Methods

Experiment design

The experiment was conducted at the dairy farm of the Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad to determine the effect of the four feeding groups on compositional quality of milk and milk yield in crossbred cattle. It is situated on an altitude of 89 metre (320 feet) above elevation, latitude and longitude position being 25.413° N and 81.849° E respectively. Minimum ambient temperature is recorded near 9°C in winter, and maximum temperature goes up to 36°C in summer with annual rainfall of 1025 mm. For the present study, sixteen crossbred lactating cows were selected from the dairy farm of SHUATS, Allahabad. These animals were further divided equally into four groups (4 cows in each group) *i.e.* concentrate mixture as a control (group I), concentrate mixture with 1.0% (group II), 1.5% (group III) and 2.0% (group IV) of NaHCO_3 (Sodium bicarbonate), Initial body weight of crossbred cows were 421.46 ± 4.26 kg. The mass of nearly similar age and stage of lactation were selected for the study. All cows were kept under same feeding schedule for 9 days under preliminary period to adapt the test diet followed by 28 days experimental period for record of data.

Feeding and management of animals

The experimental animals were kept in separate pens throughout the study. The concentrate mixture and straw (Table 1) were offered in the morning (10:00 AM). Cows were fed individually to meet the requirements (Kearl, 1982) on respective diets.

Milk sample analysis

Daily milk production of each cow was recorded and weighted through digital

balance. Milk samples, consisted of proportional volumes of morning milk were taken after cleaning and disinfection of teats and discarding the first streams of foremilk. Milk samples were collected in 100 ml sterile plastic vials at last consecutive 10 days through the lactation period and taken to the laboratory. Specific gravity was determined in milk sample by using Lactometer according to Murphy (1999), Total solids was done by Badcock's formula according to Prasad *et al.*, (1999), Fat percent was determined in milk samples by using Gerber's method according to BIS (1977), Solid not fat was calculated according to Prasad *et al.*, (1999) and Milk yield of cows was recorded daily in morning at 4.00 to 5.00 am and afternoon at 2.00 to 3.00 pm.

Statistical analysis

The data on milk yield and its composition were analyzed statistically using one way ANOVA technique as per Snedecor and Cochran (1994). Means were separated for significance by using Tukey Kramer range tests.

Results and Discussion

The results of all parameters are showed in Table 2. The highest specific gravity was recorded in group IV (1.0378) followed by groups III (1.0368), II (1.0370) and I (1.0368), respectively. The differences in these values were found non-significant between the groups but numerically higher in groups. The results of specific gravity of the study are in the line with the observation of Counotte *et al.*, (1979), who has reported that non-significant difference between the groups.

The highest total solid in milk of cows were registered highest in group IV (15.677) followed by groups III (14.185), II (13.294) and I (12.852). The differences in these values

of total solids were found significant ($P < 0.05$) in between the groups. This clearly indicates that feeding of buffer has significant effect on total solid percent of milk. These results are in agreement with Xu and Harrison (1994). The highest fat percent was recorded in group IV (5.167) followed by groups III (4.160), II (3.348) and I (3.015).

The differences in these values were found significant ($P < 0.05$) indicating thereby a significant effect of treatments on fat percent. This indicates that feeding of buffer has significant effect on fat per cent of milk. These results are in agreement with Harrison *et al.*, (1989), who has reported that feeding buffer has affected fat percent in result. The average highest solid not fat (SNF) percent was recorded in group IV (10.497) followed by groups III (10.024), II (9.945) and I (9.845).

The differences in these values were founded significant ($P < 0.05$) indicating thereby a significant effect of treatments on SNF percent. However, these indicate no significant difference found groups III and II being at par. This indicates the feeding of buffer has significantly higher in SNF in milk of cows. Results of SNF per cent of the study are in agreement with Xu and Harrison (1994). The average milk yield (kg/d) was recorded in group IV (5.54) followed by groups III (5.33), II (4.74) and I (3.13). The differences in these values were founded non-significant differences in between among groups.

The result of milk yield of the study is agreement with Rogers and Muller (1985), who has reported that feeding of buffer results in decrease in milk yield having inverse effect. Hence, feeding of buffer has non-significant effect on milk yield of cows. The main parameters Milk yield and Fat percent were graphical presentation in Figure 1, which was shown the effect of buffer feeding in

Table.1 Feed ingredients and chemical composition used in the experimental ration

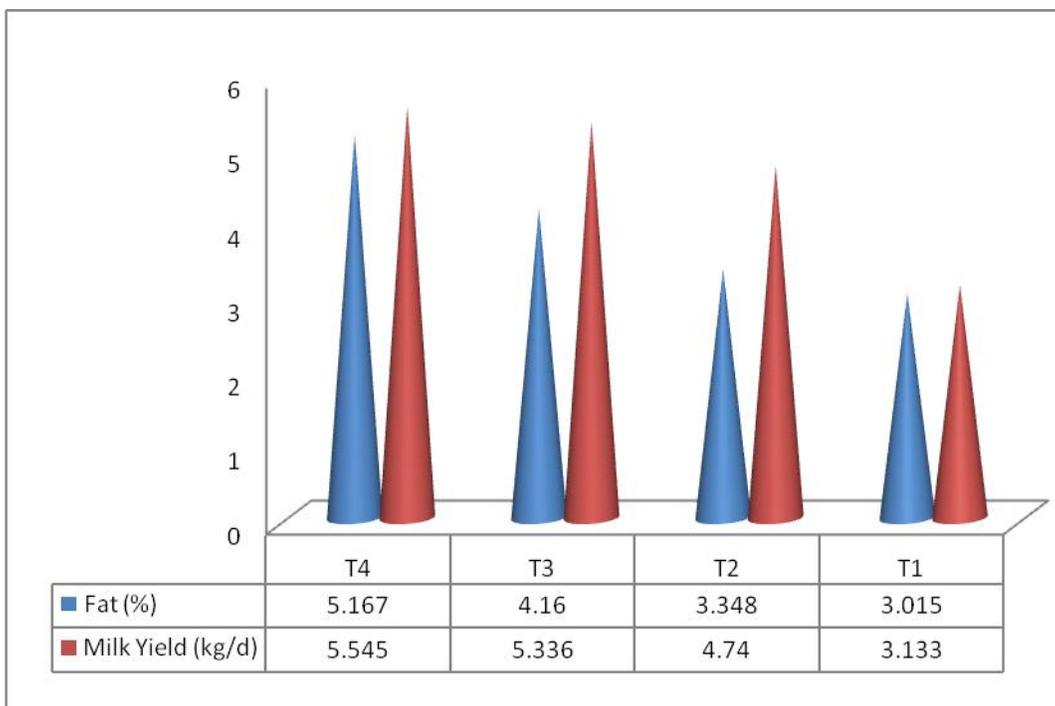
Chemical Composition	Concentrate mixture	Wheat straw
Dry matter %	88.97±0.60	89.785±0.29
CP %	10.47±0.22	3.10±0.11
Ether extract %	2.59±0.06	1.04±0.04
CF %	16.49±0.13	39.41±0.26
NFE %	64.04±0.61	45.61±0.54
TA %	6.41±0.45	10.84±0.68
*TDN %	69.77±0.88	47.31±0.61

*Total Digestible Nutrient calculated by NRC, 1989.

Table.2 Milk yield and its composition of lactating crossbred cows fed Sodium bicarbonate (NaHCO₃) as a buffer feeding

Parameters	Group IV	Group III	Group II	Group I	Result
Specific gravity	1.03788	1.03681	1.03702	1.0368	NS
Total solids (%)	15.677 ^a	14.185 ^b	13.294 ^c	12.852 ^d	S
Milk fat (%)	5.167 ^a	4.160 ^b	3.348 ^c	3.015 ^d	S
Solid not fat (%)	10.497 ^a	10.024 ^b	9.945 ^b	9.845 ^c	S
Milk yield (kg/d)	5.545	5.336	4.740	3.133	NS

Figure.1 Graphical presentation of fat percent and milk yield during experiment



From this experiment and observation of the data, it may be concluded that buffer feeding in dairy animals found to be beneficial because it has significant effect on milk fat, total solids and solid not fat percent which are the important parameters in fixing the price of milk in markets as well as in cooperatives and private sectors.

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