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Abortion's Impact on Heidelberg Dairy Cow Milk Output, Wellness, And Reproductive Performance: A Systematic Review

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Abstract

A vital part of the world's food supply is the dairy business, where the productivity and health of dairy cows are essential to the production of milk throughout time. The purpose of this systematic study is to look at the way abortion affects the reproductive health, milk production and general well-being of Heidelberg dairy cows. Numerous reasons, such as dietary deficits, environmental stresses and infectious illnesses, can lead to abortion episodes in dairy cows. Abortion, which is the natural ending of pregnancy between 42 and 260 days, affects the reproductive success, viability of herds and milk production, all of which have a substantial financial influence on dairy producers. The abortion records were divided into two categories: 1) new abortions (NLA) and 2) rebreeding abortions (RA). Examining the long-term consequences on reproductive capacity, overall measures of cow health and the physiological implications on milk production, the study dives into the subject. We look at how variables like breed, season, age and parity affect abortion rates. The current findings indicate that milk production dropped in cows with abortions that were categorized as NLA or RA. The results show that the abortion rate is 3.77 percent, with some variation by breed and season. The research highlights how crucial it is to understand these intricate interactions to maintain reproductive health in dairy herds efficiently. This information helps to reduce the financial losses brought by abortion incidents while enhancing the sustainability and effectiveness of dairy production.

Keywords: Dairy cow abortion, Milk production, Reproductive performance, Holstein herds, Days Not Pregnant (DNP), Probability of Pregnancy at Age (PPA)

INTRODUCTION

Milk production, animal well-being and reproductive success are impacted by the wealth of aspects that make up dairy cow management. An essential and complex phenomenon, abortion in dairy cows is one of the most important reproductive occurrences (1). The complex relationship between abortion occurrences and three critical variables milk production, cow health and reproductive success is the focus of this investigation. Dairy herd profitability is dependent on reproductive performance, which is affected by voluntary and involuntary variables (2). The former includes daily production of milk for each cow, age and extra to the herd; the latter includes disease, injury, infertility and death, which causes eliminating rates. Another important factor in dairy enterprises' profitability is the cost of breeding and the rate of genetic development (3). Decreases in income for dairy producers can be attributed, in large part, to health problems and reproductive complications; particularly to late-pregnancy abortions. The term abortion is used in the context of dairy farming to describe the natural termination of a pregnancy that happens between 42 and 260 days into the pregnancy (4). Economic efficiency can be diminished as a result of this

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reproductive challenge's potential to affect dairy farms' output and reproductive competence. Loss of a pregnant cow reduces herd viability and productivity because fewer females are available to replace lost mothers and less milk is produced during the lifespan of the herd (5). The economic losses linked to this reproductive abnormality are exacerbated since abortion leads to increased expenditures for breeding and early removal. The unidentified nature of connected causes makes addressing the matter of abortion in cattle, which is economically significant for farmers, a tough undertaking. Up to 57.3% of instances are attributable to unknown components. Utilizing predictive methodologies based on recognized and anticipated risk factors is a strategic way to limit the financial impact of abortion (6). Preventing implantation or improving care for extremely dangerous cows are two actions that could be placed based on abortion probability forecasts, which can reduce the occurrence of pregnancy losses and the economic difficulties associated with them. These studies in this area had their constraints imposed by their exclusive concentration on herd-cow variables (7). A significant portion, about 57.3%, of abortions is thought to be caused by random chance. To improve the accuracy of abortion event forecasts, it is essential to examine other factors outside herd and cow dynamics. Both sheep and cattle have a genetic susceptibility to give birth. Heritability estimates for abortion have remained consistently below 0.10, similar to other reproduction characteristics. This means that additive genetic variables the animal's genotype concerning important genes that increase the probability of abortion, can clarify 10% of the observed variance in abortion occurrences. Predicting pregnancy losses using bovine genetic characteristics, as evaluated by the sire's anticipated transmission ability (PTA), appears to be a good avenue to explore (8). The use of stallion PTA, such as pregnancy rate, to predict insemination results is consistent with this paradigm. According to previous research, sire PTA is a strong predictor of successful insemination, which suggests it might be used for reliable pregnancy outcome prediction evaluations. Abortions performed later in pregnancy cause the early removal of cows from the herd, which increases the replacement costs for farmers, whereas abortions performed earlier in pregnancy are linked to a longer time between calves (9). In addition to influencing culling times, abortion impacts milk output, days not pregnant (DNP), calving interval and merit occurrences. Notably, there seems to be a correlation between abortion rates and mastitis susceptibility in cows, indicating a complicated interplay between both health issues (10). Figure (1) displayed the Unraveling the Dynamics of Abortion impacts.

The Complex Phenomenon of Dairy Cow Abortion

There is a complicated interaction between inherited, dietary, environmental and viral variables that causes abortions in dairy cows. To appreciate the larger effects of abortion occurrences on the general well-being and output of dairy herds, it is crucial to understand the dynamics of these components.

Using Milk Production to Evaluate a Cow's Well-being

An important measure of a dairy cow's health and an economic indication, milk production is fundamental to the dairy industry. In this part, we examine the potential physiological effects of abortion on breastfeeding, including changes in hormone levels as well as stress reactions and how these variables can affect milk production.

Metrics for Wellness: Extending Beyond Milk Yield

As a whole, dairy cow health is measured by more than milk yield. Study after study has shed light on the potential effects of abortion on dairy cows' health, including their resilience, immunological function and physical condition.

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Maximizing Reproductive Potential and Stability

The reproductive abilities of dairy cows might be permanently affected by abortions. To better understand the reproductive sustainability of dairy herds in longer operations, this section examines how abortions can affect estrous cycles, conception rates and calving intervals.

Importance to Dairy Producers and Others in the Sector

Improving efficiency without affecting animal well-being is a major priority for the ever-changing dairy business. We highlight the potential advantages of a more complex knowledge of abortion's effect on the health and performance of dairy cows, as well as the practical implications of our work for veterinarians and dairy producers. This study provides an overview of the study's aims and methods used to examine the complex connections between abortions, milk production, cow health and reproductive efficiency. By tackling these goals, we want to provide useful information for the continuing campaigns to make dairy production more sustainable and efficient.

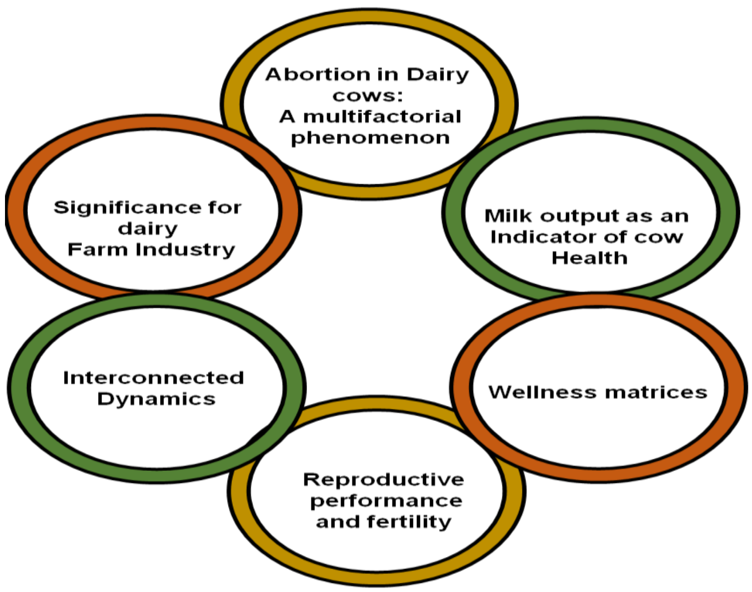

Figure (1). Abortion's Impact on Dairy Cow Health, Milk Production

(Source Author)

Holstein Dairy Herd Reproductive

The pregnant cow used in this research was from nine dairy herds of Holsteins that were well-managed. Services involving heat synchronizing and performance assessment of cows were included in the routine veterinary treatment these herds acquired. On average, the herds produced 32 kg of milk each day, with herd sizes varying from 700 to 6,000 cows (11). In addition to immunizations against an illness foot-and-mouth disease (FMD) and blackleg, young stocks were vaccinated against strains 19 of Bacillus aborts. The herds were chosen at random from more than one hundred herds in Tehran province using an electronic registration system. A total of 30,403 pregnancies involving 12,265 cows were included in the data since the research included cows that had at least one previous verified pregnancy (12). Because the variables that are considered could only be measured in cows that had given birth at least once, this requirement was crucial to the model. Between 40 and 50 days into the pregnancy, the initial diagnosis was established, between 160 and 170 days into the pregnancy, the gastrointestinal region was examined to confirm the pregnancy. To prevent registration errors and guarantee accurate data, we evaluated cows with non-pregnant intervals spanning from 1 to 12 months (13).

Reproductive performance

Treatment of postpartum reproductive disorders continued until the patient made a complete recovery, a pregnancy was confirmed, or the animal was destroyed. Participants in this research willingly withheld food and drink for 45 days from the time of calving to the first mechanical implantation. To recognize when a cow is pregnant, trained observers watched the animal twice a day (14). Countless variables were meticulously documented, including the day of first services, the number of procedures per development, day's accessible and calving interval. Sixty days after artificial insemination, a thorough assessment of the reproductive system was carried out to determine the state of pregnancy, involving rectal exploration of the endometrial tissues (15).

Risk factors affecting abortion

There were 79 abortions out of a total of 2098 pregnant cows, which is a 3.77% abortion rate. Although it falls anywhere between 0.6% and 1.2% for dairy cows, this percentage is more than the 1.17% perceived for cattle maintained under large pasture systems. A study of 1,001 pregnant dairy cows found a total incidence of 6.9% pregnancy loss. Similarly, the reported frequency of abortion in cattle herds falls anywhere between 0.6% and 4.5% at present (16). The experts suggest that parents should be worried about an abortion rate higher than 3% and look into getting a diagnosis. The actual rate of abortion can be lower than that which is reported, particularly in cases when the pregnancy remains in the beginning stages (less than 60 days) and the removal of the pregnancy and brain has not been visible or documented (17). Factors including as biological appearance, dietary habits, herd management techniques, local climate and disease prevalence explain that abortion rates could vary across herds. Successful herd health management and resolving any concerns associated with abortion rates need an understanding of these elements (18). A comprehensive understanding of the many factors involved and the ability to identify cases efficiently and precisely are essential for the implementation of successful abortion prevention strategies. The research highlights the challenges in determining the exact reasons for abortion in cattle since several elements might interfere with the regular functioning of the gestational system. Included in this category are infectious agents, dietary deficiencies, hormonal imbalances, toxic exposure, immunizations, physical stresses and chromosomal abnormalities (19). The abortion rate in Friesian cows was 4.19 percent, which is higher than the rates in crossbred cows (3.62% and 2.94%, respectively), as shown in Table (1). Based on these findings, it suggests the breed of cow has no effect on the abortion rate. As a result, a more effective and focused management strategy for reducing abortions in bovine herds can be achieved by using a holistic approach that takes into account the wide variety of possible reasons (20). The information shows that the prevalence rate is highest in the summer at 5.44%, followed by winter at 3.60%, autumn at 3.55% and spring at 2.39%. Fall and winter had non-statistically significant increases in likelihood (0.71 to 3.27; P=0.280) and 1.50 times (0.70 to 3.21; P=0.292) of spring, respectively. According to these results, there could be a link between environmental factors and the frequency of abortions, with the existence of infections playing a role (21). This is consistent with previous studies that found heat stress during certain months to be associated with an increased chance of miscarriage. Heat stress can induce fetal hypertension, hypoxia and acidity, which can explain why there is an increase in miscarriages over the summer, according to earlier research. While it's true that a rapid increase in temperature might trigger abortion, there isn't an abundance of data lot suggests that heat stress is a frequent cause of abortion (22). It stresses the intricacy of the link between environmental variables and abortion by highlighting protective factors such as amniotic fluid. The study's findings are consistent with earlier research that has shown comparable patterns, such as a pregnancy loss ratio in the summer

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as opposed to lower rates in the winter and autumn. High temperatures can cause heat stress and abortion in animals, which explains why there are large discrepancies in the estimations (23).

Abortion is indicated to be more common in older cows than in younger ones and the rates vary among parity categories (24). The tendency was confirmed by logistic regression analysis, which showed that third or higher-parity cows had a 2.13 times greater chance of abortion compared to first-parity cows. This discovery was significant (P=0.011). Even though the outcome was not significant (P=0.328), second parity cows showed a 1.45 times greater chance (25).

Table (1). Odds Ratios and 95% CI for Abortion Incidence in Multivariable Logistic Regression: Egyptian Context (Source Author)

Variable	95% CI	Abortion (%)	Odd ratio	No	P-value
Season of abortion					
Winter	(1.71-4.28)	15.36(4.61%)	2.53	584	0.281
Spring		17.73(3.40%)	2	419	
Summer	(2.13-5.93)	18.09(6.45%)	3.36	479	0.025
Autumn	(1.71-4.22)	17.37(4.56%)	1.51	620	0.293
Parity number					
1		16 (3.34%)	2	645	
2	(0.70-3.04)	15 (3.34%)	1.46	421	0.329
≥ 3	(1.20-3.84)	51 (5.85%)	2.14	1035	0.012
Cow breed					
Friesian	(0.78-2.72)	45 (5.20%)	1.45	1050	0.253
Ballad	(0.65-2.50)	23 (4.63%)	1.25	608	0.545
Crossbred		14(3.95%)	2	443	

(Source Author)

The impact of abortion on conception rates

The intricate process of giving birth in cattle is shown in Table (2), which displays the impact of stillbirth and abortion on various fertility indices among breeds. Complications might interrupt the complicated process, which is determined by developmental signals, hormonal dynamics and impact reproductive effectiveness (26). The data shows that the number of days until the first service after an abortion is much longer than the typical calving time, at 83.9±19.1 or 126.5±23.9 days, compared to 75.1±17.2 days. The significance level is P<0.05. Notably, the first service was delayed by 51.4 days due to stillbirths, while the first service was delayed by 8.8 days due to abortion. As a result of the acute stress caused by difficult calving, hypothalamus function is affected, leading to aberrant ovarian activity and delays in the surge of luteinizing hormone (27). To make things worse, inflammation blocks FSH-induced cAMP synthesis and inhibits FSH's effect on LH receptor development. Pregnancy loss, postoperative intervals and uterus disorders are some of the reproductive problems in dairy cows that are covered in the given material. Changes in nitric oxide production suppressing GnRH can influence LH pulsatile secretion after endotoxin exposure since cytokines are released (28). Due to factors including delayed uterine involution and a higher risk of endometritis, the average time between a third-trimester pregnancy loss and the first service is longer. Estrous cyclist resumes sooner after giving birth in cows that do not have uterine diseases (29). Ovulation resumption can be hindered if germs are present in the postpartum uterus, which affects ovarian follicular activity. The amount of services provided every conception is affected by abortion (P<0.05), as shown in Table (2). A significant increase (P<0.05) was observed in the number of services per conception in the first group (2.7±1.1) and the second group

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(4.9±1.3) when comparing cows who had miscarriages or stillbirths to those delivered healthy calves (30). A higher average of 4.1 inseminations per parturition after an abortion and 5.3 after a stillbirth are consistent with this discovery in pure Holstein cows, whereas 3.2 inseminations per normal calving are in line with previous research. Researchers have shown that uterine illnesses including metritis and clinical endometritis affect the success of artificial insemination pregnancies. Large-scale research with 2,793 cows found that reproductive efficiency was greatly diminished during the mating season due to clinical endometritis, which affects 21.2% of the population (31).

Table (2). Factors influencing reproductive success after abortion (Source Author)

Trait	Normal calving	Abortion	Stillbirth
Number of services to conception			
Ballad	$1.6±0.6^{c}$	$3.0±1.0^{b}$	$4.0±1.6^{a}$
Overall mean	$1.9±1.0^{c}$	$2.8±1.2^{b}$	$5.0±1.4^{a}$
Crossbred	$1.8±1.2^{b}$	$2.8±1.4^{b}$	$4.7±1.2^{a}$
Friesian	$2.2±1.0^{c}$	$3.1±1.2^{b}$	$5.3±1.2^{a}$
Calving interval (day)			
Ballad	$388.5±56.1^{b}$	$409.9±43.6^{ab}$	$439.7±57.4^{a}$
Overall mean	$403.3±54.4^{c}$	$432.8±48.2^{b}$	$478.1±39.3^{a}$
Friesian	$412.5±46.8^{c}$	$442.6±49.9^{b}$	$491.8±20.8^{a}$
Crossbred	$406.8±60.9^{a}$	$434.5±44.1^{a}$	$459.5±46.6^{a}$
Days to first service (day)			
Ballad	$63.2±15.5^{b}$	$71.2±10.^{b}$	89.6±10.0+
Overall mean	$75.2±17.3^{C}$	$84.0±19.1^{b}$	$126.6±24.0^{a}$
Friesian	$85.0±14.2^{b}$	$90.4±20.9^{b}$	$140.9±9.4^{a}$
Crossbred	$75.2±17.3^{c}$	$84.0±20.2^{b}$	$126.6±24.0^{a}$
Days open (day)			
Ballad	$92.2±35.8^{b}$	$112.9±29.5^{b}$	$148.5±55.0^{a}$
Overall mean	$109.5±36.8^{c}$	$139.0±45.9^{b}$	$183.0±35.1^{a}$
Friesian	$122.8±24.6^{c}$	$150.9±47.8^{b}$	$194.3±18.1^{a}$
Crossbred	$108.3±47.0^{b}$	$140.0±48.8^{ab}$	$172.3±39.9^{a}$

A Predictive Analysis of Pregnancy Abortion Factors

This research summarizes the regression coefficients and their Population Odds Ratio (POPR) based on the logistic regression analysis that was carried out. Significant herd and seasonal effects were considered in the study. According to the results, several variables raise the risk of abortion in dairy cows (32). In addition, the abortion rate was much greater in summer-inseminated cows than in other seasons.

Survival Review

The outcomes of gestation rank (GR), non-pregnancy interval (NPI), gravidity (G) and abortion timing (L) were accounted for in the survival model. The non-pregnancy interval was not significant, GR. There was an increased chance of fetal mortality during gestation due to previous abortions. Pregnancies whose mothers had abortions before 60 days of gestation or whose mothers had a higher gravidity had a better probability of surviving during a certain non-pregnancy time (33). However, abortions that occurred after 60 days had a decreased rate of fetal survival. The risk for a typical cow with a 120-day open period, three prior pregnancies, a 4.5-year-old gestational age and winter insemination varies depending on her abortion time. The risk of abortion is highest around 64 and 122 days into the pregnancy, with a small increase at 210 days. Improving and controlling cow reproductive health requires an understanding of survival probability and dangers.

Age and Parity Effects on Cow Pregnancy Outcomes

The Probability of Pregnancy at Age (PPA) increases with age, even if breeding for cows with a high risk of abortion is pursued. There is a new lactation number for abortions that happen beyond 152 days of gestation, according to Dairy Herd Improvement (DHI) regulations. Although there is no clear evidence to differentiate between second and third lactation, it is known that greater lactations are associated with an increased chance of abortion (34).

Gravidity

According to studies, the results of a cow's pregnancy are affected by their gravidity. It has been shown that greater gravidity is associated with increased fetal maintenance throughout the pregnancy (35). The probability of successfully delivering a baby to a 4.5-year-old cow that was inseminated in the winter with 120 days of open gestation and no history of abortions during the previous gestation fell by 13% between gravidity 2 and gravidity 4. This could be because cows get some protection from infectious pathogens throughout their pregnancy. As breeders want to keep fertile animals, the selective removing strategy based on reproductive performance might tilt the representation towards heavily gravid cows (36).

Earlier abortions

Before abortion is a major risk factor for recurrent miscarriages in cows, especially when it comes to infectious agents such as Neosporin caninum. The risk of recurrence, linked to further abortions, differs from the diverse risk caused by inherent cow problems. Time to abortion (TTA) in future pregnancies is affected by the result of previous pregnancies, whether they were successful, aborted at <60 days, or >60 days of gestation (37). A possible preventive function of early abortion against infectious agents and false-positive pregnancy diagnoses is that it influences TTA, which is influenced by the impact of prior abortions before or after 60 days of gestation. Significantly, for Tehranian cows, the effect of a ≤60 day abortion on TTA is different, particularly in terms of postponing subsequent pregnancies. Further complicating efforts to decipher cow reproductive patterns, this abortion method somewhat heightens postpartum anestrous (PPA). A better understanding of the complex relationship between infectious agents, the timing of abortions and the reproductive outcomes in cows is provided by these results (38). An extensive examination of Herd 7's background was necessitated given its significantly elevated abortion rate displayed in Figure (2) and Table (3). This herd's very high Net Pregnancy Advantage (NPA) suggests possible shortcomings in reproductive management compared to others. Milk production was above normal and when deciding whether to reduce the herd, it was more important than considering reproductive reasons. It is worth mentioning that the interaction between age and the frequency of past abortions was found to be significant among Tehranian cows and not in herds from California. There was a significant increase in danger for Tehranian herds from 50 to 90 days and then a less dramatic increase from 100 to 150 days. This research highlights the need for individualized monitoring schedules and calls attention to the fact that the two groups can have different causes (39).

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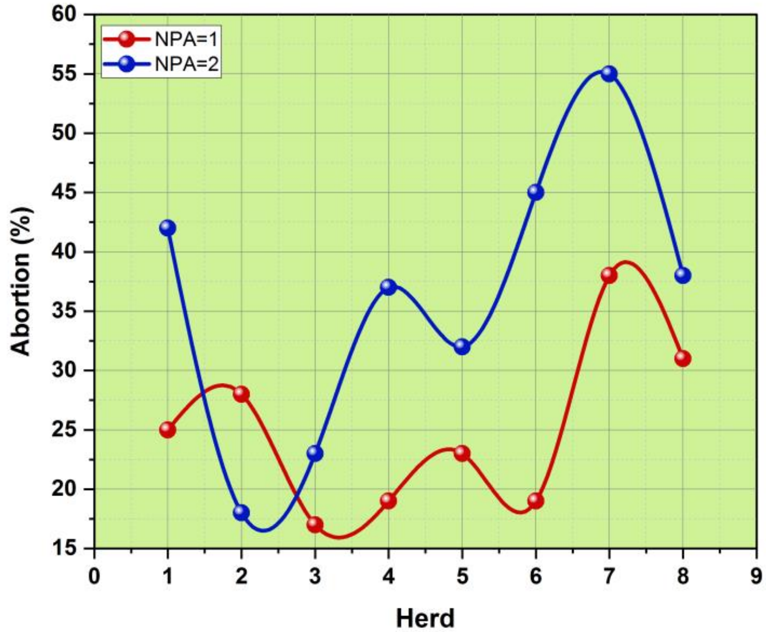

Figure (2). Comparative Abortion Rates in Dairy Herds Based on NPA Categories

(Source Author)

Table (3). Numerical outcomes of Abortion Rates in Dairy Herds (Source Author)

	Abortion (%)	
Herd	**NPA=1**	**NPA=2**
1	25	42
2	28	18
3	17	23
4	19	37
5	23	32
6	19	45
7	38	55
8	31	38

Seasonal effects

Cows inseminated during summer exhibited an increased abortion frequency, contrasting with the lowest abortion probability observed the winter shows in Figure (3) and Table (4). The odds ratio of abortion between winter and summer indicated a lower risk during winter. No significant disparity in abortion rates was found between cows inseminated during autumn and spring (40). While some studies found no correlation between the time of insemination and the frequency of miscarriages, another found the opposite to be true: an increase in abortions throughout the fall. Pregnancy termination is more likely in the summer due to heat stress and other variables like glandular function, ratio and sensational organisms.

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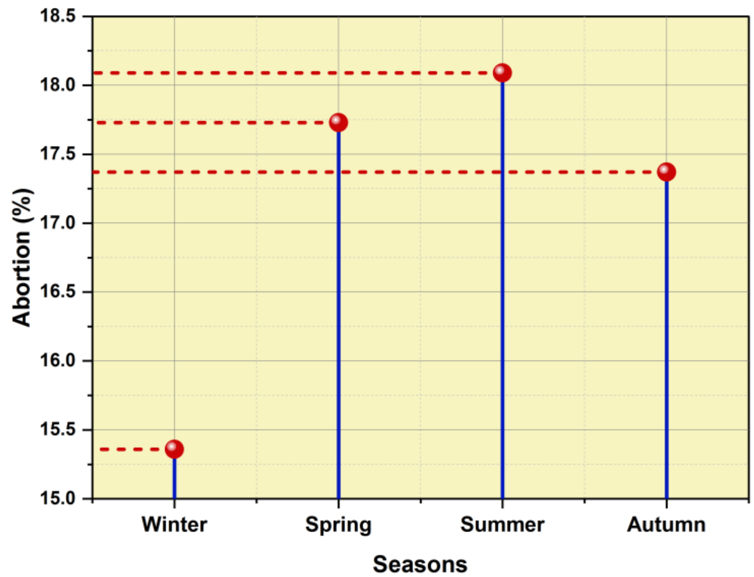

Figure (3). Seasonal Variations in Abortion Rates among Dairy Cows

(Source Author)

Table (4). Numerical Outcomes of Seasonal Variation (Source Author)

Seasons	Abortion (%)
Winter	15.36
Spring	17.73
Summer	18.09
Autumn	17.37

CONCLUSION

This comprehensive research explains the substantial effects of abortion on Heidelberg dairy cows' reproductive health, milk production and general well-being. The findings demonstrate the diversity of abortion cases, influenced by breed, age, season and equalization, among other factors. Differentiating between RA and NLA allows for a more detailed examination of the consequences on cows' health and fertility over a long period of time. The stated abortion rate of 3.77% highlights the need for holistic methods of managing reproductive health and the monetary impact on dairy producers. The reduction in milk production linked to abortion incidents highlights the need to reduce these instances even further. Through educated management of reproduction methods, dairy farmers can maximize production efficiency, minimize financial losses and improve sustainability with the help of the useful information provided by this research. The Heidelberg dairy cows were the main subject of this research, therefore generalizing the results to other breeds or geographic areas could require some care since management styles and environmental factors are possible. To better control reproductive health and minimize abortions, greater studies might examine the genetic and molecular variables that affect dairy cows' sensitivity to abortions.

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