UNIVERSITY OF FLORIDA

IFAS EXTENSION

Feeding and Managing Cows in Warm Weather[1]

Barney Harris, Jr.[2]

It is widely accepted that thermal (heat) stress has a major negative impact on the performance of lactating dairy cows. This decline in performance usually occurs as the mean daily environmental temperature approaches 24 degrees C (75 degrees F). In addition to ambient temperature, humidity and wind velocity also affect performance.

It is common knowledge that animals lose body heat by radiation, conduction, convection and evaporation. An understanding of these different principles often help dairymen to develop programs to alleviate heat stress in animals.

Heat loss by radiation depends on the temperature of the surfaces which radiate toward each other and not the temperature of the air between them. As an example, a cold barn becomes warmer when filled with animals or an animal may gain heat by standing in the sun. Heat loss by conduction happens when the animal is in direct contact with objects such as the earth or the food and water consumed by the animal. An animal standing in a cooling pond will lose heat to the water by conduction. Heat loss by convection is the transfer of warm air away from the body by wind or forced ventilation. Evaporative cooling is the loss of heat from the body by sweating and panting. In recent years, dairymen have applied these principles and used shades, sprinklers and fans to cool cows during the summer. In Florida studies, shade alone improved milk productivity by 10% in two consecutive years.

In an Arizona study, Armstrong and Weirsma reported an improvement in dry matter consumption and milk yield when shade was placed over the feed bunk. All cows had access to corral shades but only half the cows had access to feed covered with shade. The results are in Table 1.

As the environmental temperature increases, the temperature difference between the cow's body and the surroundings is reduced, reducing the amount of body heat that can be lost. As the environmental temperature continues to increase, the cow must rely more on evaporative cooling (sweating and panting) to lose body heat. Active cooling such as panting increases the cow's maintenance (energy) requirement. As a result, the maintenance needs for a 1400 lb cow producing 60 lbs of milk is about 20% higher when the temperature is 95 degrees F as compared to 68 degrees F (NRC). This being true, it is easy to understand the impact of heat stress on high-producing cows in early lactation when energy intake is critical to her performance.

Feeding high-producing dairy cattle becomes more and more complicated each year due to an ever

1. This document is DS48, one of a series of the Animal Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date September 1992. Reviewed June 2003. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.
2. Professor, Dairy Science Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.

increasing level of milk production. As the level of milk production increases, either the cow must eat more pounds of feed, or the feed must contain more nutrients per pound. The latter seems to have become more popular in recent years. The amount and density of nutrients in the ration continues to be increased by the addition of an ever increasing amount of grain to the ration. This seems to work for a while since, as more grain is fed, more nutrients are consumed per pound of ration and a greater amount of dry matter is consumed. Unless good strategies and practices are used as the level of energy is increased, feed intake may decline due to the occurrence of acidosis type conditions caused by a lack of roughage in the ration.

Current feeding practices at many dairies have reached a limit in respect to both the concentration of nutrients that can be packaged in the total ration and the amount of feed that can be consumed. We must now gain a better understanding of what can be done to fine-tune a seemingly well balanced ration and at the same time, improve the quality of available forages.

It is common knowledge that early lactating cows do not eat as much feed as they do during later lactation, even though the level of milk production may be the same. Feed intake lags behind milk production until about 2 to 3 weeks after peak production. This results in a negative energy balance and as such body tissues are mobilized to overcome the energy deficit which results in some body weight loss. Although it is normal for high producing cows to lose weight in early lactation, the energy and especially protein available from body stores can supply only a limited amount of her needs. As body fat is mobilized, proportionally more energy is available than protein. Therefore, the percent protein in the ration during early lactation should be higher in order to maximize the efficiency of energy utilization and to meet added protein needs.

Under most feeding situations, energy is the primary limiting nutrient in the high-producing cow. Research conducted at the University of Florida, looking at various energy densities in rations, resulted in different levels of feed intake but similar levels of energy intake. When highly digestible diets are fed, energy intake frequently plateaus and dry matter intake decreases. Such diets are usually associated with a depressed milk fat percent, looseness in bowel movement and acidosis. Dry matter intake appears to increase as dry matter digestibility increases from a lower energy diet to a higher energy diet. Above about 74 to 76% TDN, intake is more related to level of milk production and energy requirement of the cow. The exact point at which intake depression occurs is variable, but it is usually between 72 to 76% TDN or .76 to .78 Mcal/lb of ration dry matter.

ENERGY AND/OR DRYMATTER INTAKE

Energy intake can be equated with dry matter intake since dry matter intake is the key factor in maximizing production performance. Two practical approaches have been used with success: 1) increased dry matter intake by more frequent feeding, improved forage quality, more palatable feedstuffs and greater nutrient balance; or 2) increased energy density or concentration per unit of dry matter consumed.

Dry matter intake is important in formulating dairy cattle rations because of its close relationship to milk production. The dry matter intake consumed by a cow depends on many variables that may be included under three general categories: environmental; cow differences; and type and quality of the feedstuffs that make up the ration. These variables are shown in Table 2.

High fiber levels in the ration can lower energy intake by having a negative impact on digestibility and DMI. This is especially true for roughages that have a high neutral detergent fiber (NDF) value such as bermudagrass. NDF is the more complete measure of total fiber since it measures all the cellulose, lignin and hemicellulose. Crude fiber measures only cellulose and some lignin, whereas acid detergent fiber (ADF) includes cellulose and all the lignin. For this reason, ADF appears more closely associated with digestibility and NDF with rumen fill or dry matter intake.

Research has demonstrated a practical application for using NDF as a guideline in formulating rations for dairy cows. The scheme (Table 3) is based primarily on the use of silage and hay as sources of roughage.

The use of neutral detergent fiber values may be useful in purchasing hay and balancing rations for high producing cows. The use of NDF values should be used only as a guide since particle size, length of cut, effectiveness of fiber, and palatability are not measured by NDF but are also important considerations in formulating rations for dairy cows. Cottonseed hull (CSH) rations may need to be adjusted upward when using NDF values since they have a greater rate of passage than hay containing rations. Florida research with CSH rations suggest 35% NDF to be optimal when fed to high producing cows.

The new 1988 NRC recommendations suggest a minimum of 21% ADF and 28% NDF for cows during the first three weeks of lactation. Michigan State studies showed an advantage to using a higher level of ADF (23% ADF) for early lactating cows. As cows increase in milk production and stage of lactation, the fiber content of the ration may be reduced somewhat provided feed intake remains good and droppings are fairly firm. As the lactating cow approaches mid to late lactation, fiber content should be increased.

PROTEIN INTAKE

Intake of digestible protein declines in proportion to the reduction in total dry matter intake associated with hot weather. Increased protein content in the diet is necessary to supply the quantity of protein necessary for high milk production. However, rations high in protein may result in excessive rumen ammonia levels that require extra energy to metabolize and excrete the ammonia in the form of urea as waste. Metabolizable energy intake was decreased by 12 kcal per gram of digested nitrogen consumed above requirement in one study. In addition, diets high in rumen degradable protein have been implicated in infertility problems in dairy herds. In Arizona work (Table 4) where cows were fed high protein diets (19% crude protein) with high and medium degradabilities, the high degradable protein diet reduced milk yield (59.3 lb) when compared with the medium degradability protein diet (63.7 lb). It appears there is an antagonism between heat stress and rations that contain high protein degradability values. In the lower protein diets (Table 4), there was no difference in milk yield or dry matter intake.

High-producing cows respond to the addition of bypass protein but not medium- or low-producing cows. Protein levels should be higher in early lactation while cows are in a negative energy balance. This is probably about 16 to 17% of ration DM for silage base rations and 14 to 15% for CSH rations. Less protein is needed as the cow declines in lactation.

In some cases, a combination of bypass protein and non-protein nitrogen (NPN) may be equally as productive and more economical. This is especially true when good bypass protein sources such as brewers grains and distillers grains are economically priced.

As milk production increases, it becomes more and more important that some dietary protein escape degradation in the rumen. Research tends to suggest a little higher level of protein in very early lactation, with the total diet to contain about 35 to 40% undegradable intake (bypass) protein.

MINERALS

Recent studies at Florida have shown an advantage from adding more sodium, potassium and magnesium during heat stress periods. Cows receiving higher levels of potassium and sodium produced two more pounds of milk and appeared more comfortable or less stressed on hot days. The levels of potassium and sodium should be calculated on a dry matter basis so that the final ration dry matter contains about 1.5% potassium and 0.5 to 0.6% sodium. Recent work also shows an advantage to increasing the magnesium from the NRC recommendation of 0.2% of DM to a level near 0.3% of the dry matter (Table 5).

Complete minerals designed to contain the higher levels of potassium and sodium should be fed only to lactating cows since udder edema is more prevalent in dry cows receiving extra salt or potassium. Under summer feeding conditions, the total ration dry matter should contain about 1.5%

potassium, 0.6% sodium and 0.3% magnesium on a dry matter basis.

FUNGAL PRODUCTS AND HEAT STRESS

Heat stress of cows in Arizona studies fed a fungal product (Amaferm) resulted in lower rectal temperatures and respiration rates than control animals, even though the magnitude of effects was variable. Also, research with another fungal product (YeaSacc) has given similar results. While the authors have been unable to define the mechanism responsible for the decreased body temperature, a possible influence on the body temperature control center was suggested.

WATER INTAKE

The water consumption of dairy animals is influenced by many factors including body size, ambient environment, water temperature, humidity, feed supply, salt and level of milk production. Generally, cattle consume 2 to 4 lbs of water for each pound of dry matter consumed and an additional 3 to 5 lbs of water per pound of milk produced. Usually, in hot weather dry matter intake and milk yield decline but water intake increases due to the effect of increased temperatures. Texas researchers have shown some improvement in production performance when the drinking water was cooled during the summer.

SUMMARY

In summary, economic losses from heat stress conditions during the summer months are great. Both nutritional and management strategies are needed in order to minimize and cope with the problem. The following strategies may be useful in reducing stress.

Early Lactation Strategies

Since peak production and persistency are key factors in determining level of milk production and profitability, an early lactation feeding program should be developed that will maximize performance. Since the early stages of lactation are stressful on the dairy cow, it becomes important that the cow be in good flesh at calving and somewhat already adapted to the feeding program. In general, early lactating cows should be fed well-balanced rations according to appetite for a period of 3 to 4 months.

The first calf heifer undergoes considerable social change at the time of calving since her routine and feeding patterns are changed, and she is placed with more mature and aggressive cows. The stress of such a change is partially reduced by allowing her to move into the heavy-springer dry cow group and allowing her to move through the milking barn prior to calving. This makes her familiar with the new surroundings and facilities. Also, there is an advantage in having first lactation cows with older fresh cows during the first 3 to 4 weeks of lactation for closer observations and ease in training, and developing good milking habits. Afterwards, the first lactation cows should be placed in a separate group for maximizing intake and production. English workers reported an increase in milk production of 1573 lbs milk per cow when first calf heifers were grouped and fed together, compared to those that were blended with the older cows. Since the greatest advantage is more likely to occur during the first 120 days of lactation, first calf heifers could be blended with the remaining herd after 120 days or as soon as desirable. If left together as a single group for a total lactation, over-conditioning will become a problem.

Frequency of Feeding

High-producing cows require large quantities of feed in order to peak high and reach their genetic potential for producing milk. This may be accomplished by feeding a properly balanced ration about 2 to 4 times per day. In general, feeding at more frequent intervals has served to stimulate feed intake; maintain a more uniform pH in the rumen, a more stable fat percent, and less problems associated with metabolic disturbances; and reduce wastage of feed. Cows having access to feed for 12 to 15 hours per day would have considerably more chances at the feed bunk than four feedings per day. Even so, the feed should be delivered to the feed bunks or mangers at least twice per day in order to maintain freshness (feed bunk management). Three to four times per day is suggested in hot weather. Allow the cows to have access to the feed during the cooler part of the day.

Facilities

The facilities and traffic patterns should be designed to minimize stress. Avoid driving cows long distances and avoid holding cows in an unshaded or crowded area for long periods. Cows standing on concrete or in paved areas for long periods tend to have more problems with sore feet. Using dirt lots or free stall housing to get the cows off the concrete is helpful.

External Parasites

Control flies and other pests as much as possible. External parasites such as lice, horn flies, house flies, stable flies, horse flies, mosquitoes and deer flies present serous problems to the dairy industry. These pests are most prevalent during spring and summer months and should be controlled through use of specific pesticides and preventative programs. Clip weeds and grass around the barn to eliminate breeding areas. Consult your local county Extension agent for more detailed information on specific recommendations.

Fat Cow Syndrome

Dairymen, on rare occasions, allow cows to become too fat during the dry period. Over-conditioning cows is just as bad, or worse, than underfeeding them. Fat cows are poor eaters and usually have more problems at calving. Problems frequently encountered with fat cows include ketosis, milk fever, and lowered production. Cows should be in reasonably good condition but not excessively fat at calving.

Rations Changes

The more common stress conditions seen at dairies are caused by rapid changes in feed composition or feed ingredients. Avoid drastic or sudden changes in feeds and feeding practices as these tend to reduce milk production. Changes to and from feeds such as silage, pasture, citrus pulp, brewery by-products and molasses should be gradual.

Diseases

Diseases such as mastitis, ketosis, milk fever, etc., cause considerable losses in the dairy industry annually. A well defined, good herd health program is needed to combat the many potential problems arising daily in a dairy operation. A good monitoring system and records are important to good herd health management. Many diseases can be largely controlled through a good health program. Certain vaccines are used by many dairymen to immunize their cattle against certain bacterial or virus infections. The aid of a good veterinarian and diagnostic laboratory can help control and prevent diseases at your dairy.

The Normal Routine Stress

The dairy cow rapidly develops a normal routine and any drastic change in her habits causes stress. Examples of such stress would be irregular milking hours, milking at different times due to mechanical failure or perhaps running out of feed in the parlor. Once a routine has been established, it should be observed and followed as close as possible.

Management Strategy

Perhaps the most important feeding strategy a dairyman could develop would be a good record system of the total feeding activities for the day, week and month. Information is needed on average and total daily feed intake by group, changes in feeding habits if noticeable, bulk tank weights and the general conditions of the various groups. Walking and observing the cows as well as feeding more frequently will generally stimulate greater feed intake.

Table 1. Milk yield and feed consumption with and without shade over the feed bunk.

Treatment	No. cows	Milk yield (lbs)	Fat %	3.5% FCM	DMI (lbs)
Shade	26	68.4	3.51	68.6	48.2
No shade	27	63.6*	3.47	63.1	45.3
* (P < .05).					

Table 2. Variables that impact dry matter intake.

Environmental	Cow	Ration
Temperature	Milk production	Physical texture
Ventilation	Body size	Palatability
Humidity	Hormonal status	Fiber content
Feedings/day	Breed	Nutrient balance
Water	Body condition score	Moisture content
Sprinklers, fans	State of health	Forage quality
	Social structure	

Table 3. Suggested optimal NDF levels as a percent of total ration dry matter at various production levels.

3.5% Milk Fat	Optimal NDF %
70 lbs or more	28 - 32
50 - 70 lbs	32 - 36
35 - 50 lbs	36 - 38
less than 35 lbs	38 or more

Table 4. Influence of protein level and degradability on performance of lactating cows during the summer.

Protein Level Degradability	19 High	19 Mod.	16 High	16 Mod.
Hot environment (60 cows)				
Milk (lb/day)	59.3*	63.7*	62.8*	62.6*
3.5% FCM (lb/day)	51.9*	58.7**	57.8**	59.5**
DM Intake (lb/day)	47.4***	48.3***	51.4****	50.9****
*,** Means not showing a common superscript are different (P < .05).				
,* (P < .10).				

Table 5. The effect of adding magnesium, potassium and sodium to the ration on milk yield and composition during the summer.

	Magnesium				Sodium	
	.21	.32	1.3	1.8	.18	.55
DMI, lbs/d	52.4	55.4	39.2	40.9	39.8	40.0
Milk Yield, lbs/d	54.1	57.2	42.0	43.8	41.8	43.8
Milk Fat, %	3.46	3.48	3.50	3.48	3.46	3.53
Milk Protein, %	3.36	3.35	3.60	3.50	3.57	3.53
4% FCM, lbs/d	49.5	52.8	38.5	40.3	38.1	40.5