**A Nutritional Perspective on Reproductive Management**

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The concept of setting goals and time constraints is not new in business management. But how does it apply to dairy farm management? In evaluating the production cycle of the dairy herd, a 100 day period of critical importance exists. The "100-day contract" begins 30 days before calving and runs through first breeding at 70 days after calving. The terms of the contract include: birth of a live calf with the cow remaining healthy during the transition period; a high peak milk production; controlled loss of body condition; and high fertility at first breeding. The momentum of achieving success begins in the close-up dry cow group and builds through calving to first breeding. Getting the cow off the track disrupts the momentum and can lead to "wrecks". Wrecks include metabolic disorders during the periparturient period that can have a long term impact on production and reproduction. This paper will focus on a phase by phase look at the "contract" and the long-term consequences of cows getting off track.

**The Dry Cow**

The contract begins with the care and preparation of the prepartum dry cow. The idea of preparing the dry cow is different from the traditional role that considers the dry period a "rest" phase (Gerloff, 1988). The cow needs to be prepared for calving and initiation of lactation. Although not producing milk, the pregnant, prepartum cow is very metabolically active both reproductively and in



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establishing new mammary growth. Bell and coworkers (1995) measured energy and protein deposition in the uterus and fetus. Their research clearly illustrates the increased nutrient requirements during the final 30 days of gestation (Table 1).

**Table 1. Rates of energy and protein deposition in uterus and fetus during pregnancy in Holsteins.**

| Gestation (d) | Energy (Kcal/d) | | Protein (g/d) | |
|---|---|---|---|---|
| | Uterus | Fetus | Uterus | Fetus |
| 210 | 631 | 500 | 76 | 54 |
| 230 | 694 | 601 | 90 | 73 |
| 250 | 757 | 703 | 103 | 91 |
| 270 | 821 | 805 | 117 | 110 |

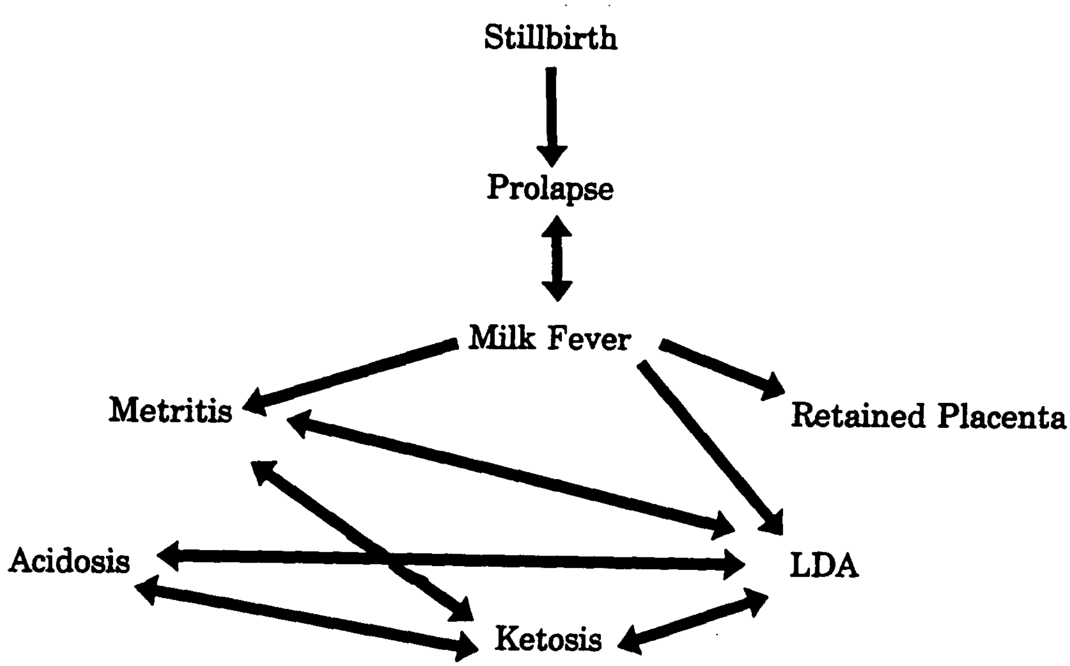
Adapted from Bell et al. (1995).

During this same time period, there is rapid development of the mammary gland and initiation of lactation. In short, there is a significant increase in metabolism of the cow during the final 30 days of gestation and therefore a need to maintain intake and proper plane of nutrition.

Dry matter intake is also altered with feed intake decreasing during the last 2 weeks of the dry period. Dry matter intake has been shown to decline by as much as 30 to 40% from 2% to less than 1.5% of the animals' body weight. Lower feed intake results in a negative energy status and mobilization of fat and protein. Severe decreases in feed intake puts the animal at risk for a number of metabolic disorders.

## Parturition Disease Complex

Severe losses of body stores or a more general lack of properly balanced nutrients increase the risk of the animal experiencing a number of metabolic diseases. Markusfeld (1993) describes these as a parturition disease complex. This is an important concept in understanding that these disorders are not independent but are related (Figure 1). As shown in the illustration, a cow suffering from milk fever is at increased risk of having retained placenta, left displaced abomasum, and/or ketosis. A number of other interactions exist between preparturient diseases.




Gröhn and coworkers recently reported the incidence of these diseases for Holstein cows in New York (1995). Values are reported in Table 2.

**Table 2. Lactational incidence risks and median days postpartum of disorders in 8070 multiparous Holstein cows in New York state.**

| Disorder | Lactational Incidence Risk (%) | Median Day of Occurrence (d) |
|---|---|---|
| Retained placenta | 7.4 | 1 |
| Metritis | 7.6 | 11 |
| Ovarian Cyst | 9.1 | 97 |
| Milk Fever | 1.6 | 1 |
| Ketosis | 4.6 | 8 |
| Displaced Abomasum | 6.3 | 11 |
| Mastitis | 9.7 | 59 |

Gröhn et al. (1995)

As the median day of occurrence indicates, these diseases are most likely to occur during the time immediately after calving. However, these disorders will impact production and reproduction during the entire lactation.

**Reproduction:Calving**

The culmination of these disorders is lost production and income. Murkusfeld reported significant decreases in milk production and reproductive performance of cows suffering from postparturient uterine (PPU) disease (Table 3).

**Table 3. Losses due to postparturient uterine diseases[1]**

| | Milk lb/305d | Days Open |
|---|---|---|
| With PPU disease | 19,677 | 125 |
| Without PPU disease | 21,978 | 99 |
| Difference | + 2,121 | -26 |

[1] Adapted from Markusfeld (1993).

Decreased milk production and reduced reproduction efficiency are the typical losses associated with the periparturient diseases. Therefore, the incidence of these diseases must be closely monitored.

Retained placenta and related reproductive tract infections are often evaluated as a result of nutritional deficiencies. More specifically, since researchers at Ohio State University reported the relationship between Vitamin E, selenium and retained placenta, many producers first react to cows calving with retained the placenta by increasing vitamin and mineral supplementation of the dry cow diet. Correct vitamin and mineral supplementation is certainly a goal of properly managing the transition cow. French researchers, however, more completely described retained placenta as an under-nutrition disease. Chassagne and

Chacornac (1993) reported cows that experienced retained placenta were on a lower plane of nutrition. Blood metabolites measured showed higher fat mobilization and lower blood glucose, as well as lower blood calcium and amino acids (Table 4). In addition, cows with retained placenta also had lower circulating monocytes.

**Table 4. Measurements of blood metabolites and nutrients between normal cows and cows with retained placenta.**

| Item | Retained | Normal |
|---|---|---|
| Glucose (ng/100 m) | 59.6 | 61.8 |
| NEFA (meq/d) | .494 | .340** |
| Amino Acids (mnole/d) | 2.34 | 2.48** |
| Calcium (mg/d) | 96.3 | 98.5** |
| Monocytes ($10^3$/mm$^3$) | 225 | 310** |

** $p<.05$.

These results emphasize the importance of the overall plane of nutrition. A common limitation is the forage quality selected for feeding the dry cow herd. In addition, the feeding management system also fails to promote feed intake of the dry cow herd. Lower plane of nutrition results in excessive body weight losses and can disrupt energy metabolism.

Grohn and others determined ketosis was an important metabolic disorder compared to other diseases. Ketosis is related to disrupted energy metabolism. Simensen and coworkers (1990) reported peak levels of ketones in milk at 17 to 31 days after calving. There was a significant relationship on milk yield with increasing acetoacetate (a ketone) in the milk. As acetoacetate increased to levels > .1 nnol per liter of milk, there was a significant decrease in milk production

(Figure 2). Therefore, it has been established that early lactation cows suffering from ketosis have lower milk production.

Although not reported as often as other calving disorders, milk fever is a significant risk factor for several other disorders including retained placenta and displaced abomasum. Subclinical milk fever and/or ketosis or a combination of the two can directly contribute to successfully accomplishing the "100 day contract". Cornell researchers reported increased incidence of milk fever as lactation number and genetic potential increased. These same researchers cited studies that showed decreased productive life by 3.4 years. Given that older, higher producing cows are most susceptible to these disorders, the economic impact of parturient paresis can be significant in lost production but also loss due to premature culling.

The concern of disrupted metabolism caused by ketosis and milk fever is the increased risk of other periparturient diseases. Curtis and coworkers (1983) reported milk fever resulted in significant increases in other transition cow problems. As illustrated in Table 5, milk fever led to increased risk of dystocia, retained placenta, left displaced abomasum, ketosis, and mastitis.

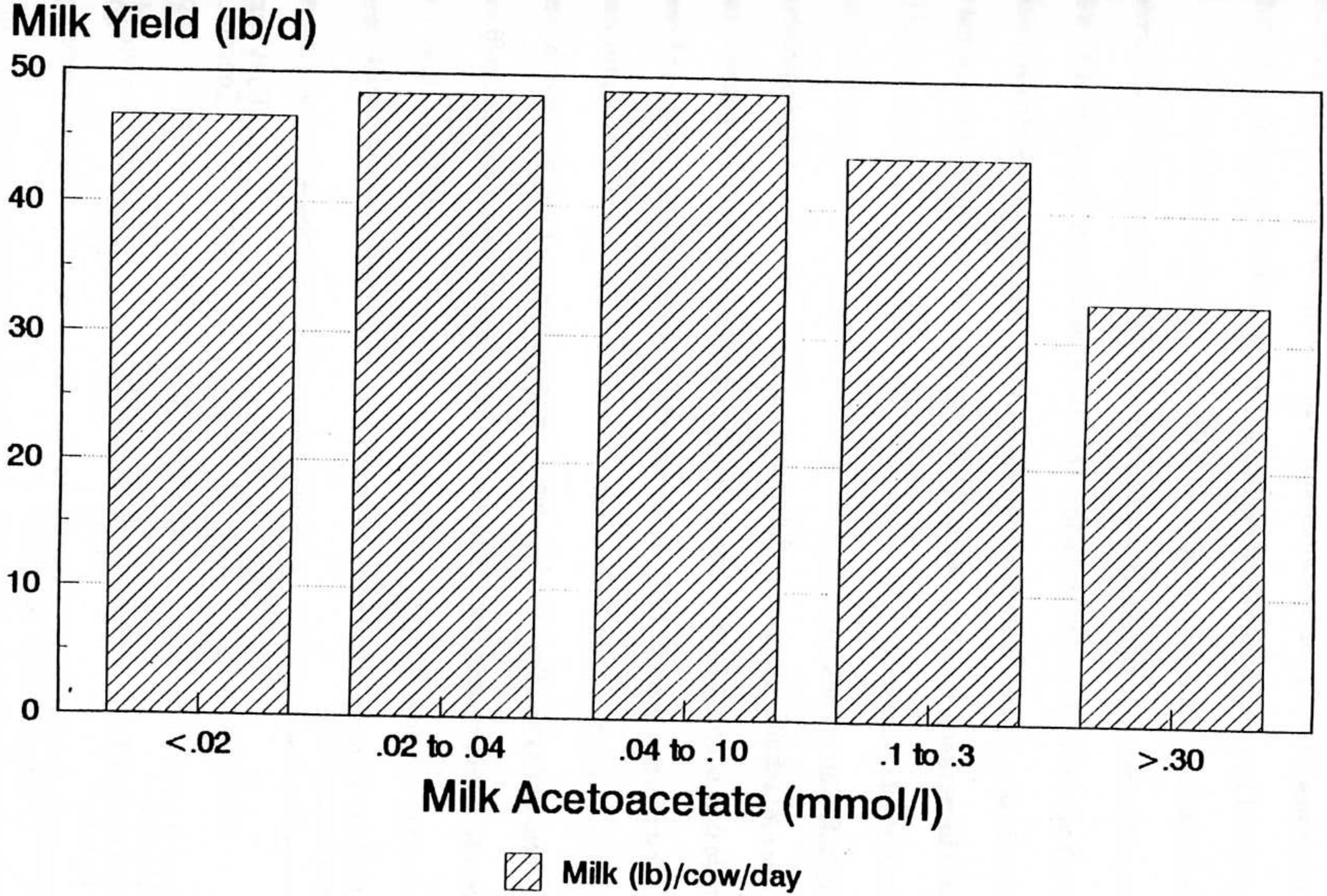
**Table 5. Influence of hypocalcemia on risk of other perparturient disorders.[1]**

| Disease | Odds Ratio | P |
|---|---|---|
| Dystocia | 2.8 | <.0001 |
| Retained placenta | 6.5 | <.0001 |
| Left displaced abomasum | 3.4 | <.06 |
| Ketosis | 8.9 | .0001 |
| Mastitis | 8.1 | .0001 |

[1] Adapted from Curtis et al. (1983).

Based on review of the literature, Coppock (1974) concluded that factors

# Figure 2. Milk Acetoacetate and Milk Yield



which caused loss of muscle tone (atony) increased risk of DA. These results were supported by a more current report by Massey and others who found milk fever increased risk of DA 4.8 times.

The often overlooked aspect of DA was the increased risk with increased stress of parturition. Other factors that Coppock identified as risk factors included toxemia due to metritis and mastitis. Although the DA can be repaired surgically, cows have reduced milk production of 8 to 10 percent compared to normal cows in the same herd.

**Early Postpartum Cows**

Metabolic disorders and diseases and the prevention of those problems are critical to successfully reaching the 100 d contract. The second phase is to achieve peak milk and good fertility at first service. Miettinen (1990) reported cows with higher levels of ketone bodies (acetoacetate and beta-hydroxybutyrate) had increased days to first service, decreased pregnancy rate at first service and as a result, a longer days open with higher services per conception (Table 6).

**Table 6. The effects of early postpartum energy status on reproductive performance.[1]**

| | Days to First Service | Days Open | S:C | First Serv. Concept. Rate (%) |
|---|---|---|---|---|
| Normal | 70.5 | 80 | 1.2 | 75 |
| Subclinical Ketosis | 75.8 | 102 | 2.0 | 44 |
| Ketotic | 78.0 | 100 | 1.9 | 40 |

[1]Adapted from Miettinen

The results of the study from Finland illustrate the importance of minimizing metabolic disorders on reproductive efficiency.

A common denominator of the periparturient diseases discussed above is a reduced plane of nutrition. This poor level of nutrition is directly related to intake and energy balance. Energy balance during the periparturient is the impact on reproduction. Butler and co-workers reported the energy balance during the first 20 days was inversely related to days to normal ovulation. These researchers also noted that normal ovarian function was observed 10 days after energy balance reached its lowest point and began to return to a positive balance. Lucy and others reported similar results with increased number of larger follicles present as estimated energy balance increased. Another concern is the carryover effect of negative energy balance on fertility. Britt from N.C. State has proposed a period of negative energy balance influences the development and quality of pre-ovulatory follicles. In this case, cows experiencing severe body condition loss in the last weeks of gestation and/or early lactation will have reduced conception rates. Poor fertility would be due to an "imprinting" of ovulatory follicles during development and recruitment of these oocytes.

In addition, nutritional management is critical to achieving peak milk production to genetic potential. In doing this, many nutrition programs are designed to "lead feed" or "challenge feed" the fresh cow immediately after calving. In fact, many producers begin to accelerate grain feeding during the prepartum cow preparation program. While the concept of this approach is correct, the implementation must be accomplished carefully. Excessive grain feeding can lead to ruminal acidosis. Ruminal acidosis decreases dry matter intake and can predispose cows to other periparturient diseases. Acidosis can also result in laminitis in cattle (Vermunt and Greenough, 1994). These scientists report systemic infections can contribute to laminitis. For example, cows with severe metritis can develop laminitis in response to the systemic disease. Poor locomotion due to sore feet can result in significantly lower milk production. The largest incidence of lameness reportedly occurs during the first 50 to 70 days after calving, the period of peak milk production (Collick et al., 1989). Lameness also resulted in a significant increase in days to first service, days open, and services per conception. The result of over compensating with grain can actually be higher cull rates due to lowered milk yield and poor reproductive performance due to sore feet.

**Summary**

Management of the "100 day contract" is a series of delicate negotiations for the dairy farm management. Failure at any point increases the risk of failure of making a smooth transition and to meet the terms of the deal. The stress of calving must be intensively managed to reduce the odds of periparturient disease and increasing the odds of success. **Details** and **intake** are the key elements of the "100 day contract".

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