

Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 2 *Dairy Research (1984-2014)*

Article 292

2003

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Recommended Citation

Shirley, John E. (2003) "Transition cow nutrition and management," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 2. <https://doi.org/10.4148/2378-5977.3217>

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Transition cow nutrition and management

Abstract

Dairy cows are generally provided with a 60-day dry period. The first part of the dry period is called the "far-off dry period" beginning at dry off and continuing until 21 days before projected calving date. The second part of the dry period is called the "close-up dry period" beginning at 21 days before projected calving date and ending at parturition. Diets formulated for far-off dry cows are generally high in forage and are designed to support body maintenance and fetal growth. Rumen function and microbial populations adjust to these diets by the end of the far-off period and require a period of adaptation before switching to a high-energy lactation diet. Thus, a close-up diet should not be formulated as an entity unto itself, but as a bridge between a low and high-energy diet, retaining some characteristics of both the far-off and lactation diets. The ultimate success of a transition cow nutrition and management program is a lactation characterized by high milk and yields of its component and an absence of ruminal, metabolic, mammary gland, and reproductive disorders. Therefore, close-up diets should encourage ruminal adaptation to subsequent lactation diets, prevent metabolic disorders, and minimize tissue mobilization prior to parturition. Rumen bacteria, protozoa, and fungi are sensitive to new diet ingredients and the amount of substrate available (dry matter intake). Thus, adequate time should be allocated to exposure to the close-up diet before parturition. Our studies indicate that cows should be offered a close-up diet that contains 13.5 to 14.5% crude protein and 35% nonfiber carbohydrate for approximately 28 days before parturition.; Dairy Day, 2003, Kansas State University, Manhattan, KS, 2003;

Keywords

Diary Day, 2003; Kansas Agricultural Experiment Station contribution; no. 04-129-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 919; Dairy; Close-up diets; Transition cows

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TRANSITION COW NUTRITION AND MANAGEMENT

J.E. Shirley

Summary

Dairy cows are generally provided with a 60-day dry period. The first part of the dry period is called the “far-off dry period” beginning at dry off and continuing until 21 days before projected calving date. The second part of the dry period is called the “close-up dry period” beginning at 21 days before projected calving date and ending at parturition. Diets formulated for far-off dry cows are generally high in forage and are designed to support body maintenance and fetal growth. Rumen function and microbial populations adjust to these diets by the end of the far-off period and require a period of adaptation before switching to a high-energy lactation diet. Thus, a close-up diet should not be formulated as an entity unto itself, but as a bridge between a low and high-energy diet, retaining some characteristics of both the far-off and lactation diets. The ultimate success of a transition cow nutrition and management program is a lactation characterized by high milk and yields of its component and an absence of ruminal, metabolic, mammary gland, and reproductive disorders. Therefore, close-up diets should encourage ruminal adaptation to subsequent lactation diets, prevent metabolic disorders, and minimize tissue mobilization prior to parturition. Rumen bacteria, protozoa, and fungi are sensitive to new diet ingredients and the amount of substrate available (dry matter intake). Thus, adequate time should be allocated to exposure to the close-up diet before parturition. Our studies indicate that cows should be offered a close-up diet that contains 13.5 to 14.5% crude protein and 35% nonfiber carbohydrate for approximately 28 days before parturition.

(Key Words: Close-up Diets, Transition Cows)

Introduction

The primary purpose of a close-up diet is to initiate ruminal changes beneficial to the cow after parturition, when her nutritional demands dramatically increase. The far-off dry cow diet is generally high in neutral detergent fiber (NDF), moderate to low in nonfiber carbohydrate (NFC), and low in crude protein, whereas the lactation diet is relatively low in NDF, high in NFC, and high in crude protein. The close-up diet serves as a bridge between far-off and lactation diets. Thus, the primary changes in formulation should be in type of carbohydrate and, possibly, level of crude protein. The most appropriate changes are not clearly understood, but a recent study indicates that the NFC content of the close-up diet should be above 32% of dry matter.

Experiments (49 diets) from 10 universities were recently used to evaluate animal and feed factors that affect dry matter intake during the prefresh transition period and demonstrated that dietary NDF accounted for 15.3% of the variation in dry matter intake of Holstein cows. Dietary NDF was negatively related, whereas NFC was positively related to dry matter intake. We would expect dry matter digestibility to increase as NDF is replaced with NFC, but a point is reached when the rumen environment becomes compromised. Confounded with the issue of the most appropriate dietary NDF to NFC ratio is the digestibility of the NDF fraction. Recent research indicates that highly fermentable nonforage fiber sources offer a means of stimulating in-

take in the prefresh cow by increasing rate of passage through the rumen. We were able to improve dry matter intake by replacing a portion of the alfalfa hay, corn silage, and corn grain with either wet corn gluten feed or a soyhull-corn steep liquor blend in diets fed to cows during early lactation. The advantage of highly fermentable nonforage fiber sources is the increase in nutrient delivery to the cow without increased risk of acidosis.

The basic question left unanswered in the literature is how rumen microbes react to diet changes dictated by the two-tier dry cow feeding programs. This presentation will discuss ruminal adaptation to changes in diet and dry matter intake during the transition from far-off to close-up dry periods through early lactation and some factors to consider regarding carbohydrate fractions when formulating close-up diets.

Composition of Far-Off, Close-Up and Lactation Diets

Successful formulations in our program for far-off, close-up, and lactation diets are shown in Table 1 and their chemical compositions in Table 2. These diets were offered as a total mixed ration (TMR) and fed for ad libitum intake. The major component changes between the far-off and close-up diet were the introduction of alfalfa hay, decreases in prairie hay and corn grain, and increases in corn silage and soybean meal. These changes increased crude protein and NFC, met NE_L requirements, and decreased NDF as a percentage of total diet dry matter.

Table 3 provides a different perspective of these diets. Total carbohydrates decrease as cows change from a far-off to a lactation diet. A major shift in carbohydrate fractions occurs, NDF decreases, and NFC increases. Starch (percent of dry matter) is only slightly higher in the close-up compared to far-off diet, but significantly greater in the lactation diet. The amount of corn grain was reduced in the

close-up compared to the far-off diet because the amount of corn silage increased. Starch values were obtained by chemical analyses of TMR samples.

A comparison of TMR particle size using the Penn State Particle Separator is shown in Table 4. The particle size is slightly less in the close-up compared to the far-off diet; the major change in particle size occurs in the lactation diet.

General Comments About Close-Up Diets

Properly formulated close-up diets can reduce incidences of postpartum metabolic problems and prepare the rumen for lactation diets. However, it is not a magic formula that can cure problems created by overly fat cows and low quality or improperly formulated lactation diets. In our view, cows should enter the close-up pen at a body condition score of 2.75 to 3.0 and gain 0.25 points before calving. To accomplish this, cows should enter the close-up pen approximately 28 days before expected calving date to ensure that they are exposed to the close-up diet for a minimum of 14, but hopefully 21 days. We found that body condition score at the beginning of the close-up period (day 31 prepartum) was negatively related to prepartum and postpartum dry matter intake (first 90 days) and milk yield during the first 90 days of lactation but not significantly related to complete lactation milk yield. These findings support the concept that fatter cows eat less than thinner cows and indicate that energy gained from fat mobilization during early lactation does not offset the decrease in dry matter intake experienced by fatter cows in support of milk production. Others also have reported a negative relationship between body condition score and prepartum dry matter intake.

The 2001 Dairy NRC recommends that close-up diets contain 0.73 Mcal NE_L /lb of dry matter. The close-up diet presented in Table 2

contained 0.71 Mcal NE_L/lb of dry matter based on the summation of values from individual feedstuffs and 0.74 NE_L/lb dry matter based on NRC (2001). A significant portion of the NE_L in our close-up diet is due to the crude protein content (15.6% dry matter), so the recommended NE_L can be achieved without a substantial increase in rapidly fermentable carbohydrate.

Conclusions

The primary purpose of a close-up diet is to initiate ruminal changes beneficial to the cow after parturition, when her nutritional

demands dramatically increase. Rumen bacteria, protozoa, and fungi are sensitive to new diet ingredients and the amount of substrate available. Thus, adequate time should be allocated to close-up diet exposure before expected parturition. Altering the type and physical form of the carbohydrate fraction can vary diet energy value. Close-up diets containing 35% NFC and 14.5% crude protein should stimulate fermentation sufficiently to prepare the rumen for the lactation diet. Properly formulated close-up diets can reduce, but cannot completely solve, the problem of overly fat cows and low quality feedstuffs.

Table 1. Diet Ingredients (% of Dry Matter)

Item	Diets		
	Far-off	Close-up	Lactation
Alfalfa hay	—	15.0	30.0
Prairie hay	48.4	20.0	—
Corn silage	19.8	30.0	15.0
Corn grain	22.4	18.7	32.0
Whole cottonseed	—	—	9.3
Fishmeal	—	—	1.3
Expeller soybean meal	—	9.4	3.3
48% soybean meal	8.4	4.4	4.4
Wet corn gluten feed	—	—	—
Molasses	—	—	1.0
Limestone	0.06	0.60	1.36
Dicalcium phosphate	0.40	0.74	0.88
Sodium bicarbonate	—	—	0.75
Trace mineral salt ¹	0.34	0.50	0.32
Magnesium oxide	—	0.50	0.21
Vitamin A, D, E ²	0.11	0.12	0.13
Sodium selenite premix ³	0.02	0.04	0.01

Adapted from Park et al. (2001).

¹Composition: not less than 95.5% NaCl, 0.24% Mn, 0.24% Fe, 0.05% Mg, 0.032% Cu, 0.032% Zn, 0.007% I, and 0.004% Co.

²Contributed 4,912 IU of vitamin A, 2,358 IU of vitamin D, and 24 IU of vitamin E per kg diet DM.

³Contributed 0.06 mg Se per kg diet DM.

Table 2. Chemical Characteristics of Diets

Item	Diets		
	Far-off	Close-up	Lactation
DM, %	74.5	70.3	75.0
CP, %	11.5	15.6	18.4
Soluble protein, % of CP	25.2	25.2	31.3
RDP, % of DM ¹	7.3	10.3	11.7
RUP, % of DM ¹	4.2	5.3	6.7
ADF, %	25.2	22.0	18.2
NDF, %	42.9	34.4	27.0
Nonfiber carbohydrate, % ²	35.2	39.1	40.4
NE _L , Mcal/lb ³	0.70	0.74	0.73
Ether extract, %	3.8	3.5	5.6
Ash, %	6.7	7.4	8.4
TDN, %	67.0	69.1	72.3
Calcium, %	0.5	0.8	1.5
Phosphorus, %	0.4	0.5	0.7
Magnesium, %	0.2	0.4	0.3
Potassium, %	1.2	1.5	1.5
Sodium, %	0.1	0.2	0.3
Sulfur, %	0.1	0.2	0.2

Adapted from Park et al. (2001).

¹Based on feed analysis from Dairy Herd Improvement Forage Testing Laboratory, Ithaca, N.Y.

²Calculated based on DHI formula represented by $100 - [(crude\ protein + (NDF - NDICP) + ether\ extract + ash)]$.

³Calculated based on NRC (2001). Estimates of NE_L values from summation of individual ingredients (0.66, 0.71, and 0.77 for the far-off, close-up, and lactation diets, respectively).

Table 3. Carbohydrate Fractions in Dry and Lactating Cow Diets

Item	Diets		
	Far-off	Close-up	Lactation
Crude protein, % of DM	11.5	15.6	18.4
Ether extract, % of DM	3.8	3.5	5.6
Ash, % of DM	6.7	7.4	8.4
Carbohydrates, % of DM	78	73.5	67.6
NDF, % of CHD	55	47	40
DFC, % of CHD	45	53	60
Starch, % of DM	11.9	12.2	17.8

Table 4. Particle Size Characteristics of Diets

Total mixed ration particle size, % ¹	Diets		
	Far-off	Close-up	Lactation
> 19 mm	34.1 ± 12.6	32.2 ± 11.8	11.1 ± 4.6
8 to 19 mm	20.1 ± 01.3	19.1 ± 05.2	24.9 ± 3.3
<8 mm	45.8 ± 12.9	51.1 ± 08.0	63.9 ± 3.4

¹Particle size determined by the Penn State Particle Separator (Lammers et al., 1996), as-fed basis; mean ± SD.