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Review
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SOME REPRODUCTIVE DEFECTS IN FARM ANIMALS

Ömer Faruk YILMAZ[1]*, Mehmet Akif ÇAM[1]

[1]*Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Türkiye*

Abstract: The importance of animal products for human health and development cannot be ignored. It is important for the sustainability and profitability of the enterprises that the animals raised do not have problems in terms of reproduction, as well as in terms of meeting the demand for animal products regularly. Depending on the type of animals used in production, the number of offspring obtained in a production period varies according to the reproductive activities of the animals and the care and management methods of adding the obtained offspring to the economy. In terms of reproductive efficiency in animal production enterprises, few or many reproductive problems seen in animals do not completely prevent the realization of reproductive performance at the optimal level. The formation of a new individual in farm animals covers the process until birth, such as the formation of gamete cells, fertilization, embryo implantation and fetal development. At the same time, the postnatal factors that take place from the birth of the new individual to its entry into the economy are also part of this process. Depending on the animal species, rates of embryo losses, genetic defects, losses due to disease and losses due to care and feeding errors can vary. The care that owners take in the selection of animals and the care and management methods they apply to them is decisive in reducing possible losses, obtaining more offspring and ensuring the profitability and sustainability of the business. In this review, it is aimed to explain the problems such as embryo losses, fetal losses and loss of offspring during and after birth and the precautions that can be taken against these problems in the process from the beginning of the formation of a new individual in livestock breeding until the new individual is brought into the economy.

Keywords: Reproductive disorders, Embryo losses, Care-management errors, Offspring losses

***Corresponding author:** Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Türkiye
E mail: omer.yilmaz@omu.edu.tr (Ö. F. YILMAZ)
Ömer Faruk YILMAZ https://orcid.org/0000-0002-1411-7897
Mehmet Akif ÇAM https://orcid.org/0000-0003-3407-3913

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1. Introduction

The reproductive health of farm animals is one of the cornerstones of the livestock sector. The reproductive health of farm animals is important for the sustainability and profitability of farms and for meeting the demand for animal products regularly. However, reproductive defects are a serious problem that is frequently encountered in farm animals and can occur for various reasons. Reproductive defects reduce the reproductive efficiency of animals, decrease the survival rate of offspring and may adversely affect their general health status. This situation causes economic losses in farm enterprises and threatens animal welfare.

Reproduction in farm animals is a critical trait for sustainability, product continuity, business profitability and animal breeding studies. As a result of increasing the amount of product obtained per unit animal, reproductive results have started to experience disruptions.

In animal production, the main objective is to ensure that reproductive activities are carried out regularly and smoothly, that each gamete cell, which has the potential to be born alive as a new individual, develops without loss and is brought to the economy. In order to achieve this goal, losses should be avoided or minimized at all stages of reproduction and from the birth of a healthy individual until it is brought into the economy. When reproductive losses are analyzed, it is reported that the highest rate (20%-50%) occurs during the acceptance of the embryo by the maternal (Dixon et al., 2007; Abdel-Mageed and Abd El-Gawad, 2015; Campanile et al., 2021). In developing reproductive biotechnologies, it is reported that losses in in-vitro embryo production are reported to 60%-70%, and pregnancy rates in in-vitro produced embryos vary between 10%- 40% (Ealy et al., 2019).

Embryo losses prior to maternal acceptance vary between species and, within species, between breeds. The lack of satisfactory progress in reducing pre-implantation embryo losses is due to a poor understanding of the functioning of this period (Campanile et al., 2021).

Reproductive defects can be caused by genetic factors (Berry et al., 2017; 2018), environmental factors, inadequate care and feeding conditions and infections (Ali et al., 2015; Akbarinejad and Robert, 2024). Genetic factors include structural abnormalities and hereditary diseases. Environmental factors that cause reproductive defects include hygienic conditions of the environment, climate change and stress factors. Nutrition is an important factor that directly affects reproductive health.

Nutritional deficiency can impair the functions of reproductive organs and reduce reproductive performance. Infections, on the other hand, can cause reproductive disorders and infertility by directly affecting the reproductive organs (Ali et al., 2015; Akbarinejad and Robert, 2024).

The formation of the new individual in livestock includes processes starting from the production of gametes and continuing until parturition, such as fertilization, embryo implantation and fetal development (Uju and Unniappan, 2024). At the same time, postnatal factors, which continue until the parturition of the new individual and its introduction into the economy, are also part of this process. Depending on the animal species, rates of embryo losses, genetic defects, losses due to disease and losses due to care and feeding errors can vary (Dixon et al., 2007; Abdel-Mageed and Abd El-Gawad, 2015; Ealy et al., 2019; Campanile et al., 2021). The care of the owners in the selection of the animals and the care and management methods they apply to them is decisive in reducing possible losses, obtaining more offspring and ensuring the profitability and sustainability of the farm.

In this review, it is aimed to present the problems such as embryo losses, fetal losses, and loss of offspring during and after birth and the measures that can be taken against these problems in the process from the beginning of the formation of a new individual until it is brought into the economy.

2. Female Reproductive System and Offspring Yield

The formation of a new individual in farm animals begins with the coming together of mature female and male gamete cells in a suitable environment. The production of mature female and male gamete cells takes place in healthy individuals that reach sexual maturity and do not have anatomical and physiological problems in the reproductive system (Lea and England, 2019). In normal production systems, errors in the care and feeding conditions of male and female individuals affect sexual maturity and cause a decrease in the number of offspring to be obtained from an individual for a lifetime. In the process following the fusion of gametes (fertilization, embryo), the primary responsibility for the survival, development and birth of the new individual depends on the female individual who carries it as a zygote, embryo and fetus (Lonergan et al., 2023). Here, the possible situations that can be encountered in the process starting from the gonad structures responsible for the production of gametes related to each sex and until the age of the offspring's economicization after birth will be evaluated.

2.1. Dysfunction of the Ovaries

Ovarian dysfunctions in farm animals are important health problems affecting the reproductive ability of female animals. These disorders reduce fertility rates by preventing the production of sufficient and healthy eggs from the ovaries. Ovarian dysfunctions can occur as a result of the combined effects of one or more of several causes such as disease, infection (Davis, 2019), nutritional deficiencies and imbalances (Ali et al., 2015), including temperature increase due to climate change (Chen et al., 2021).

2.1.1. Ovarian cysts

Ovarian cysts are a common ovarian disorder in farm animals. These cysts are fluid-filled sacs that grow abnormally in the ovary and adversely affect the reproductive cycle. Clinical signs vary depending on the number of cysts and the degree of luteinization. Ovarian cysts are more common in dairy cattle and reproductive problems in dairy cattle triple when milk production doubles (Lonergan et al., 2023; Steeneveld et al., 2024). Ovarian cysts are rare in sheep and goats. Ovarian cysts cause impaired ovarian function due to disruption of the hormonal mechanism (Viana et al., 2021), frequent and irregular estrus and constant desire to mate in animals (Kaymakçı, 2002; Roy et al., 2024).

2.1.2. Ovarian hypoplasia

Ovarian hypoplasia is a condition in which the ovaries are smaller and underdeveloped than normal. Ovarian hypoplasia can be found in the ovaries of farm animals, either unilaterally or bilaterally. Depending on the degree of hypoplasia and whether it is unilateral or bilateral, the animal may be infertile or sterile. This is a serious condition that negatively affects the animal's reproductive capacity and general health. It may occur due to genetic factors, embryo development, hormonal imbalances and nutritional deficiencies (Kaymakçı, 2002; 2016; Rhoads, 2023; Akbarinejad and Robert, 2024).

2.1.3. Freemartinismus

In twin or triplet pregnancies, when one of the offspring is male and the other female, various developmental anomalies can be observed in the female offspring's reproductive organs. This is due to the more rapid development of the male offspring's testicles and the hormonal effect on the development of the female offspring's ovaries and other reproductive tracts. Female offspring in this situation are called freemartins (Kaymakçı, 2016; Bozkurt et al., 2024).

Freemartinismus is especially common in cattle, but similar conditions can also be seen in other farm animals (Özhan et al., 2012; Kaymakçı, 2016). The incidence of freemartinism in sheep ranges from 0.23% to 1.23% (Davis, 2019).

2.2. Fertilization Disorders

Fertilization is the first phase of reproduction and takes place when the sperm cell and the egg cell successfully unite. Disorders that occur in this process are serious problems that negatively affect reproductive efficiency and lead to economic losses (Hafez and Hafez, 2000; Lonergan et al., 2023; Steeneveld et al., 2024). Fertilization disorders are generally divided into two main categories: failed fertilization and abnormal fertilization.

Fertilization failure can be caused by the death of the egg before it meets the sperm, structural and functional

abnormalities in the egg, poor sperm quality or obstruction of the oviduct. Abnormal fertilization, on the other hand, can result from a variety of causes that interfere with the normal fertilization process and prevent the development of a healthy embryo (Hafez and Hafez, 2000).

2.2.1. White heifer disease

White Heifer Disease is an anatomical defect characterized by various degrees of developmental delay of the Müller ducts (Ishiyama et al., 2019). This condition manifests itself in anomalies such as a perforated or partially closed hymen, absence of the cervix or the cranial part of the vagina. In addition, other developmental disorders such as unilateral development of the uterus can be observed (Kaymakçı, 2002; Ishiyama et al., 2019). In a study conducted with Holstein cattle, it was reported that defects related to Müller duct (fusion, obstruction) development occurred at a level of 2.09% (Ishiyama et al., 2019).

2.2.2. Failure of oviduct development

It is defined as a developmental disorder related to the reproductive system in farm animals. It has been observed that some or all of the oviduct of animals in this condition does not develop (Kaymakçı, 2002; Ishiyama et al., 2019). As a result of breeding efforts for high milk yield in dairy cattle, it has been reported that problems related to ovarian tract development deficiency have increased (Mee, 2012; Ishiyama et al., 2019; Steeneveld et al., 2024). This result reveals the necessity to implement production models that provide a balance between productivity increase, health and welfare in animals (Galioto et al., 2017; Segerkvist et al., 2020; Whatford et al., 2022).

2.2.3. Vulva atresia

The vulva is markedly reduced in size, creating an impediment to copulation. This usually makes it impossible for even pregnant individuals to give birth. Such animals cannot give birth normally even if they become pregnant (Kaymakçı, 2002).

2.2.4. Delay of ovulation

In normally cycling animals, the time of ovulation can be altered due to many factors such as temperature stress (Rhoads, 2023), sudden changes in nutrition, dehydration, disease and sudden hormonal imbalance. Such situations can lead to failure of inseminations. Delayed ovulation is mostly hormonal and is due to insufficient secretion of LH. In some cases, oval-bursal adhesions may completely cover the ovary and prevent ovulation (Kaymakçı, 2002; Rhoads, 2023).

2.3. Embryonic Losses and Fetal Losses

Most reproductive defects in farm animals result in pregnancy loss. Pregnancy loss can be divided into embryonic and fetal (Hafez and Hafez, 2000).

Embryonic death is one of the important phenomena that usually cause temporary infertility in farm animals (Kaymakçı, 2002). Embryonic death refers to the death of fertilized eggs and embryos until the end of implantation. In farm animals, approximately 25% to 40% of embryos are lost depending on the species (Hafez and Hafez, 2000). In cattle, up to 50% of embryos are lost in the first 7 days of pregnancy; however, failure of implantation of the conceptus and defects in placentation can cause up to 20% additional pregnancy losses between days 20 and 60 (Davenport et al., 2023). These embryonic losses are often unrecognized by breeders and the dead embryo is usually resorbed by the organism and absorbed into the body (Hafez and Hafez, 2000).

The fetal period refers to the period during which the embryo implants and continues to develop in the uterus until it leaves the uterus at birth. Losses that occur during this period occur at a later stage than embryo losses and are usually characterized as miscarriage or premature birth. Fetal losses can significantly reduce the reproductive efficiency of animals and cause serious economic losses on farms. Fetal mortality is lower than embryonic losses and varies between 3-5% depending on the species (Çam et al., 1998; Dixon et al., 2007; Abdel-Mageed and Abd El-Gawad, 2015; Koyuncu and Duymaz, 2017; Ealy et al., 2019; Campanile et al., 2021).

2.4. Perinatal and Postnatal Losses of Offspring

2.4.1. Losses of offspring during the perinatal period

Perinatal losses are defined as the death of offspring shortly before birth, during birth or within 7 days of birth. Perinatal losses, including stillbirths, account for a large proportion of losses between birth and weaning. Offspring mortality during birth can be as high as 30%, and 80-90% of deaths occur within the first 7 days after birth (Hafez and Hafez, 2000; Celi and Bush, 2010; Koyuncu and Duymaz, 2017; İder and Ertürk, 2023). Offspring losses during and after birth on farms are an indicator of animal welfare problems and represent a significant economic loss (Koyuncu and Duymaz, 2017).

The birth process is a stage that carries vital risks for both maternal animal and offspring. Complications that occur during parturition can lead to the loss of the female animal during parturition or stillbirth of the offspring. This can vary depending on the difficulty of labor, the structure of the birth canal, the size of the offspring or the general health of the female animal.

Difficult parturition (dystocia) in animals is defined as a situation in which parturition does not take place within a certain, species specific period of time, is delayed or cannot take place without any intervention (Atasever et al., 2017). Dystocia can be caused by fetal and maternal factors.

Fetal dystocia can be caused by various reasons such as fetopelvic incompatibility, offspring position problems, offspring abnormalities, birth canal problems, maternal health problems, inadequate delivery assistance and multiple litters (Hafez and Hafez, 2000).

Maternal dystocia in farm animals is a condition in which the birth process becomes difficult due to functional disorders of the maternal birth canal or reproductive system during labor. This can be caused by factors such as narrowing of the maternal birth canal, inadequate contractions, birth position problems, genital infections

or uterine abnormalities (Hafez and Hafez, 2000; Jacobson et al., 2020).

Postpartum litter losses are often closely associated with low or high condition scores, poor maternal behavior, inadequate colostrum intake, infectious diseases and environmental factors. Against these factors, the breeder is more likely to intervene in offspring survival (Çam et al., 1998; Hafez and Hafez, 2000; Celi and Bush, 2010; İder and Ertürk, 2023). The pre-weaning mortality rate after live birth varies worldwide between 8% and 30% in lambs and 11.5% to 37% in kids (İder and Ertürk, 2023).

2.4.2. Postnatal offspring losses

Postnatal offspring losses are deaths from the end of the perinatal period until weaning (Koyuncu and Duymaz, 2017). The losses of offspring during this period are usually caused by factors such as postnatal trauma, environmental conditions, inadequate colostrum intake, poor maternal behavior, infectious diseases and malnutrition.

3. Male Reproductive Defects

Male reproductive efficiency in farm animals is associated with several phenomena. These are sperm production, sperm viability and fertilization capacity, sexual desire and mating ability. Infertile males can be easily detected, but males with low reproductive efficiency can pose serious problems and cause economic losses for breeders and the artificial insemination industry (Hafez and Hafez, 2000).

Male reproductive defects in farm animals are caused by various genetic, anatomical and environmental factors that can significantly reduce fertility. These disorders negatively affect not only animal welfare but also production efficiency.

3.1. Cryptorchidism

It is a condition in which one or both testicles do not descend to their normal position but remain in the abdomen. It is a hereditary defect seen in farm animals. This condition negatively affects spermatozoite production and can lead to infertility (Hafez and Hafez, 2000; Olğaç and Sabuncular, 2023).

Since body temperature prevents the formation of viable spermatozoites, an animal with both testes in the abdominal cavity is infertile. If one of the testes has descended into the scrotum, this male animal is capable of fertilization. It has been observed that sexual desire persists in animals with cryptorchidism even if both testes have not descended into the scrotum (Kaymakçı, 2016).

3.2. Testicular Hypoplasia

It is a condition in which the testicles do not reach normal size or do not develop fully. Testicular hypoplasia, which is a congenital defect, is seen in all farm animals, especially in bulls of various breeds. This condition may cause a decrease in sperm production or infertility (Kaymakçı, 2016; Hafez and Hafez, 2000).

3.3. Testicular Degeneration and Atrophy

They are common reproductive disorders in farm animals and can negatively affect the fertility capacity of the animal. The germinal epithelial cells in the testis are highly sensitive to various factors such as temperature, infection and trauma. Due to this sensitivity, testicular degeneration and atrophy can be seen in male animals in different sizes according to their etiologies (Watt, 1972; Roberts, 1986; Ladds, 1993). Depending on etiology, testicular degeneration may be mild or severe, focal or diffuse, unilateral or bilateral. Depending on the duration, severity and type of this condition, degeneration may have temporary or permanent negative effects on reproductive functions (Watt, 1972; McEntee, 1990; Younguist, 1997).

3.4. Impotence

Impotence refers to the situation in which spermatogenesis takes place in some farm animals, but the testicles do not produce enough testosterone so that the animals show no desire to mate. This situation manifests itself in the animals avoiding the search for females in heat or remaining indifferent to them (Pickett et al., 1977; Hafez and Hafez, 2000; Kaymakçı, 2016).

4. Conclusion

Reproductive health in livestock is of paramount importance for the sustainability and profitability of the livestock sector. Genetic, environmental and nutritional reproductive defects can adversely affect male and female reproductive efficiency and cause embryo, fetal and offspring losses. The causes and effects of reproductive defects can differ at each stage of this process.

Fertilization is the first stage of the reproductive process, resulting from the successful union of spermatozoon and oocyte. However, poor sperm quality, inadequate sperm motility or reduced sperm count in male animals and ovulation problems and reduced fertilization ability of the oocyte in female animals can negatively affect this process. These problems can be caused by genetic factors, hormonal imbalances, infections or environmental stressors. In particular, extreme temperatures, nutritional deficiencies or poor care conditions can negatively affect fertilization success. In order to prevent fertilization problems, it is necessary to optimize the nutritional and care conditions of the animals and to perform genetic evaluation and reproductive health checks regularly.

After fertilization, embryo development begins, but various defects and losses can occur during this process. One of the most common causes of embryo loss is genetic disorders. In addition, hormonal imbalances, infections and nutritional deficiencies can also lead to embryo loss. In order to reduce embryo loss in farm animals, infections affecting reproductive health should be controlled, animals should be properly fed and protected against stress.

The fetal period refers to the period during which the embryo continues to develop in the womb. Losses that occur during this period occur at a later stage than

embryo losses and usually manifest as miscarriage or premature birth. Fetal losses can be caused by genetic abnormalities, nutritional deficiencies, infections, trauma or hormonal imbalances. It is common in farm animals and can be associated with uterine infections or nutritional deficiencies during pregnancy. To prevent fetal loss, close monitoring of animals during pregnancy, appropriate care and nutrition programs, and prevention and treatment of infections are essential.

Parturition is a life-threatening stage for both maternal and offspring. In order to prevent losses during birth, it is necessary to closely monitor the birth process and intervene when necessary. Veterinary supervision plays a major role in reducing the risks. In addition, prenatal care can be effective in preparing the animal for delivery and preventing complications.

The postpartum period is a critical period for the health of the newborn offspring and the maternal. Protection of newborn offspring in the postpartum period can be achieved by strengthening their immune system and proper nutrition. Therefore, careful postnatal care and monitoring the health of the maternal play a critical role in preventing losses.

As a result, careful and informed management of all stages of the reproductive process in farm animals is essential to protect animal welfare and minimize production losses. By optimizing reproductive health, minimizing genetic and environmental risks, improving nutrition and care conditions, losses before and after birth can be significantly reduced. In this way, the sustainability of farms can be ensured by improving animal welfare, while at the same time the profitability and productivity of enterprises can be maintained in the long term.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	Ö.F.Y.	M.A.Ç.
C	50	50
D	50	50
S	50	50
DCP	50	50
DAI	50	50
L	50	50
W	50	50
CR	50	50
SR	50	50

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The authors declare that there is no conflict of interest.

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