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Review Article

Transition Period and Its Importance in Profitable Dairying - A Review

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Abstract

The period from three weeks before parturition until three weeks after parturition in dairy cows is defined as transition period. It is considered the most critical period, in terms of health, production and profitability as most of the metabolic and infectious diseases occur during this period. This period is characterised by negative energy balance (NEB), when an animal fails to metabolically adapt to the NEB, it suffers from metabolic disorders. High NEFA concentrations and ROS production are characteristics of metabolic stress and have been recognized as risk factors for diseases in transition cows. A smooth transition period indicates high productive and reproductive performance in dairy animals; on the contrary poor transition indicates compromised production and reproduction which cause tremendous economic loss to livestock farmers. An understanding about the physiological changes occurring in dairy animals during transition would go a long way in improving the feeding and management practices to enhance production.

Keywords: Dairy Animals, Economic Loss, NEB, Transition Period

Introduction

India is an agricultural country and livestock rearing forms an integral part of agriculture. Agriculture and allied activities constitute the back-bone of India's economy in the form of employment and income generated and foreign exchange earnings. Agriculture sector contributes about 17% to the total GDP and provides employment to over 60% of the population, which includes over 70 per cent of the rural households of the country. Livestock sector alone contributes around 8% of total GDP of the country and the dairy sector alone has been instrumental in bringing about huge socio-economic transformation in Indian rural sector (Arjun, 2013).

The profit of dairying depends largely on low death losses, low forced culling due to diseases, increased milk production and higher pregnancy rates. All these are dependent to a large extent on the health of the animal during vulnerable periods such as the transition period that extends from 3 weeks before parturition to three weeks after. The health, production and profitability of dairy cows are highly influenced by the transition period as this time period is more prone for the metabolic and infectious disorders (Drackley, 1999). An understanding about the physiological changes occurring in dairy animals during transition would go a long way in improving the feeding and management practices to enhance production.

Transition Period

The period from three weeks before parturition until three weeks after parturition in dairy cows is defined as transition period as transition occurs from a pregnant non-lactating state to a non-pregnant lactating state during this period. Transition period is considered the most critical period, in terms of profitability, production and health, as most of the metabolic and infectious diseases occur during this period of time (LeBlanc *et al.,* 2005). According to Wankhade *et al.* (2017) the health during this period is an important determinant as it influences the productive and reproductive performance of the cattle.

The transition from pregnancy to lactation is characterised by metabolic stress as there is reduced dry matter intake in parallel with rapid increase in milk secretion. This imbalance between reduced intake and increased demand force animals into a state of negative energy balance (NEB), especially in high yielding dairy cows (Lean *et al.,* 2013). In order to compensate this NEB animal undergoes several metabolic adaptations, mobilisation of the stored body lipid in adipose tissue as non-esterified fatty acid (NEFA) being one of the most important adaptations (Drakley *et al.,* 2001). When an animal fails to adapt successfully to the metabolic alterations, it suffers from metabolic disorders like fatty liver, ketosis and many others. This will have an adverse effect on the health of dairy cattle leading to a reduction in milk yield, diseases and protracted inter-calving interval causing great economic loss to the farmers.

Metabolic Adaptation to Negative Energy Balance

After parturition, rapidly increasing milk production increases the demand for glucose as glucose acts as the precursor for milk lactose synthesis. Glucose also supplies energy, acts as precursor for synthesis of oligosaccharides, and as precursor for glycerol for triglyceride production. This coupled with decreased energy intake causes NEB and this causes fat from adipose tissue to be mobilised as NEFA. When the level of NEFA increases, it is taken up by the liver (Fiore *et al.,* 2018) where it can be utilised as a source of energy by undergoing complete oxidation to carbon dioxide or undergoes partial oxidation and gets converted to ketone bodies which can act as a source of energy to extrahepatic tissues. Also, NEFA can be re-esterified to form triacylglycerol (TAG) which can act as source of milk fat (Drackley *et al.,* 2001). Excess TAG stored by the liver contributes to 'fatty liver' syndrome (D'Occhio *et al.,* 2019). According to Herdt (2000) skeletal muscle plays a major role in adapting to the NEB. During the period of NEB muscle utilise NEFA and ketone bodies as source of energy thereby maintaining the blood glucose levels. Being major protein reserves, the skeletal muscle proteins are mobilised as amino acids to support gluconeogenesis during NEB.

Redox Status During Transition

Free radicals are produced in the mitochondria as a normal by product of cellular respiration at the electron transport chain reaction. Consequent to changes in oxidative metabolism associated with pregnancy and lactation there is an increase in the production of free radicals (Halliwell and Gutteridge, 2007). Anisha *et al.* (2017) reported an elevation in concentration of Malondialdehyde (MDA) during transition period. MDA is considered as a good

indicator of oxidative stress in dairy cows during late pregnancy and early lactation (Castillo *et al.*, 2006). Increased mobilisation of fatty acids during transition enhances their utilization by β-oxidation also. This increases the production of reactive oxygen species (Sordillo and Raphael, 2013). High NEFA concentrations and ROS production are characteristics of metabolic stress and have been recognized as risk factors for diseases in transition cows (Herdt, 2000; Castillo *et al.*, 2005; Sordillo and Aitken, 2009; Anisha *et al.*, 2017). The free radicals have direct effect on biomolecules like nucleic acids, membrane lipids and proteins which might in turn influence several metabolic pathways.

Immune Challenges in Transition Cow

During the peripartum period the level of glucocorticoids increases in circulation because of stress (Reddy *et al.*, 2016). This leads to impairment in the lymphocyte and neutrophil activity which may lead to immune-suppression (Ingvarsten and Andersen, 2000). The NEB is considered to be the main reason for the immunosuppression in high yielding dairy cows (Priesler *et al.*, 2000). Contreras and Sordillo (2011) reported the impaired functioning of lymphocytes and neutrophils as a result of high levels of NEFA and BHBA respectively during the transition period. The risk of diseases such as fatty liver, ketosis (associated with energy metabolism), retained placenta, left displacement of abomasum (associated with reduced immunity), milk fever (associated with mineral metabolism), mastitis and metritis increase during periparturient period in case of severe NEB (Fiore *et al.*, 2018). In order to compensate for the energy demands for lactation, mobilisation of lipids occurs. When lipid mobilisation gets exaggerated, there will be significant increase in the incidence of metabolic disorders (Block, 2010).

Economics of Poor Transition

Comprehensive studies on prevalence of diseases like ketosis, fatty liver, displaced abomasum, retention of fetal membrane etc and their economic impact in dairy cattle of India is largely insufficient. Reports from Ethiopia point towards a decrease in milk yield of 18.18 to 40% from ketosis affected cows of (Tesfaye, 2019). Tucho and Ahmed (2017) reported that the economic and reproductive impacts of retained placenta in dairy cows are significant. Mostert *et al.* (2018) developed a dynamic stochastic simulation model for estimating the economic impact of subclinical ketosis and other disorders occurring during early lactation (first 30 days) for a Dutch dairy herd and reported a loss of €130 per case per year, with a range between €39 to €348. A survey in Tamil Nadu, Kerala reported an estimated loss due to ketosis of Rs. 577.09 per affected cow of which 45.57 percent was cost of medicines, 38.99 percent veterinarian's fee and additional labour cost and 15.44 percent expenses on feed supplements (Thirunavukkarasu *et al.*, 2010). Senthilkumar *et al.* (2013) has reviewed the economic analysis of metabolic diseases in bovines most of which occur during the transition period.

Clinical and Managemental Strategies to Minimize the Adverse Impact of Transition Period to Enhance the Income through Dairy Production

During the transition period, the dairy cattle exhibits clinical conditions like Insulin resistance, decrease in feed intake, negative energy balance, low immune functions, hypocalcaemia and bacterial contamination of the uterus. This reduces the performance of dairy cattle, hence monitoring and identification of cows at higher risk of the disease is necessary to limit the metabolic disorders and enhance the productivity of the dairy cattle. Exponential increase in the concentration of NEFA and sub clinical ketosis are associated with metabolic disorders and uterine dysfunction. Key link associated with the disease is feed intake. Glucose is the primary source of energy and is essential for vital organ function, foetal growth and milk production (Leblanc, 2010). Fed intake should be ad libitum during the transition period. NRC guidelines should be followed to provide adequate feed to the dairy cattle. Cows should not be overfed with starch. Ration formulation, feeding management enhance the income among dairy farmers. Heat stress, overcrowding, poor footing, lack of ventilation and rough handling of animals should be avoided. Investment should be made on proper flooring and cooling the shed where the transition cows are kept (Drackley 2010).

Conclusion

Transition period is considered to be a crucial period in the life of the dairy cows because most of the infectious and metabolic disorders occur during this time period and the health during this period is an important determinant as it influences the productive and reproductive performance of the cattle (Wankhade *et al.*, 2017). A smooth transition

period indicates high productive and reproductive performance in dairy animals; on the contrary poor transition indicates compromised production and reproduction which cause tremendous economic loss to livestock farmers (Hayirli *et al.*, 2002). Though studies on the economic impact of poor transition in dairy cows are scarce in India, studies from other countries indicate a significant impact on the profitability of dairying. The genetic component of successful adaptation also needs to be considered while selecting dairy animals.

Conflict of Interests

There is no conflict of interest.

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