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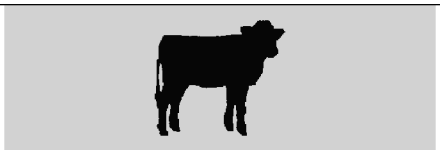

Effect of Fiber Level and Physical Form of Starter on Growth and Development of Dairy Calves Fed No Forage

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ABSTRACT

Purchased dairy calves were raised for 8 wk in unbedded, elevated stalls and given no forage to examine impact of offering no roughage on the growth and development of neonatal calves. High and low fiber starter diets were fed in pellet or coarse mash forms. Calves were fed milk replacer until weaned after 4 wk on trial. Calves were randomly assigned to 1 of 4 diet groups: low fiber pellet, low fiber coarse mash, high fiber pellet, and high fiber coarse mash. The pelleted feeds had an average particle size of 888 μm and the coarse mashes averaged 2,014 μm. Diets and water were fed ad libitum throughout the trial. Calves on coarse mash diets gained 0.64 kg/d from wk 4 to 8 and 0.41 kg/d from 0 to 8 wk, which was greater than 0.51 and 0.32 kg/d respective gains of calves on pelleted diets (P < 0.05). Calves on coarse mash diets consumed 60.9 kg starter during the 8-wk period, which was greater (P < 0.05) than 47.6 kg consumed by calves on pelleted starters. Rumination was initiated earlier and digestive upsets were reduced in calves receiving coarse mash diets. Total digestible nutrients and digestibility of DM, ether extract, CP, and nitrogen-free extract were higher (P < 0.05) in low than in high fiber diets with exception of crude fiber. Digestibility was greater (P < 0.05) in coarse mash than pelleted diets with the exception of CP, which was similar. Digestible and ME were also greater in low fiber than high fiber diets and greater in coarse mash than pelleted diets (P < 0.01). There were no symptoms of rumen parakeratosis, and rumen development was improved in calves receiving coarse mash feed.

Key words: calves, starter, physical form, fiber level, daily gain

INTRODUCTION

Early recommendations emphasized the importance of feeding calves a milk diet supplemented with concentrate and forage until weaned at 3 or 4 mo of age (Hibbs and Pounden, 1948). Subsequent practice was to feed a minimum amount of milk or milk replacer (**MR**) and to maximize concentrate and forage consumption so that the calf could be abruptly weaned at 3 or 4 wk postpartum (Slack, et al. 1971). This method reduced labor and feed costs and yet produced a thrifty calf.

Fiber affects feed intake (Kang and Leibholz, 1973) and plays a role in the development (Warner, et al. 1959; Stobo, et al. 1966; Huber, 1969) and health of the young ruminant (Gorrill and Nicholson, 1969). Pelleting improves palatability of lower quality feeds and increases intake (Moore, 1964); however, with high quality concentrates, pelleting may lower intake (Tait and Bryant, 1973). The increased rate of passage of finely-ground, pelleted feeds may decrease digestibility (Wilkins, et al. 1972).

A pelleted, complete concentrate feed also affects rumen fermentation by reduction of particle size, lowering rumination time involved in digesting feed (Balch, 1971; Welch and Smith, 1971), thus reducing saliva flow, which lowers rumen buffering capacity. The production of acetate decreases and propionate increases (Balch and Rowland, 1957), which can reduce feed intake (Bhattacharya and Warner, 1967), cause bloat (Hironaka, et al. 1973) or rumen parkeratosis (Bull, et al. 1965; Kromann and Meyer, 1972). A complete concentrate in coarse mash form (grain components crushed or crimped, but

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Table 1. Daily feeding schedule for milk replacer fed twice daily

Age, d	Milk replacer, g	Warm water, kg
1 to 5	136	1.36
6 to 8	181	1.58
9 to 11	227	1.81
12 to weaning	272	2.27

Table 2. Ingredient composition of starters fed to calves

Ingredient, %	Low fiber	High fiber
Corn and cob meal	—	20
Cracked corn	33.8	—
Crushed oats	35.0	25.0
Beet pulp	—	16.0
Brewer's grains	—	10.0
Soybean meal (50%)	20.7	18.0
Molasses	7.0	7.0
Salt	1.0	1.0
Limestone	1.0	—
Dicalcium phosphate	—	1.0
Pellet binder	1.5	1.5
Trace minerals	0.5	0.5
Vitamin A, IU/kg	8,808	8,808
Vitamin D, IU/kg	2,202	2,202
Antibiotic pre-mix, mg/kg	33	33

not finely ground) may be more favorable because of less particle size reduction.

The purpose of this experiment was to compare interrelationships of physical form and fiber level on growth and development of neonatal dairy calves on complete concentrate (i.e., calf starter diet) feeds when calves were raised in elevated stalls with no bedding and were given no forage.

MATERIALS AND METHODS

Experiment 1 was conducted with 2 replicates of about 16 calves each using a total of 32 Holstein female calves purchased at local auction sales. These were assumed to be about 3 d old and weighed between 36 to 45 kg. Upon arrival, calves were weighed, placed in elevated stalls, and given prophylactic treatment. Calves were started on MR the morning following arrival and were fed twice daily from an open pail, according to the schedule in Table 1. If a calf showed signs of diarrhea, MR solids were reduced and antibiotics were given. In cases of severe dehydration, calves were fed 1.4 kg of an electrolyte solution 2 or 3 times daily.

After 2 or 3 d, calf starter diets were randomly assigned to animals. Starter was fed ad libitum, starting at about 230 g daily per calf and increased with intake. Cool water was provided free choice, no forage was fed, and stalls were not bedded. Table 2 lists formulas for calf starter diets offered.

Two starters were designed to contain high and low levels of fibrous feedstuffs. One-half of each feed mix was ground and pelleted (averaged 880 μm), and the other one-half was kept in a course mash form (averaged 2,014 μm). There were 4 dietary groups within each replicate of 16 calves: low fiber pellet, low fiber coarse mash, high fiber pellet, and high fiber coarse mash. Analytical composition of 4 diets and MR are listed in Table 3. The objective was to formulate 4 diets that would meet the requirements of the calf and also be similar in physical form and nutrient composition, but the fiber fraction was greater in pelleted feeds than in respective coarse mash feeds, probably due to heat damage during pelleting (Goering, and Van Soest, 1970). Physical form was quantified using neutral detergent particle distribution as described by Smith and Waldo (1969). Pellet hardness was determined using a Stokes hardness tester (DT Stokes, Bristol, PA).

When calves consumed 0.7 kg starter/d for 4 to 5 d, they were abruptly weaned and given only starter and water free choice. This feeding schedule was maintained until the calf was removed from the experiment at the end of 8 wk on test. During this time, BW and feed weigh-backs were recorded once weekly, and a record was kept of fecal consistency and health of animal. Detailed charts were kept on each calf. Animals were observed twice each day and the incidences of loose feces were totaled each week and body temperatures were taken. Visual observations of initial rumination of calves on diets were also noted. Two students spent 2 h observing the calves in the middle of the day twice a week during wk 3, 4, 5, 6, and 7 of the second replicate. They recorded number of ruminations, duration of each rumination, and the number and duration of eating times.

In Exp. 2, 16 Holstein bull calves were divided into 2 replicates of 8 and were put on a digestion trial carried out from 7 to 8 wk, and were offered the same diet as in Exp. 1. There were a total of 4 calves on each diet. The same feeding and management procedures were used for the bulls as for the heifers in Exp 1. The bulls were raised in a modified elevated calf stall, which was also used during the digestion phase. A rubber collection bag with a plastic liner was harnessed to each calf to collect feces. A large pan was attached to the bottom of an elevated stall that funneled the urine through a hose into a plastic collection jug. Two sample sets of feces were collected daily and frozen; at the end of each period, one set