Dairy Nutrition

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INTRODUCTION

In 1940, a dairy cow produced twelve pounds of milk per day or about 3,600 pounds per year. Today's dairy cows can produce more than 100 pounds per day in early lactation, and average 22,800 pounds of milk per lactation. It took 28 million cows to produce 117 billion pounds of milk in 1940. Today 9.2 million cows produce 206 billion pounds of milk per year. Producing more milk from the same quantity of resources (or the same amount of milk with fewer resources) reduces the demand for non-renewable or energy-intensive inputs (e.g. land, water, fossil fuels and fertilizers) and promotes environmental stewardship. Today it takes 23% of the feed, 35% of the water, 10% of the land, generating only 24% of the manure to produce a unit (glass, gallon, etc.) of milk.

How can this improvement in efficiency be explained? Certainly, the genetic base of today's dairy cow is much different than 80 years ago. The highest producing cows have produced more offspring over time than their lower producing sisters. We know a great deal more about cattle health and nutrition today. There are new feed analyses and computer formulation to fine-tune dairy rations. And record-keeping systems implemented in the late 1930's have helped identify the more efficient cows from the least efficient. Artificial insemination using the best genetics from the bull's side and many other factors have contributed to this move to more sustainability. Thus, the dairy industry has achieved an increase in the milk production potential of the dairy cow while implementing technologies and management practices that allow the cow to achieve that potential.

Increasing this production efficiency comes with a price to the cow if not done carefully on both large and small farms. There are more frequent disorders like displaced abomasum (twisted stomach), acetonemia (ketosis), fatty liver, and "sophomore slump" or "burn-out" where a cow

produces poorly in a subsequent lactation because she failed to recover body condition in the previous lactation. Are dairy farmers "pushing" their cows too hard in the interest of a better bottom line? Can this production be sustained and cow well-being enhanced through proper nutrition and management?

NUTRITION ESSSENTIALS

This chapter will discuss the dairy cow nutritional changes which have come about over time as part of this improvement in feed efficiency and the challenges faced, now and in the future, in supporting cow well-being with this higher production.

The science of modern dairy cow nutrition is important in understanding how the cow is considered in producing milk efficiently. The National Academies of Sciences, Engineering, and Medicine says their mission "spurs progress by connecting understandings of science, engineering, and medicine to advising national policies and practice." A group within the Academies is the National Research Council which considers this progress in facets of agriculture, including dairy cattle nutrition. About every ten years a committee of dairy cattle nutrition experts reviews scientific research literature on dairy cattle nutrition and health to develop a publication of standard cattle nutritional requirements. This publication's recommendations are backed by literally thousands of research trials from universities and private industry. Cattle nutritionists rely on these standards to develop rations (diets) for today's high-producing dairy cows.

Cattle are housed or grazed in groups. The dairy manager must feed a ration that meets the needs of each cow in the group. This is more difficult than it sounds. Say a group of cows is averaging 75 pounds of milk per day. Half of the cows in that group are producing more than 75 pounds and half are producing less. Feeding for the average production will short the high producers and may over-feed the lower producers. Managers take advantage of the higher producing cows eating more of the feed because intake is partly a function of milk production. On larger dairies, the variation from high to low within the group will be less. It might only be 73–77 pounds, whereas smaller groups might be 60–80 pounds for the same average production.

Good dairy cow nutrition is more than just meeting the requirements for protein and other nutrients. It includes understanding the nature of the cow and using this "biology" to the cow's advantage.

Feeding behavior – When cows are confined and fed in a barn, they spend four to six hours daily feeding. This time is divided into nine to fourteen feeding sessions, or meals. One or more of these meals is associated with laying out fresh feed in the bunk. To take advantage of this behavior to enhance the amount of feed consumed (dry matter intake), there should always be feed available when cows in a group return from milking. Having the cows stand to eat for a time after milking is beneficial in reducing intermammary bacterial infections, too. Laying out fresh feed and pushing feed closer to cows more often during the day will increase consumption. Time of day, other than the middle of the night, has little influence on confined cow feeding patterns.

When cows are managed on pasture, there is a strong temporal pattern to feeding behavior influenced by sunrise and sunset, as well as the movement to and from the milking parlor. Grazing meals are often right after sunrise, right before sunset, and when cows return to the pasture from the milking parlor. Moving cows to a fresh pasture is usually done after a milking or near sunrise/sunset.

Feeding frequency – Providing fresh feed more often stimulates intake in cattle. It also stabilizes the pH of the rumen because highly-fermentable feedstuffs are fed in smaller quantities more often. This prevents rapid declines in rumen pH caused by "slugging" large amounts of these feeds and the subsequent rapid fermentation by microorganisms. Nutrient flow and availability are more desirable with more frequent feeding as well.

Overcrowding and social effects – Having feed available which appeals to a cow's appetite stimulates feed intake, but if the cow can't have it when she wants it, production and animal health

suffer. Adequate feed bunk space is important because many cows will eat at the same time. Ideally, there should be a place for each cow in the group. However, studies have shown that having 1.2 cows per feeding space (stocking rate-feed) will not limit intake and subsequent production. This is highly variable depending on the facilities, social order within the group of cows, and feeding practices so managers often evaluate the cows' body condition in a group over time to determine their appropriate stocking rate as it relates to feed intake.

New comers to the herd, those cows who have just calved the first time (primiparous), generally have the lowest social ranking in the group. They will be the last to eat when housed or grazed with cows having calved more times (multiparous). Often managers will group primiparous cows together, rather than mix them in with older cows. However, loose-housed cattle milked by robot seem to do well when housed as a mixed group per a recent study.

Lying time and rumination – Cows need time to ruminate ("chew their cud"), about 6 hours per day. They prefer to do this lying down so lying time and effective rumination go together. Overcrowding cows in a group will reduce 24-hour rumination time. Lying down is a primary need in dairy cattle. If deprived of lying time (2–4 hours), they will choose lying down over eating. More lying time equates to less feet and leg problems and more blood flow to the mammary gland. Like feed bunk space, there should be a bed or lying space for 1.2 cows. Adequate space for lying will improve milk production, reduce health costs, and improve cow welfare.

So how can one know if a nutrition program is working and benefiting the cow's health? Routine monitoring of signals the cow gives is step one. On large dairies, there are nutrition teams (nutritionist, feeder, herd managers) which do the monitoring daily. Milk production changes quickly in response to adequate or inadequate supplies of nutrients. For example, a shortage of energy or calories will change production in 12–24 hours while a shortage of protein may take a week. The components (fat, protein, lactose) will also change with inadequate nutrition, sometimes causing unusual concentrations of several components at once. There is always more fat in milk than protein, but when the diet is improperly formulated there may be an "inversion" where there will be a higher concentration of protein than fat! While a cow will reduce production when she is short of nutrients, she can use nutrients from body tissues to support her production. Much like humans on a strict diet, she will lose weight over time and this weight loss will show in her "body condition." Dairy farmers and nutrition specialists use a five-point system to evaluate a cow's body condition; one being very skinny and five being obese. The body condition will change throughout a cow's lactation as shown in Figure 1. She will be heaviest at the start and end of her lactation and weight the least at about 13–15 weeks into her lactation. If she loses weight too fast, she is susceptible to the disorders mentioned earlier and the manager needs to make the ration or diet denser and increase her dry matter intake. This evaluation is done often because there are cows in the herd at all different stages of lactation.

Rumination is another indicator of adequate nutrition. A healthy, well-fed cow will contently chew her cud about six hours a day. When they are lying down it appears they are always chewing. If the rumen pH is out of balance or there isn't enough fiber in the diet, she may quit chewing her cud completely. Likewise, it can lead to sore feet and lameness. Managers and employees check the "locomotion" of cows as they move them around the dairy. When lameness increases, changes must be made to even out the pH spikes and valleys in the rumen as much as possible using antacids and the cow's alkaline saliva.

Ironically, looking at what comes out of the cow indicates what's going on inside of her. Normal feces from a cow on a good diet is the consistency of pudding containing about 12% solids. Too watery, too stiff, slimy, lots of undigested feeds all indicate adjustment to the ration are needed.

Figure 1 also shows a challenge in getting cows bred back after calving and, occasionally, the reason for poor cow health early in a lactation. Notice the two lines with dots in them. One shows milk production per day. It gradually increases after calving until 6–8 weeks into lactation and then declines about 6% per month until the cow is no longer milked (dry). The other line with solid dots

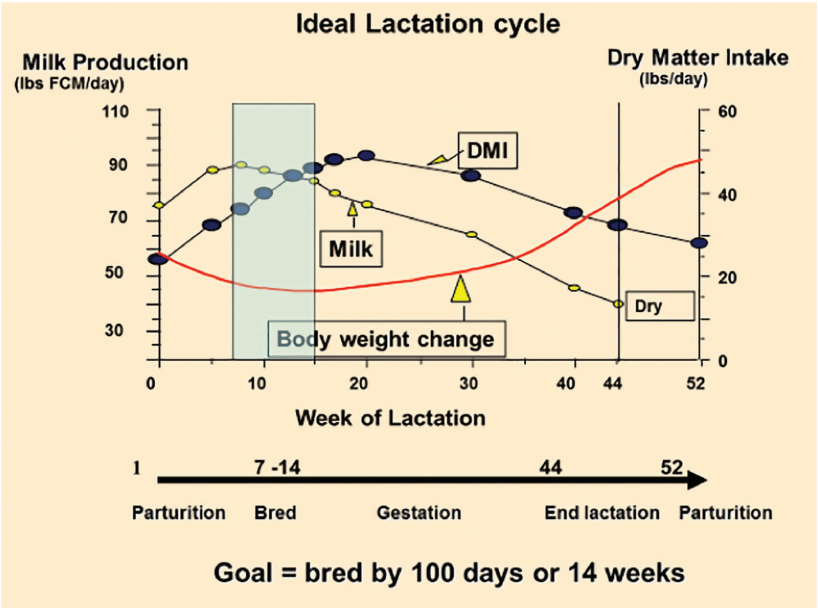

Figure 1 The ideal lactation cycle.

shows the typical dry matter intake for a cow. It also increases after calving, but more slowly than milk production and it tops out about 12 weeks later than milk production peaks. This means the cow goes through a period of "energy deficit" and loses weight. The shaded box shows the period within the lactation when a cow needs to be bred to calve within a 12-month cycle. It is difficult to get a cow pregnant while she's losing weight. Dairymen will delay breeding and settle for a 13 to 14 month period between calves (calving interval). They also work hard to shift that DMI peak to earlier in the lactation.

Abundant, high quality drinking water is the most important essential nutrient for dairy cows. Water makes up 88% of milk and 70% of the cow's body. If water nutrition (quality and/or quantity) is an issue, cows have a big problem! Water treatment methods are available to remove salts and minerals. When surface water is used, microorganisms can affect cows just like people. If water quality is not an issue, the most common water nutrition problem on dairies is not providing enough watering stations, enough space at watering stations, and thus, enough uninhibited drinking opportunities for each cow during her normal daily routine where she lives and is milked. In recent years, lack of adequate water supply is often related to over-stocking in group housing areas, whether free stalls barns or loose housing.

TYPICAL DIET

What makes up a typical dairy cow diet and how is it fed? An example dairy cow ration follows. It is a combination of forages, grain, by-products, and supplements. Forages, such as dried hay, fermented plant materials (silage), fresh grass, are the starting point. They make up 50–60% of the cow's diet. Forages provide the fiber which a cow ferments in her rumen to create energy for growth and milk production. The combination of microbes in the rumen and cud-chewing allow her to convert something indigestible into highly digestible milk and meat.

The better the quality of the forages, the easier it is to provide all the nutrients needed for efficient milk production and good cow health. There has been genetic progress in the selection of

Typical Milk Cow Daily Ration

Feed	As Fed (lb)	Dry Basis (lb)
Alfalfa hay	12	10
Corn silage	50	17
Cereal grain	15	13
Protein supp.	5	4
By-products	23	11
Totals	95	54

forages just as in selecting cattle. Varieties with higher sugar content is one example. Others have been selected for faster growth higher, yield, and resistance to pests like plant diseases. Generally, a cow is fed a variety of forages based on the nutrient content. Chopped corn silage is fed for its energy content, while alfalfa hay is fed to increase protein in the ration.

Harvesting forages at the proper stage of development improves digestibility and conserves some nutrients. As grass grows, its first stage is leaves only (vegetative stage). These plants are high in protein and vitamins but low in fiber. As the growth continues, the plant begins to lay down fiber in a stem to support a seed head for reproduction. This fiber gets stronger as the season goes on by laying down indigestible lignin. A mature grass plant is high in lignin, lower in vitamins, and must less digestible than the vegetative plant. The corn plant is a type of grass. To get higher energy from the corn grain, the corn plant must be more mature than the vegetative grass desired for its protein and vitamins. However, letting the corn plant mature too much lowers its digestibility as chopped silage so it must be harvested "just right" usually just as moisture begins to leave the kernels.

After harvest it is important to store forages properly to prevent spoilage and loss of nutrients. Field-dried hay and mature grains just need to be kept clean and dry. They will lose some vitamin content over time unless stored air-tight and in the dark, not practical on the farm. Higher moisture feeds like silage depend on a good fermentation to create acids which prevent spoilage and then storage in the absence of air to prevent mold. Fresh cut plant material is packed into a vessel or a stack on the ground and covered to prevent air contact and to shed rain. Natural, and sometime supplemental, microbes will ferment and acidify the material in about two to three weeks. As this material is being fed the surface becomes exposed to air. It is essential to take a few inches of feed off the entire exposed "face" to reduce spoilage and waste.

Dairy cattle need minerals and vitamins like all living creatures. The requirement for individual minerals varies with the stage of growth and level of production. Minerals are powerful in helping keeping the animal productive and healthy. With some minerals, the difference between deficiency and toxicity is quite small. Minerals interact with each other. For example, too much iron in the diet reduces the effectiveness of phosphorus. Also the biological availability (bioavailability) is different for each mineral compound. Sulfate salts of minerals generally have good bioavailability, but some minerals are chelated with proteins to improve absorption while other are protected from action in the rumen to retain intake into the small intestine where more of the absorption occurs. Clearly, it takes a professional to formulate the mineral supplement used in cattle nutrition.

PREPARATION/PRESENTATION

Many dairies today practice feeding all the ration components in one total mixed ration (TMR). Specialized feeding equipment is used. A pull-type or truck-mounted wagon has motorized mixer paddles inside which stir all the feed components together. Such wagons usually have pressure-sensitive scales onboard so the wagon can be filled with the appropriate amount of each feed.

In some cases, the paddles can cut or tear whole bales of dried hay reducing the need to prepare the hay prior to loading.

The purpose of a total mixed ration is to try to make each bite of feed the cow consumes the same. All nutrients are provided and consumed together. This evens out nutrient flow to the intestine and stabilizes rumen fermentation for fewer highs and lows in pH. Dry matter intake is higher with a TMR than with individual feeds provided separately. Animals eat some of each of the feeds provided with less opportunity to only eat their "favorites."

It is not a "mix it, lay it out, and forget it" practice though. It is important to monitor the moisture level of the final mix; too wet or too dry, intake will be lower than planned. Monitoring the quality and amounts of ingredients delivered to the cow must be done. Certain ingredients can settle during mixing and delivery meaning they will come out of the wagon first and be more dilute later in the load. Cows need longer fiber to stimulate rumination and to produce one of the volatile fatty acids used by the cow for energy and for secreting milk fat. Longer fiber means a healthier cow so managers monitor particle size of the TMR. Again, too long or too short fiber will affect the cow and her milk production.

Over the last 20–30 years equipment has been developed to provide grain and supplements when a TMR can't be fed. These operations needed a way deliver these supplements without a cow overeating or eating all the grain and supplement at once. Early versions were magnet feeders with cow identification using magnetic necklaces, like dog collars. A cow with a necklace could get through a head gate and receive some supplement. These were crude in that the cow could eat all the supplement she wanted. A step up were electronic feeders where the manager could tell the unit how much a cow should get in a day and split it into individual meals. The cow might get two pounds in each of 6 feedings for a 12 pound supplement intake. The multiple meals solved the problem of a large amount of grain being consumed at once resulting in a sharp drop in rumen pH. Many of these are still in use, however, large dairies use a TMR because special id on each cow is not required. Cows are fed as a total group with a TMR.

GRAZING DAIRY CATTLE

Often the public thinks cows grazing grass in the field is the only natural behavior for cows. While it is true cows enjoy the outdoors and fresh grass, that's not all there is to it when considering the cow and her production. Grazing is much more technical than it might seem with today's higher-producing cows and proper grazing is part art and part science. Grass alone can only support about 1/3 of a cow's daily milk production.

First consider the grass plant. A source of nutrients for grazing animals, but it needs to reproduce and thrive itself to provide these nutrients. Grass starts growing with mostly leaves lengthening from the "crown" of the plant at soil level. This early, leafy growth is high in moisture and meant to catch as much sunlight as possible to support photosynthesis going on inside the plant. This is also the most desirable stage of growth for grazers, too. Grass between 3 inches (7.5 cm) and 9 inches (23 cm) is most nutritious and digestible. As the plant continues to grow, it switches to reproductive mode, preparing a seed head and elongating leaves and stems. These stems are to hold the seeds in the air as they mature. Of course, the stem needs more structure than the earlier produced leaves. The structure comes from fiber laid down in the tissues to "stiffen" the stems. As fiber in the grass increases, digestibility decreases so cows producing milk need to be rotated to younger, shorter grass. Non-lactating animals like yearling heifers and dry cows can clean up the more mature grass with no harm.

Vegetative grass is high in moisture, usually about 80% of the total weight. When a cow is fed too much high-moisture feed, her overall intake will go down because she is full. With early pastures, grazed grass must make up a smaller amount of the total daily feeds until it

contains less moisture. When the moisture is lower, cows can graze fields longer and other feeds can be reduced.

Some other challenges faced in a grazing system are providing water to pastures distant from the farm water source, the walking distance from milking parlor/barns to individual pastures, the quality of walking lanes to prevent hoof injuries, providing shade for animals in treeless, open pastures, providing protection from severe rain and wind and protection from wildlife or other animals like dogs from gaining access to the cattle These challenges can make or break a grazing system.

FUTURE TRENDS

Labor shortages and increasing regulation requiring technical human resources have caused producers to install robotic milking stalls. A cow chooses when she will be milked and how many times per day. Grain mixes containing all the required minerals and vitamins are fed in the stall to lure the cow in to be milked. Usually, managers will only provide a small amount of grain in the stall. The rest will be mixed in a partial TMR laid out in the barn for the cows to consume day or night. Robots are new and more information on optimal feeding systems to accompany them will come in the next five years.

RATIONS FOR HEIFERS

Dairy heifers consume a lot of resources including feed, buildings, and labor; yet they return no money to the farm until they calve and start producing milk. Overall management of dairy heifers must be handled in a manner that yields the best quality heifer, with a high potential to be productive, and at minimal cost to the farm and the environment.

Feed represents the largest cost associated with heifer production so controlling feed cost is a major way to control the total costs of raising the heifer. Feed efficiency for a growing animal is measured as pounds of gain per pound of feed. There are several factors that can affect feed efficiency in the dairy heifer, such as genetics, forage quality (digestibility), growth rate or stage of growth, body condition or gain in body composition, gestation, heat or cold stress (environmental stresses), and exercise level.

Several of the factors affecting feed efficiency are affected by management, such as housing, types of feed, and nutritional system used for the heifers.

One of the feeding systems used commonly on dairies is “orphan rearing” where the calf is removed from the mother at birth and raised by farm employees. Why would this system become the standard in the industry when there is a preference for the cow and the calf to stay with each other? Keep in mind that preference for a behavior doesn’t necessarily mean there is a physiological need for such behavior.

There are reasons for this kind of management. Cows have been selected for milk and component production for years. There has been a small emphasis on body structure and health of animals, but for the most part the industry has ignored the “mothering ability” which is a selection criteria in the beef industry. There are some cows which ignore their newborn calf completely, especially their first calf. Some are good mothers and lick the calf clean and encourage it to suckle. However, research has shown that few calves, even from good mothers, get enough colostrum in the early hours after calving.

Calves are born without antibodies to defend against disease. It is critically important to get colostrum, the first milk rich in antibodies, into the calf in the first hours after birth when the calf can absorb these large proteins. These antibodies are going to be the calf’s defense against diseases for 14–28 days. After 24 hours they can no longer absorb the proteins as intact antibodies.

When calves are removed from the cow, they are fed bottles of colostrum immediately to ensure they receive the protection they will need. Because of the lack of immunity and less vigor in newborns again due to breeding, good sanitation is important for calf survival, too. Clean housing with abundant, clean bedding is needed by the calf early in his or her life. Several diseases can be contracted right after calving if the disease organism is swallowed. A clean pen separate from other animals reduces the calf's exposure to disease.

This calf is going to become a member of the herd in the future. The interaction with humans immediately after birth is the reason dairy cattle can be handled during milking and in the barns. Calves which are hand-fed are more docile later in their life.

Calves are typically fed a milk or milk substitute diet for eight weeks or so while they are transitioned to grain and finally hay. They get about 8% of their body weight over two feedings a day. A vigorous calf with its mother would get about twice this much milk over 6 feedings. More managers are beginning to feed a mid-day feeding of milk to increase intake and growth. They are also using more milk substitute solids with each feeding. The future is automated systems where the calf can be fed more often with freshly made milk substitute. Some of these systems will be in group pens so calves with interact with one another from day 2 until weaning. Weaning is done based on the consumption of grain "starter." When a calf is eating 3–4 pounds of starter per day, they are replacing the calories they have been receiving from milk.

An important nutritional aspect related to feed efficiency that has been researched in growing heifers for several years is the concept of precision feeding, which promotes greater efficiency of nutrient utilization and allows nutrient requirements to be met more precisely. Feeding high concentrate, high energy diets as opposed to traditional high forage diets has also been an area of recent study. Each of these concepts can improve the heifer's feed efficiency, and research has shown that they are additive and can be used together in a single heifer feeding scenario without negatively impacting future productivity or animal well-being. The concept of precision-fed, high concentrate feeding has been the subject of several recent research trials and continues to be studied.

In the case of precision feeding, no additional free choice forages are fed, and the balanced diet is likely fed in the form of a TMR or mixture of forage and grain, fed once daily. Transitioning heifers from a high forage diet to lower forage, precision fed diet requires incremental steps to allow for adequate rumen adaptation. Precision feeding higher concentrate diets to dairy heifers is a major nutritional and management shift from traditional heifer diets which were nearly all forage.

Precision feeding is discontinued and heifers adapted to normal pre-freshening diets 30 to 45 days before calving. Precision feeding heifers until 30 to 45 days before calving has had no adverse effects on calf birth weight, dystocia, metabolic problems, early lactation intakes, or first lactation milk production. Changes in rumen and gut volume have been shown to occur rapidly and do not limit postpartum dry matter intake.

WHY FEED GRAIN? OR CANDY?

Ruminants like dairy cows can change fibrous plants into absorbable nutrients. Plants like grasses would be wasted without the unique re-chewing/fermentation combination found in animals with multi-compartment stomachs. Then why is grain fed to a ruminant? Remember that good quality forage can only support 1/3 of the milk produced by an average or better cow. The cow will need more energy, protein, minerals, and vitamins than she gets in a full day of grazing. Without grain, the cow would move energy from her tissues and become thin and even gaunt. Some believe grain feeding is a new "lazy" way to feed cattle. Nothing is further from the truth. Stockmen have fed grain in some form for a long time. Grain supports faster growth, better fertility, higher milk production, and body condition maintenance. It is readily fermentable so it must be fed wisely to

prevent drops in rumen pH (acidosis). If fed carelessly it can lead to animals not eating, sore hooves and lameness, and runny, "sour" feces.

Dairy cows eat a variety of waste foods or by-products of food processing in small amounts. Often the by-products fed are from nearby sources and may be somewhat unique to the area such as chocolate and other candy in Pennsylvania or waste fruits and vegetables in California. They are usually cheaper per unit than more conventional feeds, sometimes even free for the taking. They provide nutrients to blend into the bigger ration. And feeding them contributes to the environment by safely recycling useful nutrients while saving space in landfills. By-product nutrient content varies a lot probably because a similar by-product can come from different farms, growing regions, and production practices. Managers need to constantly monitor the nutrient content and moisture of by-products and adjust rations accordingly. Animals relish the addition of these tasty feeds.

Dairy farmers depend on feeds grown from GE (genetically engineered) seeds. These varieties are currently the fastest growing corn, the high protein alfalfa, and most vigorous Canola protein. Most of the feeds are resistant to the effects of glyphosate herbicide, and save using several other herbicides to control different weeds. The crop looks, tests, and tastes the same as non-GE varieties. Organic dairies must avoid GEs in their feeds. GEs can be grown under organic conditions, but regulations prevent them from being certified for use in producing organic milk.

HOW TO KNOW?

There is no question the public is concerned about how farm animals are treated. In a recent Purdue survey of a thousand participants, consumers put "produced on farms with animal welfare and handling standards in place" right behind fat and protein content in their selection criteria. Other surveys have reported that about 80% of people feel animals have rights related to pain and suffering.

Dairy processors have listened to consumers' preferences. When everyone was afraid of dietary fat, processors produced low-fat and non-fat dairy products. There are milks for those who cannot tolerate lactose. The market is growing with Mediterranean- style yogurts preferred by U.S. yogurt-eaters. Processors quickly refused to accept milk from cows treated with rBST when the public had doubts about its safety in human and in cows. Now consumers want to know if their dairy products are produced humanely.

How can a processor assure consumers the milk they use comes from operations where cows come first and are treated well? It is not as easy as remove fat from a product or filtering water out of yogurt. Because of these concerns, evaluation of dairy practices related to cow care have become the norm rather than the exception.

Audits. An animal care audit evaluates the client's facility against the same recognized standards to verify conformance or non-conformance to these specified requirements. Non-conformances need to be addressed by the client and are re-evaluated when the problem is corrected. Some criteria must be corrected immediately for the certification process to continue, such as colostrum to bull calves or lack of adequate feed or water. These are Critical Control Points. Neither assessments nor audits specify management of the farm, recognizing there are a lot of ways to reach compliance with the standards. When possible, outcomes are measured. For example, using body condition scores of cows can measure the effectiveness of the nutrition management on the farm.

So what happens during a third-party, external audit? If you are just starting a program, you contact the auditing program. They will provide a list of standards and request information on the numbers of animals by age or production status. Once you are in a program, your next audit is scheduled by the program. The auditor may contact you prior to the visit so management is available and records are up-to-date.

The day of the audit you need to schedule about 90 minutes for a short explanation of the audit process, an interview with the auditor, the review of written protocols and training materials, and reviewing animal numbers and locations. The interview is a friendly series of open-ended questions to help the auditor understand procedures he or she should see later in the audit. Then the auditor will begin evaluation of animals and the facilities.

The auditor will gather "evidence" that your farm *meets or exceeds* criteria which are a defined set of external or internal requirements that must be adhered to assure good animal care. The evidence is used to verify that audit criteria are being met (or not). Evidence can be gathered from documents such as treatment/processing protocols, records, interviews and observations with employees, and measurements of cow condition. All the evidence gathered is confidential and is simply used to support compliance with criteria.

Observing the housing and handling conditions are important basics, but cows tell a pretty good story. Are they in proper body condition for their stage of production? Are they relatively clean? Are they alert, but calm? Is there evidence of injury? Do they have sound feet? As cow measurements are recorded the auditor will observe work area cleanliness, pen/stall conditions, equipment use and wear, gates and fences, and hanging or other documentation to which employees can refer.

The auditor will review the farm mission statement for mention of animal well-being, the treatment/processing protocols that establish the consistent care given each animal, and the farm's emergency action plan for loss of power, fire, employee injury, and catastrophic animal loss and disposal.

A week or two after the visit you will receive a report of assessment strengths and challenges or a report of audit conformances and non-conformances. Each of the criteria will be listed with the evidence supporting the findings.

What are the nutrition standards within a welfare audit?

The nutrition standards cover the points already covered, but let's summarize. Colostrum of a high antibody concentration must be fed to *bull and heifer* calves as soon as possible after calving. The calves must receive adequate milk daily with clean water available at day 1. Starter should be fed starter grain starting at three or four days and intake monitored at each milk feeding. Calves should be weaned from the milk diet based on energy intake from the starter grain (at least 3 lbs intake daily). Cows should have feed and clean water available 24 hours per day. Equipment used to prepare feeds must be clean. If the equipment is used for other duties on the farm, it must be cleaned before feeding. Rations should be developed using nutrition expert advice and monitoring. There should be adequate feed bunk and water trough space for cows in a pen or pasture.

Besides the nutrition criteria, there are certain core issues in each of the animal care evaluation programs. Evidence to support compliance may vary by program, but each is a "must" for assuring good overall animal care.

1. **A valid veterinarian-client-patient relationship.** The veterinarian overseeing health care for the animals must know procedures and challenges the farm deals with daily. They must be involved in the development of a herd health plan and be part of the periodic review of the plan. Ideally, they should be closely involved in developing the treatment and care protocols and in training employees to those protocols.
2. **Employee training.** There should be evidence of new employee training to the tasks they are assigned and general training in animal handling and farm policies. There should be evidence of continued training and a source of reference materials for each employee, such as posted protocols.
3. **Use of animal pain management.** Protocols and the herd health plan should include appropriate use of analgesics and anesthetics as prescribed by the herd veterinarian. Employees should know the timing, dose, and route of administration. There should be evidence of the appropriate

administration equipment and drugs on the farm. Training should include safety with such drugs for the animal and the employee.

4. **Confined animals must have access to food & water.** In general, animals should always have feed and water. In some cases that is not possible. There should be evidence that those periods are as short as possible, depending on ambient conditions.
5. **Non-ambulatory animal management.** This is one that gets into every animal abuse video. The goal should be to move the non-ambulatory animal without harm. Legs and head hanging out of a small bucket loader is not adequate. An adequate sized sled on the ground is the safest way to move an animal to a separate care area. Non-ambulatory animals must be able to reach feed and water. They should have shade and be protected from other animals.
6. **Proper euthanasia.** The farm should practice on-farm techniques approved by the American Veterinary Medical Association. There should be evidence of equipment used in good working condition and training of employees who can physically & emotionally carryout this procedure on cows/calves. The euthanasia protocol and practice should include timing of the decision based on the condition and prognosis of the animal. It should also include a practice for confirming death.

Most well-managed dairies can already comply with the standards used by any of these audit firms, but there is always room for improvement.

CONCLUSION

Dairying has changed dramatically in the last 50 years. Milk production per cow has increased 3-fold. The national dairy herd has consolidated onto fewer, larger farms. More milk in produced in the western U.S. and large dairies produce most of the milk consumed. Fortunately, new techniques and practices have helped the industry cope with the changes. Large dairies can assign employees to more specialized tasks and train them to do these husbandry jobs as the owner would do them. There will always be challenges in feeding dairy cows to support high production, while limiting the nutrition-related problems of high production. The world record for milk production is 77,500 pounds in 365 days! It is remarkable production when compared to the average of 22,800 pounds average for the national herd. The record cow shows that much higher production can be supported while keeping cows healthy and comfortable.