Dry-cow management and the unborn and neonatal calf

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Abstract

The dry period of cows has not received the level of attention in management of other classes of dairy cattle over the years. The primary measurements of dry-cow management effectiveness have primarily been focused on the cow's ability to transition from the dry period into lactation. Little to no emphasis has been granted to the management of dry cows for the mutual benefit of the cow and the unborn and neonatal calf. Dry-cow management strategies must be founded upon a rational understanding and application as to the physiological dynamics of late-term gestation, cow transitioning from non-lactating to a high level of lactation, colostrogenesis, birth and calf transitioning from in utero through the first 30 days of life. When properly designed, implemented, and monitored, these dry-cow management strategies will result in success for both the cow and the calf. Monitoring measurements beyond those commonly employed should be added in order to more completely evaluate the impact of management on both the cow and the calf. These should include, assessment of colostrum quality and quantity, calf birth weight, and 24 to 48-hour serum IgG in the calf.

Key words: calf, dry cows

Introduction

Historically, the management of dry cows has been one of the least intensive programs of all classes of cattle on a dairy. Housing, feed, and daily care have tended to be much less than that afforded to other groups of dairy cattle. Far-off dry cows (greater than 21 days from calving) have received less attention than close-up dry cows (less than 21 days from calving). Some of this decline in management intensity can be understood to a degree in that the dry cows are not producing milk daily, they have different nutritive requirements, and environmental impacts tend to be less obvious than lactating cows. The focus of dry-cow management has largely been directed towards the close-up dry cow due to her impending transition from dry to fresh and all of the associated physiologic and metabolic shifts.

The dairy industry has had a relatively good working understanding of the impact of environment, nutrition, and health during one productive phase on the subsequent productive phase. For example, over-conditioned cows entering and going through the dry period with excess body condition will more likely lead to some level of ketosis in the late dry period and definitely into the early stages of lactation. As a result of this understanding, management strategies are employed to try to prevent over conditioning in late lactation cows. It is quite interesting to note that while management strategies tend to focus on the impact of environment, nutrition, and health on the cow, a motivating factor in managing dry cows is still the concept of employing least cost measures. While to some "least cost" may imply least cost, but still meeting quality standards, to others it is to get the cows through the dry period using the least amount of inputs, quality and/or quantity. Dry-cow management programs are somewhat variable from dairy to dairy, with some facilities employing a much more intensive management model than others. An additional part of this strategy is that the outcome of these programs tends to be measured by productivity of the cow herself. Monitoring transition cow issues such as dead on arrival, dystocia, ketosis, retained placenta, metritis, milk fever, body condition, and even milk output at 2, 4, and 8 weeks fresh is a common practice. This monitoring can be quite effective if corrective measures are employed to prevent the negative productive issues from occurring and not just treating existing conditions. Most often, these corrective measures will require attention given to the cow's management prior to the existing condition to prevent predisposing her to the negative outcome.

Are these currently employed measures enough to adequately assess a cow's progress through the dry period and into early lactation? What about the additional aspects of the cow's productivity, delivering a viable offspring and producing sufficient quality and quantity of colostrum and transitional milk to assist the offspring in successfully transitioning from the in-utero environment through the first 30 days of life? What impact does the management of a cow during the dry period have on the developing calf? Is there a correlation between the success of the cow transitioning through this dry period and the calf transitioning into life outside the womb? Are our current measures of success significant enough to adequately evaluate both of these physiological phenomena? These are several of the questions I began asking myself several years ago in order to help my clients realize the greatest success in managing their herds. Following is a discussion as to some of my experiences in trying to answer these questions.

The Dry Cow and Unborn and Neonatal Calf

The first 6 months of in utero growth and development of the embryo and fetus is phenomenal in the sense of cellular multiplication, replication, and differentiation leading to tissue development and function, which leads to organ de-

velopment and function, which leads to system development and function. The physiological activity of these developing cells is incredible to say the least and it occurs during a high demand of productivity on the cow, early lactation to near the end of a lactational period. It is generally accepted that two-thirds of the fetal growth occurs in the last one-third of gestation. Typically, 30 of the last 90 days occurs at the end of lactation, while the remaining 60 days of in utero growth and development occurs during the dry period. Nutrient requirements for the fetus and cow combined during this period of rapid fetal growth has been identified as being similar to a mid- to late-lactation cow. However, the industry has historically significantly reduced the nutritive intake of far-off dry cows from even that of late lactation cows. While an escalating nutritive requirement for growth of the fetus occurs, a cessation of nutritive requirement for lactation exists. However, there is also a need for mammary tissue involution and secretory cell development which occurs simultaneously to the increasing growth of the fetus. New cells and growing cells require quality proteins, fats, and an energy source to fuel the growth processes and vitamins and minerals to support these functions.

This nutrient requirement of all 6 basic nutrients for the cow and the developing calf became very apparent to me in 2009. Observations of calves at calf ranches were that of relatively good health, but somewhat listless activity and poor growth performance for calves in the first 60 to 90 days. Several dietary changes were employed to try to improve performance and activity levels, few were successful in sustaining a level of adequacy. Mortality rates had not changed much, but morbidity was markedly higher and performance significantly lower. Further observations revealed that the calves were listless from day one and total serum proteins were lower than previous years. Dehydration at arrival was not markedly different as determined by packed cell volume readings. Investigation into the colostrum management at the various dairies supplying the calves identified no difference in process, but a significant reduction in both quantity and quality of colostrum being harvested on a per cow basis. A couple of herds had employed a colostrum monitoring program over the previous few years and thus had records that allowed comparisons to evaluate colostrum changes at those herds during this time period compared to the colostrum production of other herds also supplying calves to the calf ranch. These 2 herds had not experienced a noticeable change in quality or quantity of colostrum harvest from previous years. However, the colostrum quantity and quality collected by these herds were significantly higher than other herds at the current time. Calves from these 2 herds did not appear to be affected in the same manner as previously described whereas calves from the affected herds exhibited the poor performance and activity. The obvious question then arose as to why the 2 herds experienced no change and the other herds did. Through conversation with the owners of the other herds and their consulting veterinarians and nutritionists, there did not appear to be any noticeable change in typical transition cow measurements, but these herds had removed the vitamin and mineral supplements in the far-off dry cows and reduced the overall nutrient intake. The calves at the calf ranch were responsive to an increased bioavailability of trace minerals and increased levels of vitamins.

All too often, a successful birth is measured by deliverance of a live calf. In fact, success should be measured in delivering a live calf and providing the nutrients and other biologically active substances via colostrum and transitional milk to ensure an adequate transition from in utero through the first 30 days of life. It is quite possible that a poor transition is a primary cause of delayed calf morbidity and mortality. It is important to understand that this transition begins with the start of the dry period and not just at or near the time of birth.

It is widely accepted that stress results in compromised performance. There are many forms and/or causes of stress to animals. Some common examples of stress as they relate to dry cows are; over-crowding, poor pen/environmental conditions, poor feed and/or water quality, inadequate feed and/or water intake, inadequate nutrient balance, over or under conditioned cows, and pathogen-laden cows. By identifying any one or more of these stressors, it is possible to somewhat physiologically follow the impact on normal physiological function and/or disruption whichever the case in the cow and even as it affects the unborn calf. It is also significant to note that there are often more than one stressor occurring simultaneously and that the negative impact on the cow and the calf is most often the result of the cumulative effects of each of these stressors over a given time period.

In order to help illustrate the relationship of stressors on cows and the impact on their calves, the following review of colostrogenesis is given. Colostrogenesis begins approximately 3 to 4 weeks prior to parturition. Progesterone, which is present to help maintain the pregnancy, also has an inhibitory effect on nutrient input into secretory cells. Growth hormone and other growth factors are present that influence nutrient uptake by secretory cells. There is a limited amount of fluid released into the mammary tissue that contains growth factors and transforming substances which influence the appearance of receptors on the secretory cells. These receptors help to transfer immunoglobulin G (IgG), hormones, growth promoters and other biologically active factors from the circulating blood stream of the cow into the mammary tissue alveoli. At about 2 weeks prior to parturition, IgG receptors become fully active and allow for the transfer of IgG via special portals through mammary cells into the alveoli. Immunoglobulin M and A are also similarly transferred, but at significantly lower rates. Additional receptors for other biologically active substances are fully activated by about 3 to 5 days prior to parturition. Approximately 2 days prior to parturition, there is a significant shift in hormone balance due to increased levels of prolactin and glucocorticoid. The combination of these hormones effectively over-rides the

inhibitory effect of progesterone on the secretory cells. This switches "on" the ability of secretory cells to synthesize all milk components and initiates the copious secretion of milk components. With parturition, the placenta is eliminated, thereby removing the progesterone source and the inhibition of nutrient flow into the secretory cells. Protein is formed in secretory cells that effectively blocks the special portals which allowed the transfer of antibody. Colostrum is thus produced which contains a concentrated amount of IgG, a much lower amount of immunoglobulin M and A, several biologically active substances (epidermal growth factor, insulin-like growth factors I and II, oligosaccharides, lactoferrin, lysozyme, lactoperoxidase), and colostral fat, protein, lactose, vitamins, and minerals. These antibodies, nutrients, and biologically active substances are removed in a concentrated form via colostrum extraction and diminish in concentration over subsequent milkings, eventually yielding normal whole milk.

Given the previously described series of events, a reduction in dry-matter intake due to over-crowding might seriously reduce the availability of amino acids, peptides, fats, fatty acids, carbohydrates, vitamins, and minerals necessary to support the physiological functions described in colostrogenesis. Colostrum amount and/or quality would thus be compromised, leading to a reduced ability to adequately transfer antibody and other biologically active substances to the calf. Growth opportunities for the calf might be compromised as well as cow maintenance and growth. All animals live by a physiological hierarchy of nutrient distribution based on survival as a primary priority with growth next, followed by production and finally reproduction. This physiological hierarchy is involuntary and is evidenced by the outputs of the animal. Therefore, it should stand to reason that by measuring these outputs we can gain more knowledge as to the true impact of our management programs.

What measurements could be identified to assist us in monitoring the effects on both the cow and the calf through the dry period? In addition to the parameters currently employed of monitoring transitional anomalies, I suggest the following;

1. Colostrum quality as defined by estimated antibody content (colostrometer or refractometer) and periodic analytical assessment for IgG (Radial Immunodiffusion, RID or Enzyme-Linked Immunosorbent Assay, ELISA), nutritive content (protein, fat, carbohydrate, including lactose, and ash), and standard plate count, lab pasteurization count and coli count
2. Colostrum quantity as measured by volume and matched to lactation number of the cow
3. Time from parturition to harvest of the colostrum should also be monitored as colostrum quality diminishes significantly within a few hours of parturition (immediate removal is best, < 2 hours post-parturition is good, > 2 and < 6 hours post-parturition is okay)
4. Birth weight of the calf
5. 24 to 48-hour serum IgG (RID)

With these additional measurements, a clearer assessment can be made of the dry period as to the effects on cows and calves. As with most evaluative measures, it is the consistent monitoring and consistent review of the measures taken that identify drifts from the normal, and can help to focus on the appropriate corrective action to employ to prevent the issue from occurring.