# FEEDING MANAGEMENT STRATEGIES THAT INFLUENCE INTAKE

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## INTRODUCTION

Dry matter intake (DMI) is a primary factor contributing to the success of commercial dairy farms. Dado and Allen (1994) define feed intake as the relationship between number of meals per day, length of meals, and rate of eating during each meal (amount consumed per meal). These workers determined that DMI was positively correlated with milk production (Pearson correlation coefficient $r=.91$; $p<.001$). Given the importance of DMI for maximum milk production, significant efforts have been directed towards defining factors that regulate or influence DMI of lactating dairy cows.

Waldo (1986) described two classical mechanisms that regulate intake:

*metabolic control
*physical fill

Metabolic control is described by the condition where nutrient (energy) dense diets meet the animals' requirements. In contrast, physical fill controls the intake of diets of lower digestibility before requirements are met. While these classical mechanisms that control intake are important, other factors that influence DMI have also been identified. These factors include nutrient balance, environmental stress, palatability of the diet, water consumption, and feed access. Elaborate and extensive research efforts have focused on nutrient balance and quality of the diet. Factors influencing intake of forage based diets and the impact of environmental stress (heat stress) on intake have been discussed by earlier presenters. Chase (1993) pointed out, the first step in developing feeding programs for high producing herds is to design a feeding management system that allows the cows to achieve and maintain high DMI. The feeding system must also control selective intake of diet ingredients. Therefore, factors that influence intake and interact with feeding management strategies will be discussed.

## RUMEN FERMENTATION AND FUNCTION

Maintaining normal microbial fermentation and rumen function is essential for maximum intake. Rumen fermentation and function is sensitive to pH changes, especially large decreases associated with excessive starch intake. Rumen acidosis and decreased intake and performance are common problems in cows fed large meals of grain at one or two feedings per day. Istasee et al. (1986) reported cows fed diets containing either 40 percent or 60 percent forage dry matter differed in intake and milk production due to feeding method. In two studies (Table 1), cows fed concentrates mixed with forage had higher DMI and milk yield with less body weight loss compared to cows fed concentrate twice daily and forage fed separately. These changes in production were associated with decreased apparent digestibility of the diet organic matter (65.4%, mixed vs 62.1%, 2x concentrate; $p=.001$). In addition, the digestibility of the straw forage was also reduced from 51.5% to 43.6% ($p=.001$) with 2x concentrate feeding. Nocek et al. (1986) reported no differences in performance of lactating cows fed concentrate separate from forage when using a computer concentrate feeding system. The potential benefits of controlled concentrate feeding include: 1) prevention of rumen acidosis, 2) improved DMI, and 3) improved milk production. Therefore, feeding strategies to control large fluctuations in ruminal fermentation and pH should enhance DMI.

**Table 1. Effect of feeding system on performance of lactating dairy cows.**[1]

| Variable | | Method of feeding | | |
|---|---|---|---|---|
| | | Mixed | Conc. (2x/d) | p= |
| Experiment 1 | | | | |
| DM intake | (lb/d) | 39.2 | 33.4 | .001 |
| Milk yield | (lb/d) | 57.6 | 52.4 | .05 |
| Fat | (%) | 3.6 | 3.8 | NS |
| | (lb/d) | 2.1 | 2.0 | NS |
| Protein | (%) | 3.3 | 3.2 | .05 |
| | (lb/d) | 1.8 | 1.7 | .05 |
| BW change | (lb/d) | -0.4 | -0.9 | .05 |
| Experiment 2 | | | | |
| DM intake | (lb/d) | 34.1 | 32.1 | .05 |
| Milk yield | (lb/d) | 55.7 | 52.8 | .01 |
| Fat | (%) | 3.8 | 3.8 | NS |
| | (lb/d) | 2.1 | 2.0 | NS |
| Protein | (%) | 3.3 | 3.3 | NS |
| | (lb/d) | 1.8 | 1.7 | NS |
| BW change | (lb/d) | -0.5 | -0.9 | .05 |

[1]Adapted from Istasse et al. (1986).

In addition to grain feeding strategies, rumen function and pH has also been shown to be affected by forage intake and size of forage particles. Consumption of finely processed forages decreased chewing activity associated with eating and rumination. Beauchemin and Buchanan-Smith (1990) studied the influence of fiber source, particle size and feeding sequence on performance and digestive function of lactating cows. Cows fed hay prior to concentrate and silage or hay mixed with silage had higher intake and milk production compared to cows not receiving hay (Table 2). Increased milk production by cows fed hay was associated with changes in rumination activity (Table 3). Increased rumination activity modulated rumen pH changes and increased the extent of alfalfa silage DM disappearance measured in situ. The results of this research illustrate the importance of controlling forage selection and intake. Therefore, feeding systems should be designed to control intakes of **concentrates <u>and</u> forages** to maintain normal rumen function, optimize DMI, and maximize milk production.

## FEED ACCESS AND FEEDING SYSTEM

Availability of feed can often be a limiting factor in maximizing DMI. Some nutritionists use the term "slick-bunk syndrome" to describe feeding situations where cows are simply underfed and lick the bunk clean giving it a "slick" appearance. In most controlled investigations, feed access is measured as the time cows have physical access to adequate amounts of feed. Freer et al. (1962) observed an interaction of forage quality, feed access, and DMI (Table 4). These results indicate intake is influenced by forage quality and should be considered. This difference would be especially noticeable if cattle were grouped and fed different quality forages across groups.

More applicable to well managed farms, access to ad lib amounts of high quality feeds should be considered. Erdman et al. (1989) reported increasing feed access time from 8 h to 20 h per day increased feed intake from 51.7 lb/d to 54.3 lb/d in

**Table 2. Effects of diet and feeding sequence on production of lactating dairy cows[1]**

| Variable | Diet[2] | | | Significance[3] | |
|---|---|---|---|---|---|
| | C-S | H-C-S | C-S+H | Hay | M |
| DMI (lb/d) | 36.1 | 36.6 | 37.1 | .10 | NS |
| CP (lb/d) | 5.8 | 6.1 | 6.1 | .01 | NS |
| Milk (lb/d) | 38.1 | 41.6 | 40.3 | .01 | NS |
| 4% FCM (lb/d) | 35.0 | 38.1 | 35.6 | NS | NS |
| Fat (%) | 3.6 | 3.6 | 3.7 | NS | NS |
| Milk efficiency | | | | | |
| Kg/milk/Mcal $NE_l$ | .58 | .63 | .60 | .01 | NS |

[1]Adapted from Beauchemin and Buchanan-Smith (1990).
[2]C-S = concentrate fed followed by silage. H-C-S = hay fed prior to concentrate followed by silage. C-S+H = concentrate followed by blended silage + hay.
[3]Significance: H = hay; M = method.

**Table 3. Rumination and digestive function changes due to diet and feeding method[1]**

| Variable | Diet[2] | | | Significance[3] | |
|---|---|---|---|---|---|
| | C-S | H-C-S | C-S+H | Hay | M |
| Meal duration | | | | | |
| (min) | 15.4 | 18.2 | 18.0 | .04 | NS |
| Rumination | | | | | |
| Periods per day | 12.4 | 14.3 | 14.4 | .05 | NS |
| Chews per period | 1306 | 1316 | 1350 | NS | NS |
| Min/d | 274 | 318 | 328 | .05 | NS |
| Min/kg DM | 16.7 | 19.3 | 19.5 | .05 | NS |
| Boli per d | 297 | 364 | 380 | .05 | NS |
| pH | | | | | |
| <6.0 (min) | 280 | 213 | 214 | NS | NS |
| Extent of alfalfa silage | | | | | |
| disappearance (%) | | | | | |
| DM | 68.9 | 73.7 | 70.3 | .05 | .05 |
| NDF | 44.6 | 51.7 | 47.5 | .05 | NS |

[1]Adapted from Beauchemin and Buchanan-Smith (1990).
[2]C-S = concentrate fed followed by silage. H-C-S = hay fed prior to concentrate followed by silage. C-S+H = concentrate followed by blended silage + hay.
[3]Significance: H = hay; M = method.

mid-lactation cows. Increased access did not change milk production and intake, as a % of body weight, was not changed. Cows with increased feed access time did have higher weight gains (8h/d, +.8 lb/d; 20 h/d, +1.5 lb/d). In contrast, Martinsson and Burstedt (1990) measured intake and production responses of early lactation cows given different access to feed (8h to 24h). In this study, diet ingredients (hay, silage, and concentrates) were fed separately. Cows assigned 8h feed access time were fed 0600 to 0930 and 1230 to 1700h each day. Cows with restricted feed intakes in year 1 tended to have reduced feed intake (8h DMI = 30.4 lb/d vs 24h DMI = 32.6 lb/d). Intake differences due to feed access were greater during year 2 (8h DMI = 33.2 lb/d vs 2 H DMI = 35.4). The large difference in DMI resulted in a 2.4 lb increase in milk production. These workers suggested feed access is important especially for early lactation cows.

Feed access and intake can also be influenced by competition for feed and feeding space (Albright, 1993). Friend and Polan (1974) reported cows spent almost 5 h/d at the feedbunk. The social rank of animals within the group influenced time spent at the bunk after feed was placed in the bunk. Therefore, more dominant animals had more opportunity to consume feed first after feeding. Subsequent research reports showed .7 ft per cow would allow adequate access and not depress intake (Friend et al., 1976). Most current recommendations establish feeding space per cow at 1.5 to 2 ft per head. These recommendations agree with results of feeding behavior research trials. A more recent report indicated that cows selected feeding positions in fenceline feeders based on dominance relationships (Manson and Appleby, 1990). Cows with the greatest differences in social dominance had average separation of 4.4 feeding positions (feed position = 2 ft per position). Albright (1993) reported cows fed total mixed rations in fenceline feeders ate longer than cows fed in bunks with access around the entire bunk. Feeding system design and layout can potentially impact intake by influencing feed access time via manipulation of animal to animal interactions.

## FEED PALATABILITY

One critical aspect that must be considered on the feed side of feedbunk management is palatability of the diet. For example, two reports from the University of Maryland described the effects of silage pH on feed intake. Shaver et al. (1984) predicted optimum silage organic matter intake would be achieved with a forage pH equal to 5.6, with an optimal range between pH 5 to 6. Erdman (1988) reported partial neutralization of corn silage (from pH = 3.64 to pH = 5.44) increased forage DMI 2.2 lb/d. Total DMI was also increased (2.9 lb/d). Corn silage pH was manipulated by the addition of sodium bicarbonate. Milk yield was not different, but milk fat % and 4% FCM yield were increased by buffering corn silage. Palatability of forage may also explain differences in intake of alfalfa hay and straw reported by Freer et al. (1962).

**Table 4. Interaction of access to feed and forage quality on DMI and chewing activity[1].**

| | | | Time (min) | | |
|---|---|---|---|---|---|
| Feed | Access (h) | DMI (lb) | Eating | Ruminating | Resting |
| Hay | 24 | 29.6 | 405 | 565 | 470 |
| | 4.5 | 25.3 | 261 | 534 | 645 |
| | 2.0 | 17.9 | 122 | 434 | 884 |
| Straw | 24 | 13.8 | 343 | 474 | 623 |
| | 4.5 | 11.2 | 251 | 392 | 797 |
| | 2.0 | 8.5 | 121 | 358 | 961 |

[1]Adapted from Freer et al (1962).

Concentrate palatability can also influence intake. Dustiness and texture of concentrate mix can depress intake of grain mixes. Feed additives have been found to depress grain intake. The recent development of cation:anion balancing and use of anionic salts can influence concentrate consumption. Oetzel and Barmore (1993) ranked anionic salt mixtures based on intake and reported $MgSO_4$ was consumed better than other anionic salts. Animal by-product feeds (animal proteins and fats) have been reported to decrease intake. In most cases, feed intake returned to normal following an adaptation period. Inclusion of new feeds (new silo, hay cutting, etc.) and feed additives in the diet should be done gradually over an adaptation period. This strategy helps prevent potential off-feed problems and better maintains animal performance.

## WATER ACCESSIBILITY

Water consumption has also been found to influence DMI and milk production. Dado and Allen (1994) reported a highly significant correlation between water intake and milk yield (Pearson correlation coefficient r = .94). A significant relationship was also described between DMI and water intake (Pearson correlation coefficient r = .96). Drinking time required 10% of time spent eating (Table 5). While eating events required more time, cows had more drinking bouts (14.0, all lactations) than eating bouts (11.0, all lactations). These differences indicate the importance of animals access to water. Time spent drinking was not described relative to eating activities during the day. However, water supply should be convenient to feed to stimulate DMI. A general guide is to provide water within 50 ft of the feedbunk.

## FEEDING MANAGEMENT CONSIDERATIONS

Robinson (1989) described potential interactions between feeding strategies, feedstuff characteristics, and quality of animal management. Options and possibilities are unlimited for consideration of feeding systems and strategies within a given animal facility. Within a feeding system, many factors influence DMI. Diet formulation, mixing, and feeding to ensure normal rumen function is a high priority for achieving maximum intake and productivity. Control of diet ingredient intake is also a primary goal of the feeding management system. Feed access contributes to animal performance and success of the feeding program. Palatability of feed can stimulate or depress intake. Blending and use of feed ingredients with poor palatability should be done carefully to minimize off-feed problems. Maintaining fresh feed during periods of high eating activity (ie. after milking) stimulates larger meal sizes as a result of improved palatability. Water supply must also be fresh, clean and accessible to maintain intake and production. Feeding management strategies are dynamic to feeding system, diet, and farmstead layout (NRAES - 28, 1990). Manage all factors that influence DMI to achieve and maintain high intakes and animal performance.

**Table 5. Milk production and feeding behavior statistics of lactating Holstein cows.[1]**

| Item | Primiparous Mean | Multiparous Mean |
|---|---|---|
| Milk (lb/d) | 63.1 | 82.5 |
| DMI (lb/d) | 44.0 | 54.6 |
| Time eating (min/d) | 284 | 314 |
| Water intake (L) | 63.2 | 89.5 |
| Time drinking (min/d) | 17.7 | 19.1 |

[1]Adapted from Dado and Allen (1994).

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