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Review Article

# A Crucial Role of Transition Period on Later Postpartum Period in Dairy Cow

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## Abstract

Transition Period considered as an important and critical stage to the health, production, and reproduction of dairy cows because most of the metabolic, infectious and postpartum reproductive diseases take place throughout this period. It is characterized by marked physiological, nutritive, metabolic and immunological variations occur within this time as the productive cycle of cow shifts from the gestational non-lactating case to the beginning of milk manufacture and production. Transition period health is an important determinant of subsequent production and reproductive performance of dairy animals. Therefore, evaluation and consequence of metabolic changes that occur during the transition period have a significant effect on dairy cows' reproductive activity after calving. In this review, evaluation of different metabolic and hormonal changes with reference to different oxidative stress parameters during transition period and its effect on health status and reproductive performance on later postpartum period in dairy farm animals are discussed. In addition, supplementation of dairy animals with antioxidants, like vitamin E and Se during the transition period has a beneficial strategy in optimizing the reproductive efficiency of dairy animals.

***Keywords:*** *Dairy Cows; Transition Period; Postpartum Disorder; Oxidative Stress; Hormonal Disturbance*

## Introduction

The transition period is the time that extends from late pregnancy (3 weeks before parturition) to early lactation (3 weeks post-calving). It is considered as an important and critical stage to the health, production, and reproduction of dairy cows because most of the metabolic and infectious diseases take place throughout this period [1,2]. It is characterized by remarkable physiological, metabolic and nutritional modifications which resulted from the changes in the animal's endocrine status to support the late pregnancy, events of parturition and the start of milk production [3].

After parturition, the energy required for milk synthesis is not covered by voluntary feed intake of the cows creating a status of negative energy balance (NEB) to most of them. The NEB stimulates cows to mobilize body fat in the form of non-esterified fatty acids (NEFA) and subsequent accumulation of beta-hydroxybutyric acid (BHBA) in the blood. Although these changes are normal adaptive process in high yielding cows, when a cow fails to adapt to this metabolic challenge [4]. Moreover, the mobilization of body reserve from adipose tissue is leading to the elevated generation of reactive oxygen species (ROS).

The decreased dietary intake and increased ROS and result in oxidative stress status of dairy cows [5] and decrease of the neutrophil function, antibody responses and increase the production of cytokine by immune cells [6], ultimately increase susceptibility for metabolic diseases as ketosis and hypocalcemia, causing a higher incidence of postpartum disorders as puerperal metritis (PM), retained fetal membranes (RFM) and endometritis [7]. These periods of increased disease susceptibility are attributed to dysfunctional immune responses in these animals.

Studies performed in the last decade clearly indicate that adult dairy cows experience oxidative stress (OS) around the time of calving [8]. Also, some recent research has also documented that neonatal calves experience OS during the first few weeks of age [9,10]. OS diminishes functional capabilities of immune cell populations and increases the animals' susceptibility to diseases [11].

Transition period health is an important determinant of subsequent production and reproductive performance of dairy animals. Means, the occurrence of health problems during the transition period is a major risk factor for subsequent productive and reproductive performance [12]. The poor transition from pregnant to lactation stage often leads to huge economic loss to dairy farmers due to compromised production and reproduction. It may cause loss of 10 - 20 lbs (4.54 - 9.07 kg) of peak milk yield [13], which could equal to 2000 - 4000 lbs (907.18 - 1814.37 kg) of untapped milk yield. Despite, higher incidence of metabolic and infectious diseases has been reported during early lactation [14,15]. The incidence of metabolic disorders (such as milk fever, displacement of abomasum, fatty liver syndrome, and ketosis), mammary gland infections (mastitis and udder edema), and reproductive disorders (such as dystocia, retained placenta, and uterine infections) have been reported from 7.8 to 16.8, 2.8 to 12.6 and 6.7 to 19.2%, respectively, in high-producing herds [16,17]. Additionally, the delay in the postpartum ovarian resumption creates a severe problem for the reproduction and production of highly lactating dairy farms by lowering the reproductive efficiency and infertility in dairy cows causing huge economic loss [18].

Therefore, a smooth transition during this period from pregnancy to beginning of lactation is critical for minimizing health problems and to increase the productively and reproductive activity during later postpartum period in dairy cows. Early identification of these diseases may be useful to overcome future production losses [19].

Nutrition plays a vital role at the beginning of the reproductive cycle in domesticated animals. Besides general nutrition, imbalance in specific nutrients as minerals and vitamins found to have a deleterious effect on reproductive performance causing infertility [25].

Poor nutrition status before the beginning of the postpartum period accentuates the need for adequate nutrition during this period. Consequences of inadequate or improper nutrition before the beginning of postpartum period include delayed postpartum estrus, silent estrus, delayed ovulation, decreased ovulation rate and increased embryonic mortality [26,27]. Adequate nutrition during the postpartum period is even more critical in primiparous cow because of nutritional requirements for growth, in addition to those for lactation during the postpartum period [28]. Moreover, various minerals including microelements can influence the reproductive performance of dairy cattle [29]. It was found that calcium as an individual nutrient has been associated with poor production when severely deficient [30]. Cows fed high calcium and vitamin D diet had more rapid uterine involution, fewer days to first service and fewer days open [31]. Also, a deficiency of phosphorus has the same effect as the calcium-phosphorus ratio should be maintained at 2:1 [32]. Deficiency of sodium and a correlated excess of potassium can reduce fertility by irregular estrous cycle, endometritis and follicular cysts [33]. The author added that silent heat, delayed ovulation, follicular and luteal cysts, and embryonic mortality may result from vitamin A deficiency.

Postpartum uterine disorder remains a significant challenge affecting fertility, overall reproductive efficiency, and dairy industry [19]. The early predictions of postpartum uterine problems are critical for optimizing the productive and reproductive performance of dairy animals and may be useful to overcome future production losses [20].

Metabolic changes that occur 2 weeks before calving have a significant effect on dairy cows' reproductive activity after calving [21]. Therefore, Evaluation of some blood metabolites at the pre-partum period helps give any indications about the nutritional, metabolic, and

health status of dairy cows, which help predict postpartum metabolic and uterine disorders [22]. Moreover, the changes in the levels of blood metabolites in the healthy cows versus diseased ones may give insight into the possible risk factors behind for disease occurrence [23]. Improving productivity by improving the per-partum period has become an important problem [24]. Additionally, at present, several association studies between energy balance during transition period and subsequent postpartum performance are available [4].

Currently, there have been new approaches about using antioxidants, especially those relating to the immune status, to minimize the deleterious consequences which are observed during the peripartum period. Among the most known exogenous antioxidants, vitamin E (VE) and selenium (Se) can stand out in this role [34]. The appropriate supplementation of vitamin E and Se is very essential for optimizing the reproductive efficiency, productivity health of lactating and periparturient dairy animals. Vitamin E could prevent peroxidation in the susceptible subcellular membrane and prevents oxidative damage to the sensitive membrane lipids by decreasing hydrogen peroxide formation [35], thereby reducing the oxidative stress and maintaining the integrity of cell membrane [36]. Beside, Vitamin E and Se are considered as main components of the antioxidant immunodefense mechanism and play a vital role in maintaining the maximum immune function [37], also maintain animal's reproductive performance through their required in the critical enzymatic reactions [38], and act as anti-stress factors [39]. Their demands are higher as compared to the production or reproduction requirements [40].

## Hence, the objective of this article

a. Review the current knowledge on the antioxidant status and metabolic profiles of these cattle besides, measurement the level of some reproductive and stress hormones during the transition period.

b. Evaluate some hormones and blood metabolites in the hope of using these parameters to predict some postpartum uterine disorder in dairy cows during the transition period.

c. Finally, the impact of vitamin E and Se supplementation during the transition period on the metabolic status, oxidative stress, and the postpartum reproductive performance of dairy animals.

## Metabolic and hormonal profile during transition periods in dairy cows

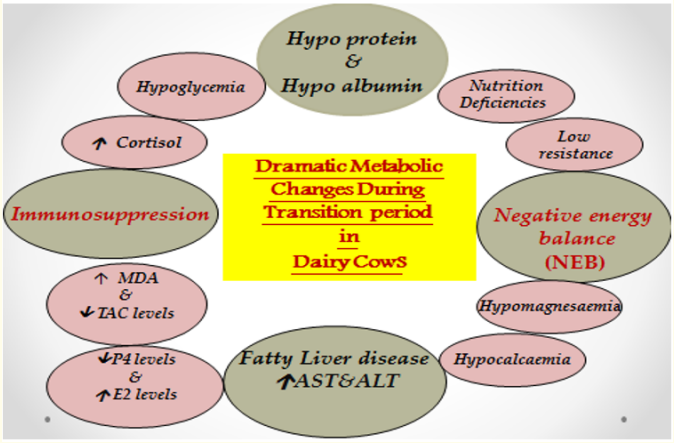


***Figure 1:*** *Source [41].*

## Postpartum metabolic and reproductive disorders in dairy cows

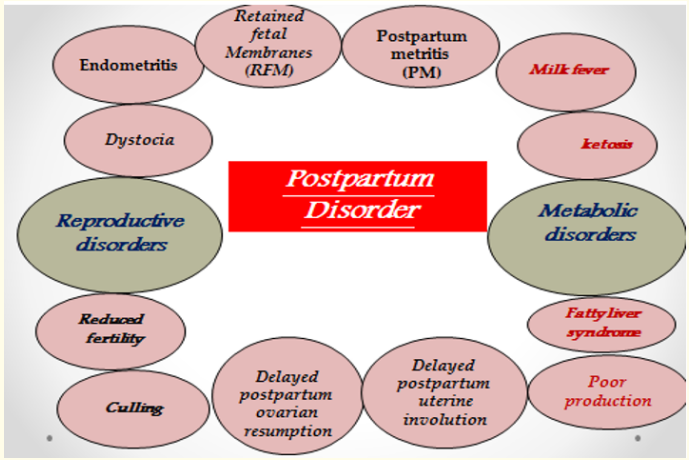


***Figure 2:*** *Source [42].*

## Impact of vitamin E and Se supplementation during the transition period on later postpartum performance in dairy cows

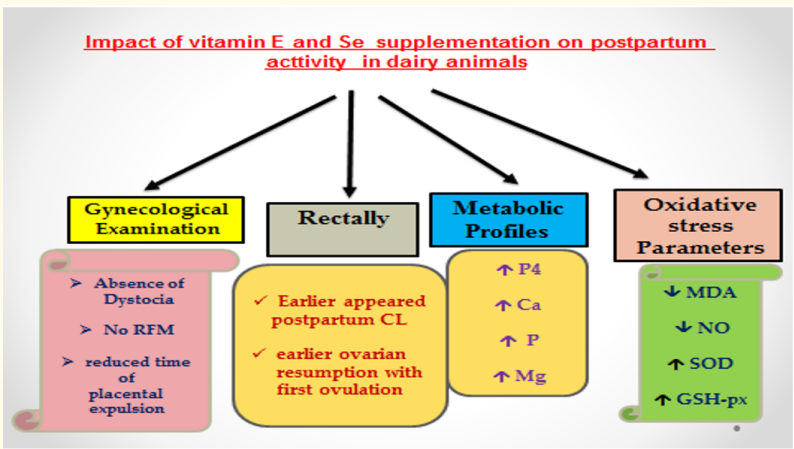


***Figure 3:*** *Source [43].*

## Conclusion

Deficiency of essential metabolites and hormones at the pre-partum period besides the presence of fetus and milk production act as a stress factor may contribute to the development of postpartum uterine disorder during the transition period in the dairy cows.

Evaluation of some blood metabolites and hormonal changes with reference to different oxidative stress parameters at the pre-partum period give an indications about the nutritional, metabolic, and health status of dairy cows, which help predict postpartum metabolic and uterine disorders and the reproductive performance on later postpartum period in dairy farm animal.

Therefore, it is highly recommended to improve the nutritional and immune health status of dairy animals at the pre-partum and early lactation time, which most probably have a significant positive effect on animals at postpartum periods. Thus, Supplementation of dairy animals with antioxidants, like vitamin E and Se during the transition period has a beneficial strategy, through enhancing the antioxidant and metabolic status, which improves the reproductive performance of dairy animals after calving.

Finally, care should be taken to provide the best methods for improving transition management is essential for maximizing dairy production, reduce culling and death, and reduce the incidence of disease.

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