

Retained Placenta in Dairy Cows: Causes, Consequences and Effective Strategies for Sustainable Dairy Development

Md. Emran Hossain*

Abstract

Retained placenta (RP) is a common reproductive disorder in dairy cows that poses a significant threat to reproductive efficiency, milk yield, and overall herd productivity. The condition, characterized by the failure to expel fetal membranes within 24 hours post-calving, results from a complex interplay of metabolic, endocrine, nutritional, and management-related factors. Key causative agents include dystocia, twin births, premature calving, mineral imbalances, oxidative stress, immune suppression, and hormonal disruptions, particularly involving prostaglandins and oxytocin. The consequences of RP are multifaceted, ranging from metritis, endometritis, and reduced conception rates to extended calving intervals, increased culling, and elevated veterinary expenses. Moreover, the condition significantly compromises animal welfare and increases the environmental footprint of dairy operations due to inefficient resource utilization. Addressing RP is critical for promoting sustainable dairy development, particularly under tropical and subtropical conditions where stressors are more pronounced. Effective strategies include early diagnosis, improvement of transition cow nutrition, targeted mineral supplementation, stress mitigation, enhancement of periparturient immunity, and refinement of calving management practices. Emphasis must also be placed on adopting precision dairy technologies and herd health monitoring systems to enable timely interventions. This review underscores the need for integrative approaches that align reproductive health with sustainability goals, thereby fostering resilient and productive dairy systems.

Keywords: Health, Calving management, hormonal imbalance, placental retention, reproductive disorder, sustainability, uterine clearance

INTRODUCTION

Retained placenta (RP) is a prevalent reproductive disorder in dairy cattle, defined by the failure to expel fetal membranes within 24 hours after parturition [1]. It poses a substantial challenge to dairy herd health, reproductive efficiency, and economic sustainability [2]. The incidence of RP varies widely depending on breed, parity, nutritional status, and management conditions, with higher rates observed in high-producing cows and in poorly managed transition periods [3]. Several intrinsic and extrinsic factors, such as hormonal imbalances, dystocia, cesarean section, twin births, premature parturition, and immune dysfunction, have been implicated in its pathogenesis [4]. The immediate aftermath of RP includes increased susceptibility to uterine infections, which may lead to

*Author for Correspondence

Md. Emran Hossain
E-mail: emran@cvasu.ac.bd

Professor, Department of Animal Science and Nutrition,
Chattogram Veterinary and Animal Sciences University,
Khulshi, Chattogram, Bangladesh.

Submission Date: June 02, 2025
Acceptance Date: December 29, 2025
Published Date: December 29, 2025

Citation: Md. Emran Hossain. Retained Placenta in Dairy Cows: Causes, Consequences and Effective Strategies for Sustainable Dairy Development. Research & Reviews: A Journal of Health Profession. 2025, 15(3): 1–11p.

endometritis, delayed uterine involution, and extended days open, thus compromising reproductive performance and reducing milk production [3–8].

From an economic standpoint, RP significantly elevates production costs through increased veterinary interventions, reduced fertility, higher culling rates, and prolonged calving intervals [7–8]. These consequences are also reflected in environmental inefficiencies, as resources such as feed, water, and land are not optimally converted into milk and meat [9]. Furthermore, compromised animal welfare associated with RP undermines public confidence in dairy farming practices [10–12]. In tropical and subtropical regions, environmental stressors such as heat load and nutritional deficiencies further intensify the incidence and severity of RP [13], [14]. Addressing this condition is, therefore, not only crucial for improving reproductive health but also vital for ensuring economic viability and environmental sustainability in the dairy sector.

Despite the long-standing recognition of RP in veterinary literature, a consolidated review that critically examines its etiological complexity, economic impact, and contemporary intervention strategies from a sustainability perspective remains limited. The novelty of this study lies in its integrative framework that connects the biological underpinnings of RP with practical herd-level strategies tailored for diverse agro-climatic settings. It emphasizes not only the treatment and prevention of RP but also its broader implications for resource efficiency, animal welfare, and sustainable dairy development. By bridging scientific knowledge and field-level practices, this study aims to support the development of resilient and productive dairy systems equipped to meet the challenges of modern livestock farming.

MATERNAL FACTORS

Dystocia

Prolonged or difficult labor often results in mechanical trauma to the uterus, hindering normal placental separation [13–17]. The extended time required for delivery can cause uterine fatigue and delay the contraction process necessary for placental expulsion, increasing the likelihood of retained placenta. Efficient delivery methods and timely intervention are crucial to prevent such complications.

Multiple Births

The presence of twin or multiple fetuses in livestock increases the risk of retained placenta. With larger placental mass, uterine contractions may be less effective at expelling the entire placenta, especially if the delivery process is protracted [16–18]. The additional strain on the uterine wall can delay normal expulsion and hinder the separation process.

Advanced Maternal Age

Older cows often experience a decrease in uterine tone and a slower rate of uterine involution, which can impair placental separation [19]. Aging may also lead to hormonal imbalances affecting uterine contractions, and older animals might have a reduced ability to respond effectively to oxytocin, a critical hormone for placental expulsion.

Obesity

Excessive body fat can interfere with normal uterine function and hormone production, including oxytocin, which is essential for uterine contractions [3, 20, 21]. Obesity can lead to metabolic disturbances, further inhibiting proper uterine involution. The increased body mass may reduce the overall efficiency of the uterus in expelling the placenta post-parturition.

Under-Conditioning

Inadequate body condition or poor nutritional status can lead to weakened uterine muscles, delaying placental expulsion [3, 20, 21]. Malnourished animals may lack the energy and nutrients required for proper uterine function, increasing the risk of uterine inertia. A lack of essential vitamins and minerals also affects immune function, increasing susceptibility to infections that hinder placental detachment.

Previous History

Animals that have experienced retained placenta in previous pregnancies are at an increased risk of recurrence. The underlying causes, such as hormonal imbalances or uterine infections, may persist, making placental expulsion less efficient in subsequent pregnancies [11, 22–24]. Proper monitoring and preventive measures should be implemented in animals with a history of retained placenta.

Stress

Emotional or physical stress during parturition can disrupt the normal hormonal balance needed for placental expulsion. High stress levels can interfere with the production of oxytocin, the hormone responsible for initiating uterine contractions [25–27]. Stress during labor or post-delivery can also lead to uterine infections, further complicating the placental separation process.

Oxytocin Receptor Malfunction

A malfunction in oxytocin receptors within the uterine muscles can reduce the effectiveness of uterine contractions, thereby hindering placental separation [23, 28, 29]. Even with normal oxytocin production, if the receptors are not functioning properly, the uterus cannot respond appropriately to the hormone, leading to delayed or incomplete expulsion of the placenta.

Excessive Physical Activity

Postpartum stress from excessive handling or movement can delay placental expulsion. Physical activity may disrupt the natural recovery process of the uterus and lead to an increase in cortisol levels, which can inhibit uterine contractions [25–27]. It is essential to minimize unnecessary physical stress during the post-partum period to allow for proper uterine involution and placental detachment.

NUTRITIONAL DEFICIENCIES

Selenium Deficiency

Selenium plays a crucial role in antioxidant defense and uterine function. Its deficiency can impair placental separation and uterine contractions, as it affects the integrity of muscle cells and the uterine tissue [30–32]. Without sufficient selenium, oxidative stress increases, further delaying the process of placental expulsion. Ensuring adequate selenium intake during pregnancy can prevent these complications.

Vitamin E Deficiency

Vitamin E is vital for proper placental detachment and immune system function. A deficiency in vitamin E reduces the efficiency of the uterine muscles in expelling the placenta [17, 23, 33, 34]. It also compromises the immune system, leading to increased susceptibility to infections that can interfere with the normal placental expulsion process. Adequate vitamin E levels are necessary to support a healthy parturition.

Mineral Imbalances

Calcium and magnesium are essential for proper uterine contractions during parturition. Deficiencies in these minerals can reduce uterine tone and hinder placental separation. Calcium deficiency, in particular, can lead to uterine inertia, making the expulsion process slower and less effective [30, 32]. Correcting mineral imbalances through balanced nutrition is key to ensuring efficient placental expulsion.

Low Protein Intake

Insufficient protein intake during pregnancy can impair placental function. Protein is necessary for the synthesis of hormones and enzymes that regulate uterine contractions [35–39]. A lack of protein also affects the structural integrity of the placenta and uterine tissues, making placental detachment more difficult. Proper protein levels during pregnancy support normal placental separation and uterine function.

Energy Deficiency

Negative energy balance, especially during late pregnancy, can contribute to retained placenta. Insufficient energy intake affects the metabolic processes necessary for proper uterine involution and placental expulsion [25, 36, 40]. Energy deficiency can also lead to weakened uterine contractions, delaying placental separation. Ensuring adequate energy intake in late gestation is critical to reducing the risk of retained placenta.

HORMONAL AND METABOLIC FACTORS**Insufficient Oxytocin Production**

Oxytocin is essential for stimulating uterine contractions post-parturition. Insufficient production of this hormone can lead to a failure in uterine contraction, preventing the placenta from being expelled in a timely manner [36, 41–44]. Without adequate oxytocin, the uterus struggles to contract effectively, resulting in delayed placental detachment. This issue may require hormone supplementation for proper expulsion.

Low Prostaglandin Levels

Prostaglandins play a significant role in initiating uterine contractions during parturition. Low levels of prostaglandins can inhibit the normal contraction process, delaying the expulsion of the placenta. This hormonal imbalance prevents the uterus from fully contracting and can result in retained placenta [36, 41, 42, 44]. Ensuring proper prostaglandin production is vital for successful placental separation and expulsion.

Hypocalcemia

Low calcium levels, known as hypocalcemia, impair uterine muscle tone and contraction. Calcium is crucial for muscle function, including those of the uterus during labor. Hypocalcemia can lead to uterine inertia, reducing the strength and frequency of contractions necessary to expel the placenta [30–32]. Adequate calcium levels are essential to maintain proper uterine function and prevent complications like retained placenta.

Pregnancy Toxemia

Pregnancy toxemia, also known as ketosis, is a metabolic disturbance that occurs during late pregnancy, particularly in high-producing animals. This condition leads to energy deficits and affects metabolic pathways, including those regulating uterine function [36, 41]. The resulting poor metabolic state can reduce uterine muscle tone and impair placental detachment, increasing the likelihood of retained placenta in affected animals.

Ketosis

Ketosis occurs when there is an energy imbalance in dairy cattle, particularly during late pregnancy or early lactation. The animal's body begins to mobilize fat reserves to meet energy demands, leading to the accumulation of ketone bodies [36, 41]. This metabolic disturbance negatively affects uterine function and may contribute to delayed placental expulsion. Proper management of energy intake can prevent ketosis and reduce the risk of retained placenta.

INFECTIONS AND IMMUNE DYSFUNCTION**Metritis**

Metritis is an infection of the uterus that can occur post-parturition. The infection often disrupts the normal healing process, preventing the uterine muscles from contracting effectively and delaying placental expulsion [6, 38, 45–49]. The inflammation and bacterial presence hinder uterine involution, making placental detachment more difficult. Timely treatment with antibiotics is crucial to manage metritis and ensure proper placental separation.

Endometritis

Endometritis is the inflammation of the uterine lining, often caused by bacterial infections after birth. This condition interferes with normal uterine function, preventing the uterine muscles from contracting

properly and causing delayed placental expulsion [6, 38, 45, 46]. The inflammatory response alters the hormonal balance necessary for placental detachment, increasing the risk of retained placenta. Effective treatment of endometritis can help resolve this issue.

Bacterial Infections

The presence of bacteria in the reproductive tract can delay placental detachment by causing uterine infections, such as metritis or endometritis. These infections result in inflammation that impedes normal uterine contractions, which are essential for placental expulsion [6, 38, 45, 46]. Bacterial pathogens can also cause systemic infections that further weaken the immune system, hindering the body's ability to expel the placenta naturally.

Viral Infections

Viral infections can suppress the immune system, making the uterus more susceptible to infections and reducing the body's ability to expel the placenta. Viruses like bovine herpesvirus or other infectious agents can cause systemic immune suppression, leading to weakened uterine function and delayed placental detachment [11, 15, 50, 51]. Proper vaccination and biosecurity measures are critical to preventing viral infections and their impact on parturition.

Poor Immune Function

A weakened immune system can impair uterine involution and delay the expulsion of the placenta. Reduced immune responses hinder the body's ability to fight off infections that may compromise uterine function [11, 15, 50, 51]. Animals with compromised immune systems are more likely to develop infections like metritis or endometritis, which can further prevent normal placental separation. Strengthening immune function through proper nutrition and management can help prevent retained placenta.

FETAL FACTORS

Fetal Abnormalities

Abnormal fetal development can affect the normal process of placental detachment [6, 38, 45, 46]. Structural anomalies or developmental disorders in the fetus can disrupt the normal attachment of the placenta to the uterine wall, making it more difficult for the placenta to separate after birth. These abnormalities may also cause mechanical challenges, increasing the risk of retained placenta. Proper fetal monitoring is essential to detect potential issues early.

Premature Birth

Premature birth, or early calving, can result in incomplete or delayed placental separation. Inadequately developed fetuses may lead to uterine dysfunction or poor placental attachment, making expulsion more challenging [52–54]. Additionally, preterm calves may not trigger the necessary hormonal signals that promote uterine contractions, further delaying placental expulsion. Timely interventions and monitoring during pregnancies at risk for preterm labor are essential.

Large Fetus

Overly large fetuses, or macrosomia, can create mechanical difficulties during parturition, leading to difficulties in placental release. The large size may stretch the uterus, impairing its ability to contract effectively and expel the placenta [52, 53, 54]. The presence of a large fetus also increases the likelihood of uterine trauma or uterine inertia, which can hinder proper placental detachment. Preventing excessive fetal growth through nutritional management is crucial.

UTERINE FUNCTION AND ANATOMY

Uterine Inertia

Uterine inertia refers to the failure of the uterus to contract effectively after parturition. This lack of adequate contraction prevents the placenta from being expelled in a timely manner, leading to retained

placenta [4, 40, 43, 50–57]. Uterine inertia can result from hormonal imbalances, infections, or metabolic disturbances. Proper management of uterine health and hormonal function is necessary to encourage normal uterine contractions and ensure successful placental expulsion.

Uterine Prolapse

Uterine prolapse occurs when the uterus inverts or is displaced outside the body following birth, which complicates placental expulsion. This abnormal condition interferes with uterine contractions, impedes the ability of the uterus to return to its normal position, and prevents the proper detachment and release of the placenta [4, 40, 43, 50, 55, 56]. Immediate veterinary intervention is necessary to correct uterine prolapse and facilitate normal placental separation.

Incomplete Uterine Involution

Incomplete uterine involution is the failure of the uterus to return to its normal size and function following parturition. This condition hinders the normal detachment of the placenta, as the uterus is unable to contract properly to expel it [4, 40, 43, 50, 55]. Factors such as infections, metabolic imbalances, or inadequate nutrition can delay uterine involution, increasing the risk of retained placenta. Timely intervention is required to support uterine health and involution.

Adhesions or Scars

Adhesions or scars from previous uterine infections, injuries, or surgeries can cause abnormal placental attachment, making placental separation more difficult. These adhesions interfere with the normal placental detachment process, as the placenta becomes abnormally fixed to the uterine wall [4, 43, 50]. Scarring can also reduce uterine flexibility, impairing its ability to contract effectively. Preventing and treating uterine infections is crucial to avoiding adhesions and ensuring smooth placental expulsion.

ENVIRONMENTAL AND MANAGEMENT FACTORS

Poor Hygiene

Unsanitary conditions during calving or the postpartum period increase the risk of infections such as metritis or endometritis, which can impede placental expulsion. Bacteria can enter the reproductive tract through unclean surroundings, leading to uterine infections that hinder normal placental detachment [13, 58]. Ensuring proper hygiene during parturition and immediate postpartum care is critical to preventing infections and ensuring smooth placental separation.

High Environmental Temperature

Heat stress can have a significant negative impact on hormonal balance, which is essential for uterine contractions and placental expulsion [59, 60]. Elevated temperatures can lead to reduced oxytocin secretion, impaired uterine function, and overall reproductive performance. Managing temperature through proper ventilation or cooling systems during hot weather can reduce the risk of retained placenta and improve overall reproductive health.

Inadequate Veterinary Care

Lack of proper postpartum care or veterinary management increases the risk of retained placenta. Postpartum monitoring is crucial to detect complications early and intervene when necessary. Inadequate care can lead to untreated infections, metabolic imbalances, or hormonal dysfunctions, all of which can delay placental expulsion [59, 60]. Regular veterinary checks and timely interventions help reduce the incidence of retained placenta and improve recovery.

Unsuitable Housing Conditions

Overcrowding, poor ventilation, and lack of space in housing conditions can cause physical stress, leading to hormonal imbalances and reduced uterine function. These environmental stressors can delay placental expulsion by affecting the overall health of the animal and increasing the risk of infections

[13, 58]. Properly managing housing to reduce stress and provide adequate space and ventilation is essential for minimizing the risk of retained placenta.

GENETIC AND OTHER FACTORS

Breed Predisposition

Certain breeds have a higher susceptibility to retained placenta due to inherent genetic differences. Breeds with larger body sizes or specific reproductive traits may be more prone to uterine dysfunction or prolonged parturition, increasing the risk of retained placenta [17, 35, 61–63]. Breeds like dairy cattle, particularly Holsteins, are often more susceptible. Selective breeding strategies can help identify and reduce these genetic risks.

Genetic Susceptibility

Inherited traits may influence the mechanisms of placental expulsion, such as uterine tone, hormonal regulation, and the ability to contract effectively after parturition. Genetic predispositions affecting placental detachment can lead to recurrent retained placenta in offspring [17, 35, 61, 62]. Understanding genetic factors can help in breeding animals with better reproductive health and a reduced likelihood of complications like retained placenta, improving herd productivity and welfare.

Toxins

Exposure to certain chemicals, environmental pollutants, or mycotoxins can interfere with placental detachment by disrupting hormonal balances or damaging uterine tissues [26]. These toxins may impair the normal physiological processes that trigger placental separation [64]. Ensuring proper feed management and minimizing exposure to harmful substances are essential to reduce the risk of retained placenta in livestock.

Overuse of Growth-Promoting Agents

The overuse of growth-promoting agents, such as hormones or antibiotics, can disrupt normal uterine function by altering hormonal regulation and affecting uterine contractility [36, 42, 44, 65]. Excessive hormonal treatments may interfere with the natural mechanisms that facilitate placental expulsion, leading to retained placenta. Managing the use of growth promoters and adhering to recommended guidelines can help mitigate these risks.

Prolonged Gestation

Gestation periods extending beyond the normal duration increase the risk of retained placenta. Prolonged gestation can result in an over-mature placenta, which may be more difficult to expel due to changes in placental structure and uterine muscle fatigue [17, 61, 62, 65, 66]. Monitoring pregnancy length and intervening, when necessary, can reduce the risk of retained placenta, ensuring both fetal and maternal health during parturition.

CONCLUSION

Retained placenta remains a critical barrier to reproductive efficiency, animal welfare, and economic sustainability in dairy production. Its multifactorial etiology demands a holistic understanding that integrates nutritional, hormonal, immunological, and management-related dimensions. Timely intervention, improved transition cow nutrition, periparturient stress reduction, and precise reproductive monitoring are essential for effective prevention and control. This study underscores the importance of aligning RP management with sustainable dairy development goals, particularly in resource-constrained and climate-stressed regions. Emphasis on integrative and context-specific strategies not only improves animal health and productivity but also enhances environmental and economic outcomes. Addressing retained placenta comprehensively is indispensable for building resilient dairy systems that are both productive and sustainable.

FUTURE DIRECTION

Future research should focus on elucidating the molecular and cellular mechanisms underlying placental detachment to identify reliable biomarkers for early prediction and diagnosis of retained

placenta. Advancements in reproductive genomics and proteomics may offer insights into genetic predisposition and breed-specific vulnerabilities, enabling targeted breeding strategies. There is also a need to refine nutritional protocols during the transition period, particularly concerning micronutrient balance, oxidative stress modulation, and immunocompetence enhancement. The integration of precision livestock technologies, including sensor-based health monitoring and automated calving alerts, can improve early detection and timely intervention. Moreover, region-specific management models that address climatic stressors and resource limitations must be developed to support sustainable outcomes. Collaborative on-farm research involving veterinarians, nutritionists, and farmers will be essential for validating practical strategies. A transdisciplinary approach is required to translate scientific evidence into actionable protocols that align animal health, productivity, and sustainability in modern dairy systems.

REFERENCES

1. Jain T, Yadav DK, S M. Retained placenta in bovines: Current understanding and future directions. 2024. doi: 10.33545/2618060x.2024.v7.i9sb.1428.
2. Kashoma I, Ngou AA. Retained fetal membrane in Tanzanian dairy cows: Economic impacts and subsequent reproductive performances. 2025. Available from: https://www.researchgate.net/profile/Athanas-Ngou/publication/388617005_Subsequent_Reproductive_Performances/links/679f3e6196e7fb48b9aeab18/Subsequent-Reproductive-Performances.pdf.
3. Rasmussen P, Machado VS, Kapur V, Thompson DN, Pinedo LA, Risco CA, et al. Global losses due to dairy cattle diseases: A comorbidity-adjusted economic analysis. *J Dairy Sci.* 2024;107(2). doi: 10.3168/jds.2023-24626.
4. Coman S, Berean DI, Cimpean R, Ciupe S, Coman I, Bogdan LM. Comparative evaluation of classic treatment and novel intrauterine infusion for retained placenta in buffaloes: Impacts on reproductive performance and economic losses. *Animals (Basel).* 2025;15(5):711. doi: 10.3390/ani15050711.
5. Huralska S, Yevtukh L, Hryshchuk H, Honcharenko V, et al. Technology of manufacture and efficacy of obstetric pessaries for preventive therapy in cows. *Sci Horizons.* 2025;28(4):9–19. Available from: https://sciencehorizon.com.ua/web/uploads/pdf/Scientific%20Horizons_2025_Vol.%2028,%20No.%204-9-19.pdf.
6. Amin YA, Hussein HA. Latest update on predictive indicators, risk factors and ‘Omic’ technologies research of retained placenta in dairy cattle – A review. *Reprod Domest Anim.* 2022;57(7):687–700. doi: 10.1111/rda.14115.
7. Kamel ER, Ahmed H, Hassan FM. The effect of retained placenta on the reproductive performance and its economic losses in a Holstein dairy herd. *Iraqi J Vet Sci.* 2022. doi:10.33899/ijvs.2021.130287.1791.
8. Küçükoflaz M, Sariözkan S. Financial losses related to placental retention in dairy herds in Turkey. *Pesqui Vet Bras.* 2022;42:e12782. doi: 10.1590/1678-4162-12782.
9. Mahnani A, Sadeghi-Sefidmazgi A, Ansari-Mahyari S, Ghorbani GR, Keshavarzi H. Farm and cow factors and their interactions on the incidence of retained placenta in Holstein dairy cows. *Theriogenology.* 2021;159:87–97. doi: 10.1016/j.theriogenology.2020.10.007.
10. Amin YA, Zakaria AM, Hasan AS. The efficacy of treatment of retained placenta with chlortetracycline and oxytetracycline through local intrauterine route in dairy cows. *J Anim Health Prod.* 2021;9(2):100–6. doi: 10.17582/journal.jahp/2021/9.2.100.106.
11. Baqir Y, Javid A, Ahmad M, Sajjad S, Ali Z, et al. Therapeutic management of milk fever with retained placenta in Holstein Friesian cows in a private dairy farm at Sheikhpura, Punjab-Pakistan. *Multidiscip Sci J.* 2021;3(3). doi: 10.29327/multiscience.2021015.
12. Magata F, Horiuchi M, Sato M, Masaki T, et al. Prevention of retained fetal membranes and improvement in subsequent fertility with oxytocin administration in cows with assisted calving. *Theriogenology.* 2021;176:200–5. doi: 10.1016/j.theriogenology.2021.09.037.
13. Abdisa T. Review on the reproductive health problem of dairy cattle. *J Dairy Vet Sci.* 2018;5(2). doi: 10.19080/jdvs.2018.05.555655.

14. Komba EV, Kashoma IP. Prevalence and economic impacts of retained placenta and subclinical mastitis in Tanzanian dairy cows. 2020. Available from: <https://www.researchsquare.com/article/rs-10984/latest>.
15. Kebede A, Mohammed A, Tadesse W, Abera D. Review on economic impacts of dystocia in dairy farm and its management and prevention methods. Nat Sci. 2017. Available from: <http://www.sciencepub.net/natureonline>.
16. Abdela N, Ahmed WM. Risk factors and economic impact of dystocia in dairy cows: A systematic review. 2016. Available from: https://www.researchgate.net/profile/Nejash-A-Ahmed/publication/303823978_Risk_Factors_and_Economic_Impact_of_Dystocia_in_Dairy_Cows_A_Systematic_Review/links/.
17. Tucho TT. Review on retention of placenta in dairy cows and its economic and reproductive impacts. J Nat Sci Res. 2017;7(7):28–37. Available from: www.iiste.org.
18. López-Gatius F. Twins in dairy herds: Is it better to maintain or reduce a pregnancy? Animals (Basel). 2020;10(11):2006. doi: 10.3390/ani10112006.
19. Islam M, Sarder M, Rahman M, Kader M, Islam M. Incidence of retained placenta in relation with breed, age, parity and body condition score of dairy cows. Int J Nat Sci. 2012;2(1):15–20. doi: 10.3329/ijns.v2i1.10878.
20. Yazlık MO, Kuru M, Baspınar N, Kaya U, Aydın I. The evaluation of superoxide dismutase activity, neutrophil function, and metabolic profile in cows with retained placenta. Theriogenology. 2019;128:40–6. doi: 10.1016/j.theriogenology.2019.01.020.
21. Seifi HA, Kia S. Subclinical hypocalcemia in dairy cows: Pathophysiology, consequences and monitoring. Iran J Vet Sci Technol. 2018;9(2):1–15. Available from: <https://ijvst2.um.ac.ir/index.php/veterinary/article/view/69198>.
22. Eger S, Drori D, Kadoori I, Miller N, Schindler H. Effects of selenium and vitamin E on incidence of retained placenta. J Dairy Sci. 1985;68(8):2119–22. doi: 10.3168/jds.S0022-0302(85)81077-8.
23. Allison RD, Laven RA. Effect of vitamin E supplementation on the health and fertility of dairy cows: A review. Vet Rec. 2000;147(25):703–8. doi: 10.1136/vr.147.25.703.
24. Bzuneh E, Alemneh T, Getabalew M. Milk fever (parturient paresis) and its economic impact in dairy cattle production. 2020. Available from: <https://www.researchgate.net/publication/343345516>.
25. Mordak R, Anthony SP. Periparturient stress and immune suppression as a potential cause of retained placenta in highly productive dairy cows: Examples of prevention. Acta Vet Scand. 2015;57:90. doi: 10.1186/s13028-015-0175-2.
26. Sheldon IM, Molinari PCC, Ormsby TJR, Bromfield JJ. Preventing postpartum uterine disease in dairy cattle depends on avoiding, tolerating and resisting pathogenic bacteria. Theriogenology. 2020;150:158–65. doi: 10.1016/j.theriogenology.2020.01.017.
27. Wiltbank MC, Baez GM, Cochrane F, Melo LF, Poole RK, Melo LF, et al. Pivotal periods for pregnancy loss during the first trimester of gestation in lactating dairy cows. Theriogenology. 2016;86(1):239–53. doi: 10.1016/j.theriogenology.2016.04.037.
28. Simões J, Stilwell G. Puerperal complications in the dam. In: Calving Management and Newborn Calf Care. 2021:209–37. doi: 10.1007/978-3-030-68168-5_9.
29. Hassan M, Nasreldin N, El-Zeftawy M. Serum biochemical investigations on retained placenta in Egyptian buffaloes. Adv Anim Vet Sci. 2020;8(1):67–76. doi: 10.17582/journal.aavs/2020/8.1.67.76.
30. Velladurai C, Selvaraju M, Napoleon RE. Effects of macro and micro minerals on reproduction in dairy cattle: A review. 2016. Available from: <https://www.academia.edu/download/80500967/230.pdf>.
31. Mordak R, Nicpoń J, Illek J. Metabolic and mineral conditions of retained placenta in highly productive dairy cows: Pathogenesis, diagnostics and prevention – A review. Acta Vet Brno. 2017;86(3):239–48. doi: 10.2754/avb201786030239.
32. Wilde D. Influence of macro and micro minerals in the peri-parturient period on fertility in dairy cattle. Anim Reprod Sci. 2006;96(3–4):240–9. doi: 10.1016/j.anireprosci.2006.08.004.

33. Xiao J, Fukhary A, Li R, Chen H, Yang L, et al. The antioxidant properties of selenium and vitamin E: Their role in periparturient dairy cattle health regulation. *Antioxidants*. 2021;10(10):1555. doi: 10.3390/antiox10101555.
34. Jovanović IB, Veličković M, Vuković D, Milanović S, Valčić O, Gvozdić D. Effects of different amounts of supplemental selenium and vitamin E on the incidence of retained placenta, selenium, malondialdehyde, and thyronines status in cows treated with prostaglandin F2 α for the induction of parturition. *J Vet Med*. 2013;2013:1–6. doi: 10.1155/2013/867453.
35. Yasothai R. Importance of protein on reproduction in dairy cattle. 2014. Available from: www.ijset.net.
36. Fahar I, Nawab A, Li G, Mei X, An L, Naseer G. Effect of nutrition on reproductive efficiency of dairy animals. *Med Weter*. 2018;74(6):356–61. doi: 10.21521/mw.6025.
37. Evans ACO, Zeng S. Causes, prevention and management of infertility in dairy cows. 2017. doi: 10.19103/as.2016.0006.20.
38. Mahnani A, Sadeghi-Sefidmazgi A, Ansari-Mahyari S, Ghorbani GR. Assessing the consequences and economic impact of retained placenta in Holstein dairy cattle. *Theriogenology*. 2021;175:61–8. doi: 10.1016/j.theriogenology.2021.08.036.
39. Cui D, Zhao Y, Chen X, Liu H, Bai Y, et al. Efficacy of an herbal formula Guixiong Yimu San in preventing retained placenta and improving reproductive performance in cows. *Sci Rep*. 2024;14:63521. doi: 10.1038/s41598-024-63521-x.
40. Esposito G, Irons PC, Webb EC, Chapwanya A. Interactions between negative energy balance, metabolic diseases, uterine health and immune response in transition dairy cows. *Anim Reprod Sci*. 2014;144(3–4):60–71. doi: 10.1016/j.anireprosci.2013.11.007.
41. Esposito G, Irons PC, Webb EC, Chapwanya A. Interactions between negative energy balance, metabolic diseases, uterine health and immune response in transition dairy cows. *Anim Reprod Sci*. 2014;144(3–4):60–71. doi: 10.1016/j.anireprosci.2013.11.007.
42. Yusuf JJ. A review on retention of placenta in dairy cattles. *Int J Vet Sci*. 2016. Available from: www.ijvets.com.
43. Li Y, Zhang L, Shao G, et al. Plasma metabolomics reveals pathogenesis of retained placenta in dairy cows. *Front Vet Sci*. 2021;8:697789. doi: 10.3389/fvets.2021.697789.
44. Rao TKS. Fetal membranes and associated complications in dairy animals: A review. *Theriogenology Insight*. 2018;8(3). doi:10.30954/2277-3371.03.2018.6.
45. Li Y, Wang Y, Teng X, et al. Potential prognostic markers of retained placenta in dairy cows identified by plasma metabolomics coupled with clinical laboratory indicators. *Vet Q*. 2022;42(1):199–212. doi: 10.1080/01652176.2022.2145619.
46. Smith BI, Risco CA. Management of periparturient disorders in dairy cattle. *Vet Clin North Am Food Anim Pract*. 2005;21(2 Suppl):503–21. doi : 10.1016/j.cvfa.2005.02.007.
47. Fricke PM, Shaver RD. Managing reproductive disorders in dairy cows. 2001. Available from: <https://www.researchgate.net/profile/Paul-Fricke/publication/251762927>.
48. Bačić G, Karadjole T, Mačević N, Karadjole M. A brief review of etiology and nutritional prevention of metabolic disorders in dairy cattle. 2007. Available from: <http://image.sciencenet.cn>.
49. Bonneville-Hébert A, Bouchard É, Du Tremblay D, Lefebvre R. Effect of reproductive disorders and parity on repeat breeder status and culling of dairy cows in Quebec. *Can J Vet Res*. 2011;75(2):147–51. Available from: <https://www.ingentaconnect.com>.
50. Oresnik A. Effect of health and reproductive disorders on milk yield and fertility in dairy cows. *Bov Pract*. 1995;29:43–5. doi: 10.21423/bovine-vol1995no29p43-45.
51. Qu Y, Fadden AN, Traber MG, Bobe G. Potential risk indicators of retained placenta and other diseases in multiparous cows. *J Dairy Sci*. 2014;97(1):923–32. doi: 10.3168/jds.2013-7154.
52. Rodríguez EM, Aris A, Bach A. Associations between subclinical hypocalcemia and postparturient diseases in dairy cows. *J Dairy Sci*. 2017;100(5):4427–34. doi: 10.3168/jds.2016-12210.
53. Galvão KN. Postpartum uterine diseases in dairy cows. *Anim Reprod*. 2012;9:290–6. Available from: <https://www.animal-reproduction.org>.

54. López-Gatius F, Santolaria P, Yániz J, Fenech M, López-Béjar M. Risk factors for postpartum ovarian cysts and their spontaneous recovery or persistence in lactating dairy cows. *Theriogenology*. 2002;58(8):1623–32. doi: 10.1016/S0093-691X(02)01046-4.
55. Opsomer G, de Kruif A. Metritis and endometritis in high yielding dairy cows. *Vlaams Diergeneeskdt Tijdschr*. 2009. doi: 10.21825/vdt.87500.
56. Onyango J. Cow postpartum uterine infection: A review of risk factors, prevention and the overall impact. 2014. Available from: <https://www.researchgate.net>.
57. Amin RU, Bhat GR, Ahmad A, Swain PS, Arunakumari G. Understanding patho-physiology of retained placenta and its management in cattle – a review. *Vet Clin Sci*. 2013. Available from: www.jakraya.com/journal/vcs.
58. Walsh SW, Williams EJ, Evans ACO. A review of the causes of poor fertility in high milk producing dairy cows. *Anim Reprod Sci*. 2011;123(3–4):127–38. doi: 10.1016/j.anireprosci.2010.12.001.
59. De Vliegher S, Fox LK, Piepers S, McDougall S, Barkema HW. Invited review: Mastitis in dairy heifers: Nature of the disease, potential impact, prevention, and control. *J Dairy Sci*. 2012;95(3):1025–40. doi: 10.3168/jds.2010-4074.
60. Galvão KN. Uterine diseases in dairy cows: Understanding the causes and seeking solutions. *Anim Reprod*. 2013;10(3):228–38. Available from: <https://animal-reproduction.org>.
61. Bruun J, Ersboll AK, Alban L. Risk factors for metritis in Danish dairy cows. *Prev Vet Med*. 2002;54(2):179–90. doi: 10.1016/S0167-5877(02)00026-0.
62. Crowe MA, Hostens M, Opsomer G. Reproductive management in dairy cows: The future. Springer; 2018. doi: 10.1186/s13620-017-0112-y.
63. Tucho TT. Review on retention of placenta in dairy cows and its economic and reproductive impacts. 2017. Available from: www.iiste.org.
64. Ghavi Hossein-Zadeh N. Effects of main reproductive and health problems on the performance of dairy cows: A review. *Span J Agric Res*. 2013;11(3):718–35. doi: 10.5424/sjar/2013113-4140.
65. Larson LL, Ishak MA, Owen FG, Erickson ED, Lowry SR. Relationship of physiological factors to placental retention in dairy cattle. *Anim Reprod Sci*. 1985;9(1):31–43. doi: 10.1016/0378-4320(85)90039-9.
66. Patel RV, Parmar SC. Retention of fetal membranes and its clinical perspective in bovines. *Sch J Agric Vet Sci*. 2016;3(2):111–6. Available from: <http://saspjournals.com/sjavs>.