Transition period and its sustainable management in dairy cows

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Abstract

Cows who are unable to make the transition to lactation are susceptible to a variety of issues that arise shortly after calving. Reduced milk production, immunodepression, and impaired reproductive function are additional effects during the early lactation phase. A few weeks prior to parturition, dry matter intake (DMI) begins to decline, reaching its lowest point at calving. Since the udder does not need to produce milk during the dry period, there is a decreased need for calories and protein. As the lactation phase progresses, dairy cows typically need about twice as much energy for milk production as for upkeep. Through the mobilization of adipose reserves, cattle can make up for feeding energy shortfalls. Numerous health issues have been linked to the decline of fat-soluble antioxidant vitamins, including retinol, α-tocopherol, and β-carotene, during parturition. The cows who were conditioned at BCS-3 had better feed intake and peak milk supply, while the ideal body condition score for a dry cow is 3.0-3.25. By secreting lymphokines and antibodies that aid in the elimination of pathogens, lymphocytes contribute significantly to the defence of the mammary gland. Dry cow therapy involves giving cows a long-acting antibiotic medication at the conclusion of lactation, either with or without a teat sealant.

Keywords: α-tocopherol, β-carotene, Dry cow therapy, antioxidant

Introduction

In dairy farming, the three weeks leading up to and following parturition are regarded as a crucial factor in determining productivity and profitability. This covers fresh cows (from calving to 3 weeks postpartum), maternity cows (2–3 days surrounding calving), and close-up dry cows (3 weeks prepartum to calving). The transition from a pregnant non-lactating to a lactating non-pregnant state occurs during this time, and it is accompanied by a number of physiological and biochemical changes that put animals under stress and increase their susceptibility to infectious and metabolic diseases (Mallard *et al*., 1998), which costs dairy farmers money. Reduced milk supply, decreased reproductive success, elevated sickness and mortality, higher treatment costs, and involuntary culling are all manifestations of these financial losses linked to inadequate peripartum care. As a result, one of the key factors influencing the productivity and profitability of dairy production is periparturient management.

Why Transition period - A challenging phase?

Failure to successfully transition into lactation puts cows at risk for a variety of issues that arise shortly after calving. Immunodepression, decreased milk supply, and impaired reproductive function are additional effects during the early lactation phase. In order to prevent production diseases from affecting the animal's welfare and productivity, it is crucial. Among the changes that take place in animals during this time of transition are:

Inadequate feed intake during transition period

A few weeks prior to parturition, dry matter intake (DMI) begins to decline, reaching its lowest point at calving. Since the udder does not need to produce milk during the dry period, there is a decreased need for calories and protein. The foetus grows significantly during the last trimester of pregnancy, putting pressure on the rumen and delivering unfavourable signals to the hypothalamic satiety centre about voluntary feed intake. The presence of clinical or subclinical illnesses and a drop in plasma estradiol concentration may potentially contribute to the reduction of feed intake during the end of pregnancy (Grummer, 1995).

Unbalanced Body weight and Body condition score

Due to a limited nutritional supply, cows frequently experience negative energy balance,

which leads to metabolic stress. Through the mobilization of adipose reserves, cattle can make up for feeding energy shortfalls. The β-oxidation of body fat stores results from this condition, which lowers body weight and body condition score (BCS) by decreasing fat depots. According to Sharad *et al*. (2016), cows that were conditioned at BCS-3 had increased feed intake and peak milk supply. A dry cow's ideal body condition score is 3.0-3.25. The animal's physiology also undergoes some adjustments, such as enhanced hepatic gluconeogenesis, decreased peripheral tissue glucose utilisation, increased adipose tissue mobilization of non-esterified fatty acids (NEFA), and increased peripheral tissue NEFA utilisation (Bell, 1995). After calving, the majority of dairy animals have a period of negative energy balance (NEB) due to the imbalance in energy status, which raises the risk of viral and metabolic illnesses (Duffield, 2000).

Diminished plasma concentrations of fat-soluble vitamins

Numerous health issues have been linked to the decline of fat-soluble antioxidant vitamins, including retinol, α-tocopherol, and β-carotene, during parturition (Weiss, 1998). At parturition, the α-tocopherol concentration will decrease by 50% and stay low for 20 to 30 days (Weiss *et al*., 1990). A substantial risk factor for intramammary infection and mastitis during the first week of lactation is a low plasma concentration of α-tocopherol at parturition (Weiss *et al*., 1997). The correct stratification and integration of epithelium depend on both β-carotene and its precursor, retinal. Their absence will cause hyperkeratinization, which compromises the integrity of the epithelium and leaves it vulnerable to the entry of several pathogens.

Immuno suppression

Animals' immune systems significantly deteriorate during and after parturition as a result of multiple interrelated events. Because of the elevated blood cortisol levels during the peripartum phase, humoral and cell-mediated immunity are both weakened (Manak, 1986). During the first week of lactation, blood polymorphonuclear cells' (PMNs') phagocytic and bactericidal properties diminish (Kehrli *et al*., 1989). When dairy cows give birth, their circulating neutrophils' gene expression patterns are momentarily changed, impairing their ability to mature, adhere, undergo apoptosis, and perform other immune-mediated functions (Crookenden *et al*., 2016). By secreting lymphokines and antibodies that aid in the elimination of pathogens, lymphocytes contribute significantly to the defence of the mammary gland. Compared to calving, lymphocyte proliferation is stronger one week before and after delivery, but the capacity to produce antibodies in response to mitogens dramatically declines around parturition (Smith *et al*., 1985). When dairy cows give birth, their serum levels of immune system components such immunoglobulin, coagglutinin, and immune system complement factors similarly drop (Stable *et al*., 1991). Changes in oestrogen and progesterone around the time of parturition may lead to immunosuppression for a few days after calving, even though the cortisol concentration is only temporarily raised (Preisler *et al*., 2000). Furthermore, the last products of β-oxidation of body fat reserves are β-hydroxybutyrate and other ketone bodies, which impair an animal's immune system and make it more vulnerable to infections during and after parturition (Ingvartsen and Moyes, 2013; Sordillo and Mavangira, 2014).

Mastitis and Metritis

About seven to ten days prior to parturition, the keratin plug sealing of the teats breaks down, allowing bacteria in the mammary gland easy access (Smith *et al*., 1985). Lactoferrin levels drop around parturition when the breast secretions transition to colostrums, increasing the amount of iron accessible for bacterial development (Goff, 2000). The majority of cows experience hypocalcaemia at parturition, which is thought to affect smooth muscle contraction, which is essential for the proper closure of the teat sphincter following milking and may lead to a higher risk of mastitis during the periparturient phase. Additionally, peripartum metritis and mastitis may result from compromised PMN function (Cai *et al*., 1994).

Enhanced chances for the occurrence of Metabolic diseases in farm

The incidence of periparturient disorders rises as a result of all the previously mentioned cascading alterations. According to Singh *et al*. (2015), 75% of dairy animal diseases occur in the first month following calving because dairy animals frequently are unable to adjust to the metabolic and management changes. Three main axes can be used to categorise the basic reproductive and productive abnormalities that occur during the transition period:

A) Energy metabolism disorders (fatty liver, acidosis, displaced abomasum, ketosis)

B) Mineral metabolism disorders (milk fever, hypophosphatemia, hypomagnesemia, and udder oedema) and

C) Immune system issues, including as pyometra, mastitis, endometritis, and retention of the foetal membrane.

Managemental interventions towards sustainability

Special managemental interventions in and around parturition should focus on the following for a safe and effective transition period and to prevent the aforementioned disorders:

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

The following management procedures must be performed in order to accomplish these goals.

Drying off the dairy animals in the farm

According to Rasani *et al*. (2005), animals should be allowed enough time to rest and renew their mammary tissue. This can be achieved by giving them a dry period of 45 to 60 days. Completely stopping milking is a frequent approach for low-producing cows (less than 6 kg). Incomplete milking or alternate-day milking for one to two weeks, followed by total cessation, is an efficient way to dry up high-yielding animals.

Dry cow therapy

Dry cow therapy involves giving cows a long-acting antibiotic medication at the conclusion of lactation, either with or without a teat sealant. This protects against new infections during the dry period and treats existing intra-mammary infections that may have been acquired during lactation. Recently, two distinct methods of dry cow therapy have been used: systemic and intramammary antibiotic dosing before calving. According to Ahmad *et al*. (2015), systemic antibiotic medication during drying out or a few weeks prior to parturition appears to be a minor supplementary treatment for intra-mammary therapy, which may be recommended for practice.

Overcome through Feeding Management

The fetus's quick growth takes up abdominal space and shifts the volume of the rumen, which lowers DMI. In the first several weeks of the dry period, this drop is 2% of body weight; in the seven to ten days prior to calving, it is 1.4% of body weight. During the changeover period, this 30% drop in DMI seems to happen extremely quickly (Bertics *et al*., 1992). DMI rises 1.5 to 2.5 kg per week during the first three weeks after calving, with multiparous cows experiencing this increase more quickly than primiparous cows. During the prepartum and postpartum periods, the ideal DMI is 1.7% and 2-3% of body weight, respectively.

Increasing the feed's nutritional density can provide the ideal amount of dry matter and nutrients. As a result, high concentrate and high-grade low roughage should be included in the animal's peripartum diet. An abrupt change to a high-concentration diet puts the animal at risk for metabolic acidosis and ruminal impaction. In order to acclimatize the ruminal microbiota to a high concentrate ration without upsetting the ruminal ecology, it is recommended to gradually raise the quantity and quality of the peripartum diet. According to some experts, the deleterious effects of prepartum nutrition restriction may be partially mitigated when increased postpartum nutrient intake is preceded by prepartum nutrient restriction. However, the degree of prepartum nutritional restriction may affect how well increased postpartum nutrient consumption works (Lalman et al., 1997).

Furthermore, microbials that are fed directly (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); methyl donors like methionine (Osorio *et al*., 2014) and choline (Grummer, 2011); microbials that are fed directly; microbials that are a lot of the dairy animals' transition stress are also effective.

Proper Housing management

At least 60 days prior to the anticipated date of calving, the animals in the dry period should be kept apart from the nursing animals for improved nutrition and care. By doing this, pregnant animals will be shielded from harm brought on by infighting, which could result in abortion, dystocia, torsion, and other issues. The following buildings are necessary for the housing of periparturient animals.

Dry Animal Shed

The animal must be moved to a shed with loose housing at least 10 to 15 days before to parturition. Using restraining techniques during milking and moving the animals to confined housing on the day of calving rather than earlier raises the somatic cell count, which is a sign of mastitis (Svensson *et al*., 2006). Under a roof in a paddock, the shed may include a centrally located manger with curbs that are 0.6 meters long and wide per animal. A paved platform with drains that is 2.2 meters wide should around the manager. The 5.6-meter-wide roofed section may have gables. For sporadic use, if necessary, ties should be placed outside the manager curb at a distance of around 1.5 meters.

Down-Calver Shed

The down-calver sheds should have calving boxes for housing those animals very close to the down-calver sheds should include standings next to the calving boxes for animals that are heavy-in-calf and calving boxes for animals who are very close to calving. Close-up pens require an ample supply of fresh, clean, and dry bedding material on a well-designed, cosy sleeping surface (Nigel *et al*., 2004). Each calving box should be 3 by 4 meters in size, with a minimum 1.2-meter-high divider between them. At the back end of the calving box, a manger and water trough that are each 0.5 meters wide should be built. For every calving box, there should be a single left-door that is two meters high and 1.2 meters wide. The floor of the calving box should slope in the direction of the drains. The upper half of the angle iron frame of the door leaf may be covered with wire netting, while the lower half may be made of galvanized steel sheet.

Standings

In order to ensure that the animals are tethered facing the wall, the down-calver shed's standing should be built with a continuous manager along the wall and equipped with tying arrangements. Each standing should be two meters long and one and a half meters wide. On the other side of the standing, a drain ought to be installed.

Conclusion

Since the cow is undergoing several sudden changes during the transition period-which is known as "physiological transit" from one lactation to the next-it marks a turning point in the cow's productive cycle and must be properly managed for dairy farming to be successful. In the post-calving transition period, all of the principles of good nutrition that are crucial during the pre-calving transition period are equally crucial. Maintaining ruminal adaptation to high-concentration meals is crucial for reducing the danger of ruminal acidosis, and successful lactation depends on paying close attention to mineral metabolism as well as energy and protein metabolism. The ideas of homeostatic and homeorhetic shifts are essential once more. Other metabolic processes will unavoidably suffer if one area of metabolism is not sufficiently supported. Giving enough calcium, magnesium, and phosphorus is crucial, but so is paying close attention to minimising the length and depth of negative energy and protein balance. Housing is crucial for the efficient management of transition cows in addition to the nutritional components, particularly to lower the likelihood of the potential consequences resulting from metabolic disruptions.

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Table 1. Recommendations to be followed during the common transition stress disorders

Common metabolic disease	Dietary Prevention
Milk Fever	Supplementation of calcium gel- 3 doses each 300 gms. Feeding negative Dietary Cation Anion Diets (DCAD) in late gestation period and high DCAD in early lactation (Razzaghi *et al.*, al., 2012), Maintain proper Ca and P (2:1) ration in the diet and Prepartum administration of vitamin-D (Thilsing-Hansen *et al.*, 2002).
Udder oedema	Excess feeding of Na and K should be avoided. Supplementation of Vitamin-E @1000 IU/day during early lactation is effective in prevention of udder oedema (Mueller *et al.*, 1989).
Retention of foetal Membrane	Daily supplementation of 100,000 IU of vitamin A and 400 IU of vitamin E with 3 mg/day of selenium or injections of Se and Vit E (Twice: 30 and 15 days prior to calving). Further, antioxidant supplementation during dry period can prevent the condition (Weiss *et al.*, 1990).
Fatty liver and Ketosis	Starvation of the pregnant animal should be avoided. Supplementation of Niacin @ 3 to 12 gm/day reduces the NEFA mobilization from adipose tissues (Dufva *et al.*, 1983). Intravenous administration of glucose may decrease blood ketones (Hamada *et al.*, 1982). Oral drenching of propylene glycol (Sauer *et al.*, 1973) & Monensin hydrochloride @2.5 mg/day; and salts of Propionic acid (Schultz, 1958) may be effective in lowering the blood ketones.
Ruminal acidosis	Provide the ration containing more than 32% NDF, with greater than 80% being from long forage and avoid sudden dietary shifts (Grant and Albright, 1996). Use neutralizing agents such as sodium carbonate, potassium carbonate, magnesium oxide, sodium hydroxide and calcium hydroxide @ 2 to 4% (Staples and Lough, 1989); Ionophore rumen modifiers like Monensin, lasalocid, narasin and salinomycin (Duffield *et al.*, 2008); Yeast culture (Dawson, 1995); Virginiamycin (Al Jassim and Rowe, 1999); and Tylosin (Nagaraja *et al.*, 1987).
Displacement of abomasum	Over feeding of cows should be avoided during dry period (Mann *et al.*, 2016). Diet should constitute about 50% forage and fed long and/or coarsely chopped good quality forage during the dry period and early lactation. Minimize stress due to other periparturient diseases like milk fever and ketosis.

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