

FEEDING BUFFERS AND SOYBEAN HULLS TO DAIRY COWS

**Key words - feeding, sodium bicarbonate,
magnesium oxide, soybean hulls, buffers**

EFFECTS ON FEEDING SODIUM BICARBONATE PLUS MAGNESIUM OXIDE AND SOYBEAN HULLS TO EARLY LACTATION COWS

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ABSTRACT

Thirty-six Holstein cows were used to determine the effects of sodium bicarbonate (NaHCO_3) plus magnesium oxide (MgO), and soybean hulls in the concentrate ration on concentrate intake, milk yield, milk fat, solids-not-fat, fecal pH and fecal starch. Cows were assigned to treatments based on age and previous milk production for 2 weeks prepartum and 18 weeks postpartum. During the 2 weeks prepartum period the cows became adjusted to their treatment ration and were consuming 7 kg of concentrate plus alfalfa haylage ad libitum and 4 kg (dry basis) of high moisture corn per head per day. Beginning 3 days postpartum the cows

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received the concentrate and haylage ad libitum plus 4 kg (dry basis) of high moisture corn. The three treatments were as follows: a) 16% CP concentrate with no buffer; b) 16% CP concentrate with 1.2% NaHCO_3 plus .8% MgO; and c) 16% CP concentrate with 30% soybean hulls. The addition of 1.2% NaHCO_3 plus .8% MgO to the concentrate ration had no significant effect on milk yield and milk fat %, but depressed concentrate intake. Replacing corn with 30% soybean hulls in the concentrate ration had no effect on milk yield, milk fat % and concentrate intake. Fecal pH was increased by the addition of NaHCO_3 plus MgO and soybean hulls to the concentrate ration. Fecal starch content was not affected by NaHCO_3 plus MgO but was lower for the soybean hull group.

INTRODUCTION

It is often difficult to get cows fed high levels of concentrates in their early lactation to consume enough fiber to maintain normal milk fat content. The NRC feeding standard recommends that the crude fiber content of ration dry matter should be a minimum of 17.3% (15). MacGregor et al (12) showed soybean mill run which has a high fiber content to be an effective replacement for corn and maintained normal milk fat content. Buffers such as sodium bicarbonate (NaHCO_3) and magnesium oxide (MgO) have also maintained normal milk fat content (1,2,4-6,7,10,13,14,18,19,20) by neutralizing acids in the rumen. However, the benefits of feeding buffers have been variable as other studies have shown no improvement in milk fat content (3,8,11). The objectives of this experiment were to determine the effects of NaHCO_3 plus MgO, and soybean hulls in the concentrate ration on concentrate intake, milk yield, milk fat, solids-not-fat, fecal pH and fecal starch.

EXPERIMENTAL PROCEDURES

Thirty-six Holstein cows were used in this experiment as they became available following freshening. The cows were assigned to treatment based on age and previous milk production for 2 weeks prepartum and 18 weeks postpartum. Each treatment group included 5 first calf heifers. During the two week prepartum period the cows become adjusted to their treatment ration and were consuming 7 kg of concentrate plus alfalfa haylage ad libitum and 4 kg (dry basis) of high moisture corn per head per day. The three treatments were as follows: A—16% crude protein concentrate with no added buffer; B—16% crude protein concentrate with 1.2% NaHCO_3 plus .8% MgO; and C—16% crude protein concentrate with 30% soybean hulls. The rations and compositions of ingredients are shown in Tables 1 and 2. The cows were kept in a loose housing feeding set-up and had free access to the bunk ration. The concentrate was fed free choice through Calan feeding gates.

The concentrate was weighed each day, weekly milk weights were recorded and weekly fat and solids-not-fat tests were conducted. Cows were weighed at calving and at six weeks intervals. Fecal pH values were determined at bi-monthly intervals. Fecal starch was determined after the cows had been on the experiment for at least 6 weeks. The starch analysis was carried out using the phenol-sulfuric acid colorimetric method (9) coupled with enzymatic hydrolysis of starch to glucose (16). The enzyme used was α - 1, 4-glucan glucohydrolase.

RESULTS AND DISCUSSION

As shown in Table 3, there were no significant differences in milk yield, FCM, Fat % and SNF % between treatments. The addition of 1.2% NaHCO_3 and .8% MgO had no effect on milk yield and composition; however, these cows consumed less ($P < .01$) concentrate. Other studies have also reported that NaHCO_3 and/or MgO had a depressing effect on concentrate intake when forage and concentrate were fed separately (5,6,13,19,20). However, NaHCO_3 fed with mixed rations has increased dry matter intake (1,3,7).

Soybean hulls with high fiber content were used to replace 30% of the corn in the concentrate ration. This level of soybean hulls had no significant effect on milk yield and composition. The fiber content of the soybean hulls was highly digestible and the energy content equivalent to that of concentrates which may explain its ineffectiveness in raising the milk fat content while maintaining milk yields (12). Body weight changes followed similar patterns between treatments, losing weight the first 6 weeks of lactation and then gaining weight, with the exception of the soybean hulls group, which did not show a positive weight gain until the 12th week. Although there were no significant differences in gain of body weight associated with treatments, the control group did have the higher weight gains following peak production. Cows receiving inadequate dietary fiber sometimes make large body weight gains (11).

The addition of NaHCO_3 plus MgO as well as soybean hulls significantly increased fecal pH ($P < .01$) (Table 4). Fecal starch was not significantly affected by the addition of NaHCO_3 plus MgO; however, the addition of the soybean hulls significantly lowered fecal starch percentage ($P < .05$). This is probably due to the lower amount of starch in the soybean hulls concentrate ration. There was no significant correlation between fecal pH and fecal starch. Snyder, et al reported no difference in fecal pH and fecal starch when fed different levels of NaHCO_3 but found a significant correlation between fecal pH and starch (17). Buffers added to high energy rations generally raised fecal pH (7,21,22,23) and provided a more favorable gastrointestinal tract pH for the digestion and utilization of starch (7).

The average daily milk production by week showed no significant difference between treatments (Figure 1). Most cows reached their peak production during the 6th and 7th week of lactation. Milk production remained quite constant during the 18 week experimental period. Likewise, FCM was quite constant throughout the study with a slight decline towards the end of the 18 weeks for all treatment groups (Figure 2). The average milk fat percentage by week shown in Figure 3 followed an expected pattern testing high during the first 2 weeks of lactation, reached a low point during the 6th and 7th weeks of lactation and then gradually increased. There was no significant difference between treatments.

In conclusion, 1.2% NaHCO_3 plus .8% MgO in the concentrate ration had no effect on milk yield or milk fat percentage but did depress concentrate intake, possibly indicating more efficient concentrate utilization. Replacing corn with 30% soybean hulls in concentrate ration had no effect on milk yield, milk fat percentage, or concentrate intake. Fecal pH was increased by the addition of NaHCO_3 plus MgO and soybean hulls. Fecal starch content was not affected by NaHCO_3 plus MgO but was lower for the soybean hull group.

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TABLE 1. Ingredients of rations.

	Ration		
	Control (no buffer)	1.2% Na HCO ₃ 0.8% MgO	30% Soybean hulls
Concentrate Mix			
Ground Corn	78.4	76.8	49.0
Soybean meal (44%)	19.6	19.2	19.6
Soybean hulls	—	—	29.4
Na HCO ₃	—	1.2	—
MgO	—	0.8	—
Mineral & Vitamin Supplement	2.0	2.0	2.0
Total	100.0	100.0	100.0
Bunk Mix			
Alfalfa haylage	78.5	78.5	78.5
High moisture shelled corn	20.3	20.3	20.3
Mineral & Vitamin Supplement	1.2	1.2	1.2
Total	100.0	100.0	100.0

TABLE 2. Composition of ingredients.

	Dry matter	Crude protein ^a	Crude fiber ^a
Alfalfa haylage	61.9	18.2	31.7
High moisture shelled corn	80.2	10.2	5.1
Ground corn	89.0	10.0	2.2
Soybean hulls	86.7	10.4	43.8
Soybean meal	90.0	44.0	6.7

^a Dry basis

TABLE 3. Average daily milk production, daily feed intake, fat and solid-not-fat percentages, & body weight changes.

	Treatment		
	Control (no buffer)	1.2% Na HCO ₃ 0.8% MgO	30% Soybean hulls
Milk (kg/day)	25.9	25.6	27.1
4% FCM (kg/day)	22.4	22.7	23.1
Conc. intake (kg/day)	12.4a	10.0b	12.2a
Fat (%)	3.2	3.2	3.1
Solids-not-fat (%)	8.8	8.5	8.5
Body weight change (kg)			
wk 0 - wk 6	-8.5	-10.1	-8.5
wk 0 - wk 12	-9.0	-2.6	-3.4
wk 0 - wk 18	+15.0	+5.2	+6.3

a, b means are different at $P < .01$

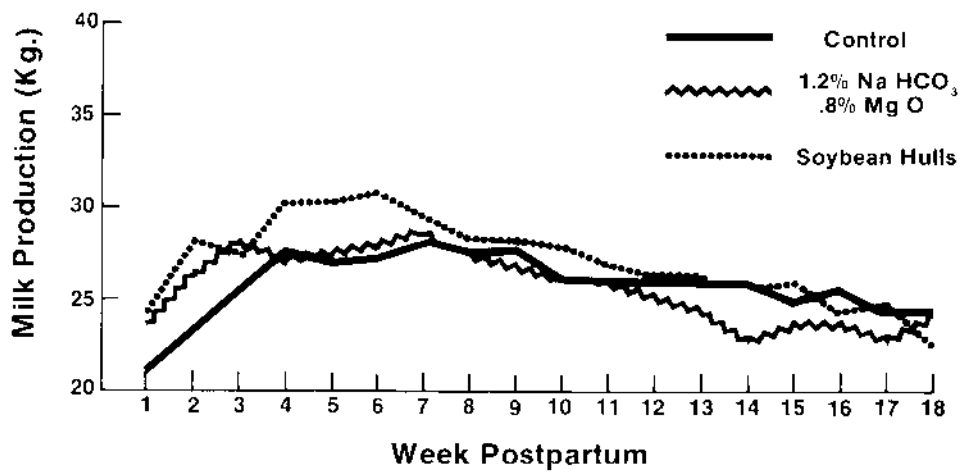


Figure 1. Average daily milk production by week.

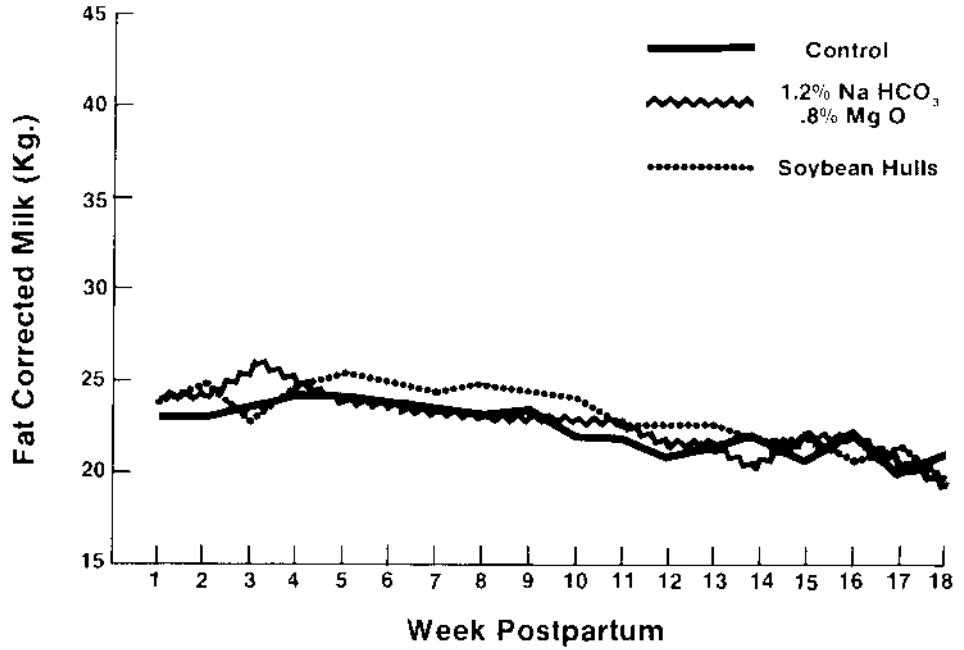


Figure 2. Average daily fat-corrected milk by week.

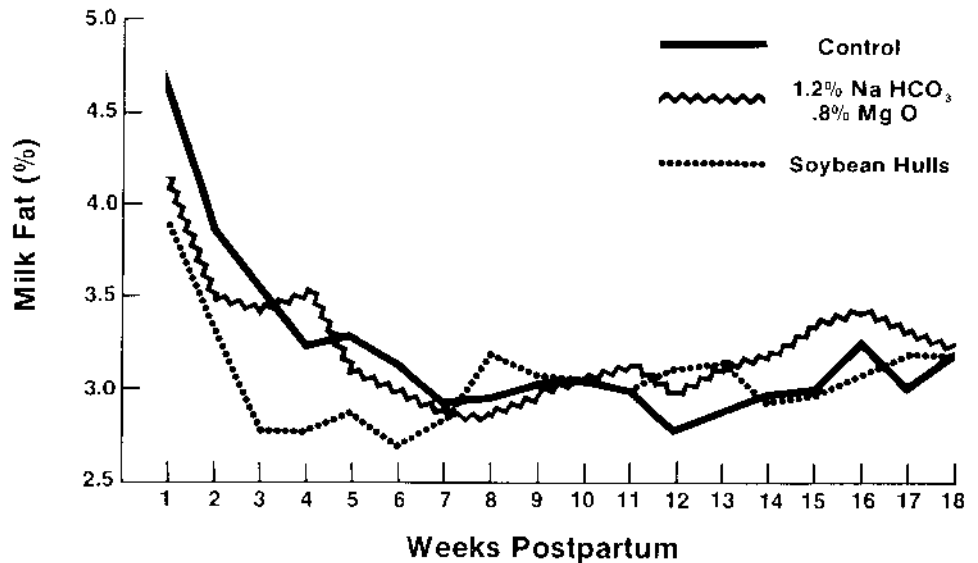


Figure 3. Average milk fat content (%) by week.

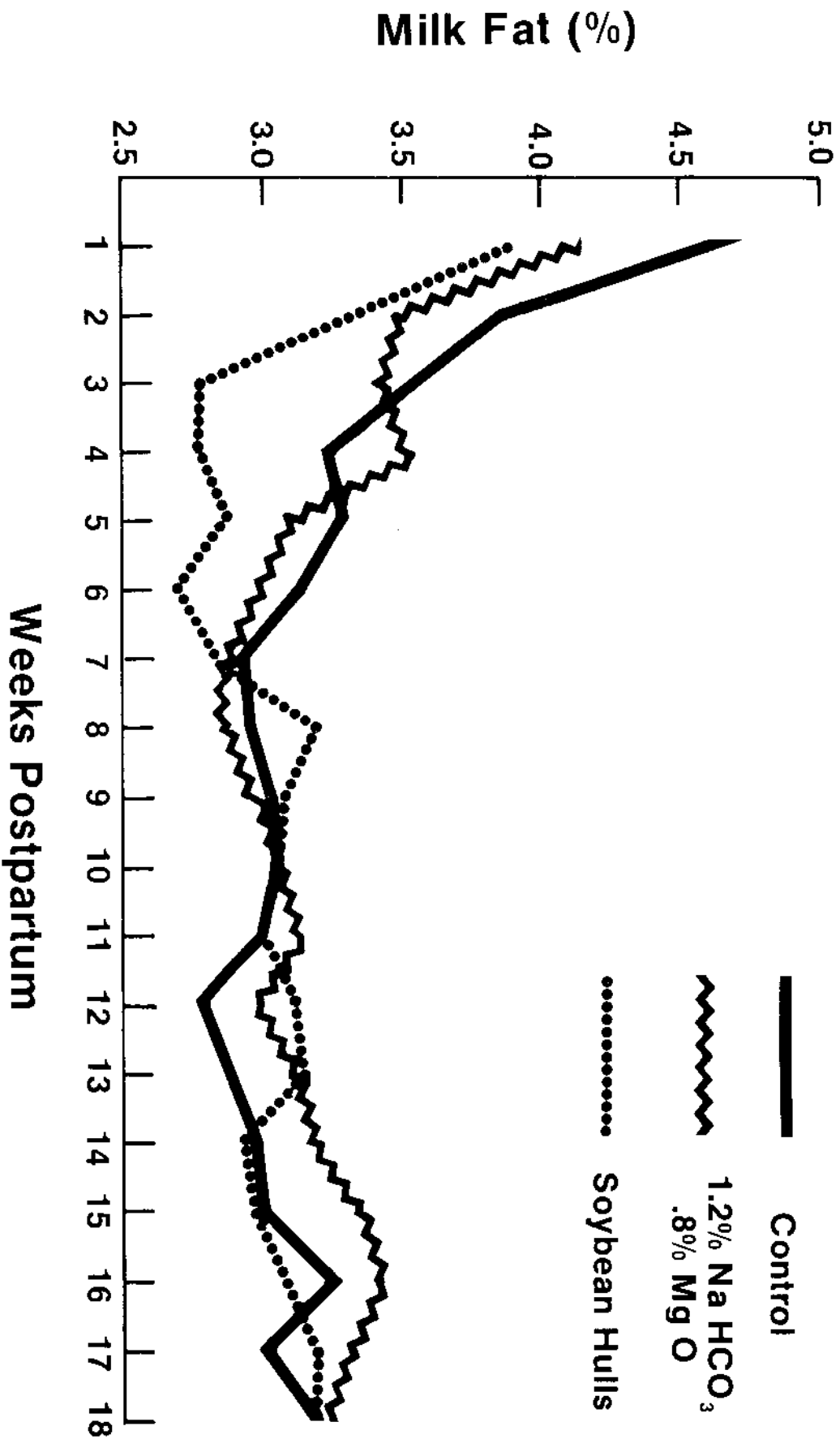


Figure 3. Average milk fat content (%) by week.

TABLE 4. Average fecal pH values and percent of fecal starch.

	Treatment		
	Control (no buffer)	1.2% Na HCO ₃ .8% MgO	30% Soybean hulls
pH	5.7 a	6.2 b	6.0 b
Starch (%)	6.8 c	6.0	5.7 d

a,b means are different at $P < .01$

c,d means are different at $P < .05$