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Review Article

Managemental Strategies of Farm Animals During Transition Period

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Abstract

The transition period in dairy cows is defined as the last three weeks before parturition to three weeks after parturition, characterized by tremendous metabolic and endocrine adjustments that the cows must experience from late gestation to early lactation. Perhaps the most important physiological change occurring during this period is the decrease in dry matter intake around parturition and the sudden increase in nutrients that cows need for milk production. As a result remarkable changes, most of the infectious diseases and metabolic disorders occur during this time period like milk fever, ketosis, retained fetal membranes (RFM), metritis and displacement of the abomasum (DA) primarily affect cows within the first two weeks of lactation. Physical and metabolic stresses of pregnancy, calving and lactation contribute to the decrease in host resistance during the periparturient period. During two weeks before and after parturition the T-cells populations exhibit a significant decline, which contribute to the immune-suppression in dairy cows at calving leads to increased susceptibility to mastitis and other infectious diseases. Other diseases that are not clinically apparent during the first two weeks of lactation (laminitis, ovarian cysts, endometritis) can be traced back to insults that occurred during early lactation. Feeding and other Managemental strategies during transition period determines the cows productivity during the preceding lactation period. Providing the right nutrition during this period greatly improve the calving ease, cow and calf welfare, milk production and reproductive performance. Careful attention to minimize the depth and length of negative energy and protein balance are equally as important as the provision of adequate calcium, magnesium and phosphorus. Apart from the nutritional aspects, housing is also very important for effective management of transition cows especially to reduce the incidence of the probable complications arising out of metabolic disturbances.

Keywords: Down-calver; Endocrine; Ketosis; Laminitis; Metritis; Transition.

Introduction

Transition period is defined as time frame from 3 weeks before calving to 3 weeks after calving (Grummer, 1995). It is characterized by tremendous metabolic and endocrine adjustments that the cows must experience from late gestation to early lactation (Drackley *et al.*, 2001). Perhaps the most

important physiological change occurring during this period is the decrease in dry matter intake around parturition and the sudden increase in nutrients that cows need for milk production (Drackley, 1999; Ingvartsen and Andersen 2000). As a result of these remarkable changes, most of the infectious diseases and metabolic disorders occur during this time (Goff and Horst, 1997; Drackley, 1999). Physical and metabolic stresses of pregnancy, calving and lactation contribute to the decrease in host resistance during the peri-parturient period (Mallard *et al.,* 1998). Milk fever, ketosis, retention of placental membrane, metritis and displacement of the abomasum (DA) primarily affect cows within the first two weeks of lactation (Drackley, 1999).

Feeding during transition period determines the cows productivity during the preceding lactation period. Providing the right nutrition during this period greatly improve the calving ease, cow and calf welfare, milk production and reproductive performance. The term transition is to underscore the important physiological, metabolic and nutritional changes occurring in this time frame. It constitutes a turning point in the productive cycle of the cow from one lactation to the next. The manner in which these changes occur and how they are managed are of great importance as they are closely linked to lactation performance, clinical and subclinical postpartum diseases, and reproductive performance that can significantly affect profitability Transition cow nutrition and management have received much attention in the research and popular-based literature in recent years because of the recognition of its importance in the productivity and health of cows.

Biological changes during transition period

1. Dry matter intake

Dry Matter Intake It is now well established that dry matter intake (DMI) decreases as calving approaches. Dry matter intake can decrease from 2.0% of body weight (BW) in the first few weeks of the dry period to 1.4% BW in the 7 to 10 d period before calving. This 30% decrease in DMI appears to occur very rapidly in the transition period (Bertics *et al*., 1992; Hayirli *et al*., 1998; Robinson and Garrett, 1999). During the 3 wk after calving DMI will increase at the rate of 1.5 to 2.5 kg /wk (Grant and Albright, 1995) with this increase being more rapid in multiparous cows than primiparous cows (Kertz *et al*., 1991; Robinson and Garrett, 1999). However, individual cow variation in the decrease prepartum and the increase postpartum in DMI is enormous (Vande Haar and Donkin, 1999). The decrease in prepartum DMI has classically been attributed to the rapid growth of the fetus taking up abdominal space and displacing rumen volume. However, there is no doubt that hormonal and other physiological factors have the most important impact on this phenomenon (Grant and Albright, 1995; Robinson, 1997). During the last week of pregnancy, nutrient demands by the fetal calf and placenta are at their greatest (Bell, 1995), yet DMI may be decreased by 10 to 30% compared with the early dry period.

2. Physiological changes

As the calving approach, blood progesterone level decreases, estrogen level increase. This influence the feed intake of cattle, as a result DMI (dry matter intake) decreases. During the last week of pregnancy, fetal calf and placenta require greatest energy but DMI decreased by 10-30% compared with the intake during early dry period. After calving, for the initiation of milk synthesis and rapidly increasing milk production, high amount of energy is needed. But total intake energy after calving is usually less than energy requirements during transition period. This leads to negative energy balance (NEB). As a result of NEB, suppression of immune system occurs which leads to decrease in immunity and increases the incidence of environmental mastitis during calving. The peri-parturient period in dairy cows is characterized by profound endocrine and metabolic changes to meet out the milk production during early lactation. Increased GH concentration during early lactation stimulates hepatic gluconeogenesis to increase glucose supply. The concentration of plasma insulin continually declines in the transition period until calving and that of somatotropin increases rapidly between the end of gestation and the initiation of lactation. Concentration of plasma progesterone, which is high in gestation, rapidly falls at calving and there is a transitory elevation in estrogens and glucocorticoids in the peri-parturient period. These hormonal changes not only contribute to the decline in DMI, but also coordinate the metabolic changes that favor, if not force, the mobilization of body fat reserves from adipocytes (Grummer, 1995). Resulting from this mobilization of lipids, we observe an increase in concentration of plasma non-esterified fatty acids (NEFA), which rise gradually in the prepartum transition period, but

rapidly in the last 3 day of gestation. A portion of this increase in NEFA is obligatory and is under hormonal control while another portion is the result of an energy deficit (negative energy balance or NEB) (Bertics *et al*., 1992; Grummer, 1995; Dyk and Emery, 1996). The magnitude of the NEB prepartum, therefore, appears to be a variable that can be mitigated through nutritional management. Additionally, the NEB and resulting increase in plasma NEFA, if sufficiently high, contributes to the development of fatty liver; which itself is a contributing factor to other health problems in the postpartum period (Grummer, 1995; Dyk and Emery, 1996). Rumen Function It is not unusual for a high producing cow in the first 100 d in milk (DIM) to consume 22 kg of DM/d, of which more than half is in the form of concentrates, without posing any particular problems to the cow if the diet is well balanced. However, this same diet consumed by a fresh cow can cause a severe ruminal acidosis. The major difference in rumen function between these 2 stages of lactation can explain the different responses to the same diet. During the dry period, cows generally consume a diet that is principally composed of forages and, by consequence, is more fibrous than the type of diet offered in lactation. This nuance affects rumen function in 2 ways. First, the rumen flora is adapted to a diet that is low in non-fiber carbohydrates (NFC) during the dry period allowing for a large population of cellulolytic bacteria and a low population of amylolytic bacteria. As the amylolytic bacteria also generate lactic acid, their decrease is accompanied by a decrease in the bacteria that utilize lactic acid (Goff, 1999). If the ration is changed abruptly at calving the capacity of the rumen flora to metabolize lactate, the principal acid responsible for acute rumen acidosis, is at a minimum at the initiation of lactation. The lactate producing bacteria increase in numbers rapidly as the amount of NFC in the diet increases, but the lactate-utilizing bacteria adapt more slowly (3 to 4 wk). Therefore, the risk of lactate accumulation in the rumen is high with abrupt changes from high to low fiber diets. Further, it is a known phenomenon that as DMI increases, rate of passage from the rumen increases as well. After calving, when DMI is relatively low, rate of passage is slow; allowing for greater extent of fermentation and acid accumulation in the rumen. If dietary NFC increases abruptly at calving, with high levels of fermentable carbohydrates, the amount of VFA produced far exceeds the capacity of the rumen to absorb them leading to elevated concentrations of VFA in the rumen. This situation leads to the phenomenon known as subacute rumen acidosis (SARA) and contributes to reduced DMI and feed digestibility as well as laminitis in the early postpartum period.

Immunological Changes and Disease Resistance

During two weeks before and after parturition the T-cells populations exhibit a significant decline, which contribute to the immune-suppression in dairy cows at calving (Kimura *et al.,* 1999). This immune-suppression during the peri-parturient period leads to increased susceptibility to mastitis and other infectious diseases (Mallard *et al.,* 1998). Other diseases that are not clinically apparent during the first two weeks of lactation (laminitis, ovarian cysts, endo-metritis) can be traced back to insults that occurred during early lactation (Goff and Horst, 1997).

The occurrence of health problems during the transition period is clearly a major complicating factor for subsequent reproductive performance (Ferguson, 2001), resulting in additional economic losses.

Productive changes

Poor transitions also result in milk income losses. Every pound of milk lost from peak production represents a loss of 200 lb of milk for the lactation. Poor transition periods often result in the loss of 10 to 20 lb of peak milk (e.g., Wallace *et al*., 1996), which could represent 2000 to 4000 lb of unrealized milk yield. It is, therefore, pertinent to elaborate nutritional strategies to facilitate the passage of the cow through this transition phase; while minimizing health problems and optimizing productivity/ profitability for the remainder of the ensuing lactation. Simultaneously, GH also creates an insulin resistance, which prevents the glucose utilization by the liver, muscle, or adipose tissue and stimulates lipolysis, which mobilizes the fatty acids (mainly non-essential Fatty acids) for milk fat synthesis or used as an energy source to some extent in the postpartum cow. Altogether, the gluconeogenesis-mediated more glucose production and lipolysis-mediated fatty acids are directly available for milk synthesis. Glucose demand is more during early lactation, resulting in hypoglycemic state. Inadequate glucose supply leads to the incomplete or partial oxidation of non-essential Fatty acids, which increases the ketone bodies concentration (primarily Beta hydroxyl butyric acid) during early postpartum period. This excessive blood Non-Essential Fatty Acids and

Beta Hydroxyl Butyric Acid unwanted peripartum complications.

Common Metabolic Disorders

1. Rumen Acidosis

Excessive acidic pH caused by greater fermentation and acid production by microbes that can be neutralized by the animal. The causes of acidosis are intake og high amount of easily digestible carbohydrate and too little fibre. Acute cause of acidosis is death. Prevention of acidosis is to avoid 'slug' feeding and balanced starch/ fibre fractions of diet.

2. Ketosis

The excessive mobilization of body fat caused by an imbalance between glucose need and glucose supply that leads to a built up of ketone bodies in the body. High demand for glucose (milk production or fetal growth) relative to supply (feed intake) leads to decreased glucose in blood and low insulin. The increase in ketone body concentration comes from beta-oxidation of long chain fatty acids in the liver. Prevention of ketosis is by avoiding over feeding (Fat cows have poor appetite), provide ample amount of well balanced diet and administer Niacin.

3. Milk Fever (Parturient Paresis)

An decreased in blood calcium in response to Calcium drain of lactation causes milk fever. Feed intake drops at calving and the cation- mobilizing system is inactive at calving thereby reduction in calcium in blood and as compensatory mechanism parathyroid hormone and vitamin D try to increase blood calcium but the target tissues are unable to respond to hormonal signals. Symptoms are decreased appetite, staggering, animal recumbent and cold ears. Prevention of milk fever is by feeding low calcium diet and high phosphorus during the dry period.

Other Health Problems Associated with the Transition Period

The conditions described above favor the occurrence of health problems during the transition period. The principal metabolic problems gravitate around 3 principal axes:

1. Disorders related to energy metabolism (fatty liver, ketosis, subacute and acute ruminal acidosis).
2. Disorders related to mineral metabolism (milk fever, sub-clinical hypocalcemia, udder edema).
3. Problems related to the immune system (retained placenta, metritis, mastitis).

Managemental interventions during Transition period

For safe and efficient transition period and to prevent the above said disorders, special managemental interventions in and around parturition should aim at:

i. Protection against infectious agents,
ii. Improvement of feed intake,
iii. Prevention of over conditioning of animal,
iv. Prevention of lipid metabolism,
v. Supply of specific nutrient factors and,
vi. Protection against environmental and managemental stress.

To achieve these objectives following managemental practices need to be followed.

Drying off the dairy animals

Animals should be given a sufficient time to rest and regenerate mammary tissue, which can be attained by providing a dry period of 45 to 60 days duration (Rastani *et al.*, 2005). The method of complete cessation of milking is a common practice in the low producing cows (<6 kg). In case of high yielders, incomplete milking or alternate day milking for 1-2 weeks followed by complete cessation is an effective method to dry off the animals.

Dry cow therapy

Dry cow therapy is the treatment of cows at the end of lactation with a long acting antibiotic preparation with or without a teat sealant. This is to treat for any intra-mammary infections contracted during lactation and provides protection against new infections during the dry period. Recently, dry cow therapy is being practiced via two different techniques i.e. use of intra mammary and systemic administration of antibiotics prior to calving. Systemic administration of antibiotics at drying off or some weeks before parturition looks

to be nominal accompanying treatment for intra-mammary therapy, which may be advisable for practice (Ahmad *et al*., 2015).

Feeding Management

A decrease in DMI occurs due to the rapid growth of the fetus taking up abdominal space and displacing rumen volume. This decrease ranges from 2% of body weight in the first weeks of the dry period to 1.4% of body weight in the 7-10 days period before calving. This 30% decrease in DMI appears to occur very rapidly in the transition period (Bertics *et al*., 1992). During the 3 weeks post calving, DMI increases at the rate of 1.5 to 2.5 kg per week, which is more rapid in multiparous cows than primiparous cows. The optimum DMI during prepartum and postpartum should be 1.7% and 2-3% of body weight, respectively. Optimum nutrient and dry matter intake can be supplied by augmenting nutrient density of feed. Therefore, peripartum diet of animal should contain high concentrate and high quality low roughage. Sudden shift to high concentrate diet predisposes the animal to ruminal impaction and metabolic acidosis. The practice of gradual increase in peri-partum diet quantity and quality will acclimatize the ruminal microflora to high concentrate ration without disturbing ruminal ecology. Some experts have suggested that when pre-partum nutrient restriction is followed by increased postpartum nutrient intake, the negative effect of pre-partum nutrient restriction may be overcome partially. However, the effectiveness of elevated postpartum nutrient intake may depend on the severity of pre-partum nutrient restriction (Lalman *et al.,* 1997). Moreover, feed additives such as Propionate production promoters; Propionate enhancers like fumarate (Remling *et al.,* 2014) and malate; Antioxidants (Osorio *et al*., 2014a); Ketosis controlling agents; Methyl donors like Methionine (Osorio et al., 2014b) and Choline (Grummer, 2011); Monensin (Duffield *et al*., 2008); Rumen inert fats (Sharma *et al*., 2016); Rumen bypass protein (Gang *et al*., 2016); Direct fed microbials (Alzahal *et al*., 2014); Niacin (Karkoodi and Tamizrad, 2009); Folic acid and Vitamin B12 (Duplessis *et al*., 2012); Pantothenic acid and Riboflavin (Evans and Mair, 2013) are very much effective in managing the transition stress in dairy animals.

Housing management

For better feeding and care, the animals in dry period should be separated from lactating animals, at least 60 days before expected date of calving. This practice will protect the pregnant animals from injuries due to infighting and hence abortion, torsion, dystocia and other complications. Housing of periparturient animals will require the following structures.

Dry Animal Shed

Preferably 10 to 15 days prior to parturition, the animal must be transferred to loose housing type shed. Shifting the animals to confined housing on the day of calving instead of earlier, and use of restraint measures at milking increases the somatic cell count, indicates the incidence of mastitis (Svensson *et al*., 2006). The shed may consist of centrally placed manger with curbs of 0.6 meter length and width per animal under a roof in paddock. The manger should be surrounded by a 2.2 meter wide paved platform with drains. The roofed portion should be 5.6 meter wide and may be gabled. Ties should be provided on the outside of the manger curb at 1.5 meter approximately for occasional use, if required.

Down – Calver Shed

The down-calver sheds should have calving boxes for housing those animals very close to calving and standings adjacent to boxes for accommodating those animals heavy-in-calf. A plentiful supply of clean, dry and fresh bedding material on a well-designed comfortable lying surface is a prerequisite in close-up pens (Nigel *et al*., 2004). The dimension of each calving box should be 3X4 meters with partition of at least 1.2 meter high between the two calving boxes. A manger and water trough, each 0.5 meter wide should be constructed at the rear end of calving box. A single leaved door 2 meter high and 1.2 meter wide should be provided for each calving box. The lower half portion of angle iron frame of the door leaf may be of galvanized steel sheet and upper half of the same may be covered with wire netting the floor of the calving box should be slopped towards the drains.

Standings

The standing of the down-calver shed should be constructed with a continuous manger along the wall and provided with tying arrangements so that the animals are tethered facing the wall. The length and width of each standing should be 2.0 and 1.6 meters, respectively. There should be a drain laid on other side of the standing.

Conclusion

The transition period constitutes a turning point in the productive cycle of the cow since it imposes a number of abrupt changes on the cow which are in 'physiological transit' from one lactation to the subsequent lactations and hence it requires proper management for successful dairy farming. All the concepts of sound nutrition that are important in the pre-calving transition period are equally important in the post-calving transition period. Continued ruminal adaptation to high concentrate diets is critical to control the risk of ruminal acidosis, careful attention to mineral metabolism, as well as energy and protein metabolism, is essential for a successful lactation. Again, the concepts of homeostatic and homeorhetic changes are crucial. Failure to adequately support one area of metabolism will inevitably impact negatively on other metabolic processes. Careful attention to minimize the depth and length of negative energy and protein balance are equally as important as the provision of adequate calcium, magnesium and phosphorus. Apart from the nutritional aspects, housing is also very important for effective management of transition cows especially to reduce the incidence of the probable complications arising out of metabolic disturbances.

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