Ovarian dysfunction in cows and its distribution in black soil farms

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Abstract. A tendency was noted for an increase in the prevalence of ovarian hypofunction in cows with an increase in their milk productivity. On average, it is diagnosed in 28.9-43.9% of examined cows. It was noted that the prevalence of hypofunction decreased with the number of calvings in animals. In first-calf cows, ovarian hypofunction was registered in 37.6-52.8% of cases, which is 1.3-2.0 times higher compared to cows of the second lactation and 1.3-2.8 times higher compared to cows of the third or more lactations . The number of diagnosed cystic formations also increased with increasing milk production. In highly productive animals, ovarian cystic formations are diagnosed 1.3-1.8 times more often, including follicular - 1.4-1.9 times and luteal - 1.2-1.7 times.

1 Introduction

Every year the demand for agricultural products increases, this helps to improve the nutritional conditions, maintenance and genetic potential of cattle. An important role is played by milk and dairy products, which occupy up to 35% of the daily diet of Russians, including through products prepared using it. Since cows must produce offspring to induce lactation, the reproductive capacity of cows is a very important factor. However, the high productivity of dairy cows negatively affects the capabilities of their body. In this regard, restrictions arise in the development of dairy production, such as non-communicable diseases and the issue of reproduction of highly productive dairy cows [1].

At the moment, an increase in disturbances in the development of offspring, leading to diseases or death at different stages of ontogenesis, the amount of infertility and diseases accompanying pregnancy and childbirth, an increase in the time between calvings in cattle cause noticeable economic damage to the industry. With an increase in productivity, the body's costs of recovery also increase, so metabolic disorders leading to the occurrence of various pathologies have become more frequently recorded in animals during milk production. In this regard, infertility has begun to spread among dairy cows, which reduces the life of the animal and leads to a decrease in reproductive potential [2, 3].

Modern data indicate a significant reduction in the reproductive period, which can be reduced to 1-2 lactations on individual farms. This leads to large financial losses, given that the period of the highest productivity of a cow occurs after the 4th lactation, and during the

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first lactation, the milk yield is only about 70% in relation to the maximum milk yield of a given cow. The decrease in reproductive capabilities is directly associated with an increase in milk productivity: with an increase in its efficiency by 1.5 thousand kg, the percentage of fertilization can decrease by up to 20% each time.

An important point in breeding farm animals is the study of the characteristics and needs of their body. The most common causes of stress in cows, leading to the loss of calves at various stages of pregnancy, including their stillbirth or in serious condition, are violations in the care of cows. Such mistakes include the lack of periodic veterinary examinations and qualified assistance in case of problems with delivery. The conditions in which animals are kept also affects their condition. Negative factors include prolonged inactivity, high humidity in the room where animals are kept and in food storage areas, which can lead to the spread of mold, which increases the risk of mycotoxicosis. Such problems are the reason that ovarian hypofunction is most often detected in winter. In addition to this, for many farms one of the important problems is the preparation of a diet that is properly balanced in vitamins and minerals. Most often, cows are deficient in macro- and microelements, especially in areas with a deficiency of one or more minerals [4]. Other negative factors are fundamental changes in the feeding diet, veterinary manipulations, high and low room temperatures, etc., as well as during periods of intensive growth, pregnancy and pathological conditions. All of these conditions can contribute to the appearance of oxidative stress in the animal's body. It is characterized by an increase in free radical processes against the background of depletion of antioxidant defense factors and promotes the accumulation of free radical oxidation products, which in turn leads to endogenous intoxication. This manifests itself in diseases of non-contagious etiology and can be enhanced by the action of iron and copper ions [5].

Oxidative stress can affect the time between calving and the onset of the next pregnancy in cows, for example, with retained placenta, animals experience increased levels of peroxidation and low lipid metabolism. Other examples of diseases of a non-contagious nature caused by physiological stress include ketosis-preeclampsia, osteodystrophy, ovarian hypofunction, and microelementosis [6]. The best way to avoid this is to eliminate risk factors, add substances with antioxidant properties to the animal diet, and periodic veterinary control, especially during periods of greatest physiological stress.

Due to the increase in productivity, the recovery time of the cow after calving also increases. Thus, with a period of 60 days between calving and the first insemination, the cow’s body does not have time to fully recover and this leads to a decrease in reproductive capacity and metabolic disorders in the future, and therefore the timing of their primary insemination after childbirth increases from the optimal 50-60 up to 80-100 or more days. One of the reasons for this phenomenon, often manifested in highly productive animals, is postpartum depression of folliculogenesis and ovulatory function of the ovaries, clinically registered as their hypofunction [2, 7-8]. Its prevalence can range from 20% to 50% [9-11].

Many foreign researchers also state the fact of a decrease in the functional activity of the ovaries in dairy cows, diagnosed in 35-65% of animals [12-13]. The hypofunctional state of the ovaries is one of the critical factors that have a significant impact on the occurrence of long-term and persistent infertility in cows [14].

Ovarian hypofunction is recorded in almost every third fresh cow (35.4%) 40-60 years after calving. The extent of this functional disorder of the gonads depends on the age of the females: in first-calf cows it is recorded almost 2 times more often than in full-aged animals, while a delay in productive insemination of even a couple of months can reduce milk productivity by more than 15% [4, 15].

It is important to understand what constitutes such a reproductive disorder in farm livestock. Ovarian hypofunction is a state of dysfunction characterized by impaired hormone production, inhibition of the generative function of the ovaries, leading to

disruption of the sexual cycle of varying severity. This disease manifests itself in decreased growth and maturation of follicles, complete or partial absence of the corpus luteum and ovulation. Ovarian hypofunction is caused by a drop in the level of gonadotropic hormones and the development of ovarian tolerance to the action of gonadotropins with increased synthesis of corticosteroid hormones under the influence of stress factors. The follicles in this case are characterized by an abortive form of maturation, where, despite the relatively large size, the dominant follicle undergoes atresia even before the onset of the preovulatory stage. Regression of the follicle stimulates the maturation of the next one, which also does not reach full maturity and the cycle repeats.

Ovarian hypofunction is accompanied by other diseases, for example, there is a decrease in the number of uterine glands in the uterus, which are replaced by glandular epithelial cells. If a cow experiences transient ovarian insufficiency, the dominant follicle may form a cyst. The cyst formed in this way can be of two types - follicular or luteal. If left untreated, inflammation of the ovaries may develop, which in turn leads to the gradual replacement of the functional tissues of the organ with connective tissue. The result of this is permanent infertility due to ovarian sclerosis.

Recently, a tendency towards an increase in the frequency of manifestations of ovarian hypofunction against the background of an increase in the overall milk productivity of cattle has become increasingly obvious. Numerous studies indicate that cows of highly productive dairy breeds are most susceptible to metabolic disorders [2]. Genetically determined high rates of milk production require significant energy expenditure, which in the new calving period often leads to hypoglycemia and the manifestation of a negative energy balance. Up to 30% of cows are susceptible to developing anovulatory anestrus due to a negative energy balance. This phenomenon is caused by a drop in the level of estradiol secretion in the follicles due to the low concentration of gonadotropins in the blood [11, 15].

Due to the occurrence of functional disorders of the ovaries in cows, up to 7.6% of infertile animals are subject to annual culling [12]. According to various studies, up to 15% of infertile cows are culled due to ovarian dysfunction [16].

Considering the high prevalence of functional ovarian disorders and the economic damage they cause, the study of dysfunctional disorders in cows at different levels of productivity, age and breed is of particular relevance.

The purpose of the research is to study the extent of prevalence of dysfunctional ovarian disorders in dairy cows at different levels of productivity, breed and age of the animals.

2 Materials and methods

The object of the research was lactating infertile cows from 40-45 days after calving, belonging to farms in the Voronezh and Lipetsk regions. The extent of prevalence of dysfunctional ovarian disorders has been studied in cows with different levels of milk production, number of lactations and breed. When analyzing the distribution of ovarian hypofunction, the animals were divided into four groups, each of which was divided by the number of lactations (1st lactation, 2nd lactation and 3rd or more): the first group included animals of the Simmental breed with milk productivity on average 4.0 thousand kg from the farm of LLC “Zhito”, the second group consisted of animals of the red-motley breed with a milk productivity of 4.5 thousand kg, the farm of LLC “Agrotech-Garant” Rostoshinsky, the third group was represented by cows of the black-motley breed (milk productivity 6.2 thousand kg), farm LLC "SP Vyaznovatovka", the fourth group, like the third, included animals of the black and white breed, however, their milk productivity was the highest among the identified groups and amounted to 9.2 thousand. kg and was studied at the farm of Verbilovskoye LLC.

The safest and most convenient way to determine pathological changes in the body of animals is to use visual echography. Ultrasound allows you to conduct research anywhere without lengthy preparation, thereby providing reliable data. This procedure allows you to examine one animal multiple times without harming it, which makes it possible to assess changes in the body over time. Detection of violations was carried out using clinical and echographic studies. Ultrasound studies were carried out using an ultrasound scanner equipped with a linear sensor with a frequency of 7.5 MHz in accordance with the "Methodological manual for ultrasound diagnosis of pregnancy and delayed development of the embryo and fetus in cows." Digital material was subjected to mathematical processing using the Statistica 6.0 application package.

3 Results and Discussion

It has been established (Table 1) that at a level of milk productivity of 4.0 thousand kg of milk, the incidence of cows with ovarian hypofunction is on average 28.9%, including in first-calf cows - 44.1%, in the second lactation - 27.0 and third or more lactations – 18.6%. With an increase in milk productivity to 4.5 thousand kg, an increase in the incidence of ovarian hypofunction to 30.6% is noted, including in cows of the first lactation - up to 37.6%, the second - up to 26.2% and the third or more lactations - up to 28.4%.

The degree of distribution of cystic formations of the ovaries in dairy cows with a productivity of 4.0-4.5 thousand kg cysts are diagnosed on average in 5.5% of the examined animals, including follicular - in 3.9% and luteal - in 1.6% .

Table 1. The prevalence of hypofunctional disorders and ovarian cysts in cows with milk production less than 5.0 thousand kg.

Features of cows	Total cows examined		
	1st lactation	2nd lactation	3rd or more lactation
Simmental breed (milk productivity 4.0 thousand kg)	34	37	43
Animals with ovarian hypofunction with milk production of 4 thousand kg, heads/%	15/44.1	10/27.0	8/18.6
Red-motley breed (milk production 4.5 thousand kg)	85	84	102
Animals with ovarian hypofunction with milk production of 4.5 thousand kg, heads/%	32/37.6	22/26.2	29/28.4
Examined for the presence of cysts, number of cows	385		
Follicular cysts detected, number of cows/%	15/3.9		
Luteal cysts detected, number of cows/%	6/1.6		

With a productivity of 6.2 thousand kg (Table 2), there is a significant increase in the level of hypofunctional ovarian disorders - up to 35.1%, or 1.2-1.3 times, compared with less productive animals, including among cows. first-calf heifers – in 43.9%, second lactation – in 32.4%, third or more lactations – in 27.3%. Also, with an increase in milk production to 6.0-6.5 thousand kg, the incidence of cysts increases to 7.7%, or 1.4 times, including follicular cysts - 1.4 times and luteal cysts - 1. 5 times.

Table 2. The prevalence of hypofunctional disorders and ovarian cysts in cows with a milk production of 6.0-6.5 thousand kg.

Features of cows	Total cows examined		
	1st lactation	2nd lactation	3rd or more lactation
Black-and-white breed (milk production 6.2 thousand kg)	82	74	66
Animals with ovarian hypofunction, heads/%	36/43.9	24/32.4	18/27.3
Examined for the presence of cysts, number of cows	222		
Follicular cysts detected, number of cows/%	12/5.4		
Luteal cysts detected, number of cows/%	5/2.3		

The highest incidence of ovarian hypofunction was found in cows with a milk production level of 9.2 thousand kg (Table 3). Thus, ovarian hypofunction was diagnosed on average in 43.9% of the examined animals, including 52.8% in cows of the first lactation, which is 1.5 times higher compared to cows of the second lactation and 2.3 times higher in comparison with cows of the third lactation and more lactations. Most often, cystic ovarian formations were registered in cows with maximum milk productivity (9.0-9.5 thousand kg) - 10.1% of the number examined, which is 1.3-1.8 times more than in animals with lower productivity. Follicular cysts in these animals are diagnosed 1.4-1.9 times more often than in low-productive animals, luteal cysts - 1.2-1.7 times.

Table 3. The prevalence of hypofunctional disorders and ovarian cysts in cows with a milk production of 9.0 thousand kg or more.

Features of cows	Total cows examined		
	1st lactation	2nd lactation	3rd or more lactation
Black-and-white breed (milk production 9.2 thousand kg)	89	37	22
Animals with ovarian hypofunction, heads/%	47/52.8	13/35.1	5/22.7
Examined for the presence of cysts, number of cows	148		
Follicular cysts detected, number of cows/%	11/7.4		
Luteal cysts detected, number of cows/%	4/2.7		

The prevalence of hypofunction varies among dairy cows of different breeds. It has been established that in cows of the Simmental breed, ovarian hypofunction is diagnosed on average in 28.9% of the examined animals, in the red-and-white breed - in 30.6%, in black-and-white domestic selection - in 35.1%, in black-and-white imported selection - in 43.9%. In highly productive animals, ovarian cystic formations are diagnosed 1.3-1.8 times more often, including follicular - 1.4-1.9 times and luteal - 1.2-1.7 times.

To combat ovarian hypofunction, vitamin-mineral and hormonal preparations are often used, and different treatment regimens can be used. Popular drugs for the treatment of disorders of the reproductive function of the ovaries and stimulation of estrus in cows often contain hormones such as gonadotropin, progesterone, corticosteroids, oxytocin, as well as their analogues, for example, carbetocin (oxytocin agonist).

4 Conclusion

Thus, ovarian hypofunction is diagnosed on average in 28.9-43.9% of examined cows and tends to increase with increasing milk productivity. In first-calf cows, ovarian hypofunction was registered 1.3-2.0 times higher than in cows of the second lactation and 1.3-2.8 times

higher in the third or more lactations. This shows that the body adapts to reproductive processes and lactation over time, regardless of breed and milk production. However, with an increase in milk production, the animal's body quickly depletes its resources. Thus, in animals of the black-and-white breed of imported selection, hypofunction of the ovaries is most often diagnosed - 43.9%, which is 1.3-1.5 times higher in comparison with the Simmental, red-and-white and black-and-white breeds of domestic selection. Thus, with an increase in animal productivity, more careful monitoring of health and living conditions is necessary, including the introduction of additives into the diet that help maintain the body during periods of intensive use and other stress factors.

References

1. E.N. Novikova, Infertility of cattle, Collection of scientific works of the KSCZV, **8**, **2**, 278–283 (2019)
2. E.A. Gorpinchenko, M.N. Lifentsova, Clinical manifestation of ovarian hypofunction in cows and their homeostasis during industrial livestock farming, Basic problems of agricultural sciences: collection of scientific papers of the International Scientific and Practical Conference, Krasnodar, 32–36 (2016)
3. M. Baymishev, S. Eremin, K. Plemyashov, PSVII-17 Program Chair Poster Pick: Reproductive function of cows depending on lipid metabolism, Journal of Animal Science, **98**, **S4**, 293-294 (2020) DOI 10.1093/jas/skaa278.529
4. V. Lukina, K. Lobodin, V. Mikhalev, V. Safonov, Anti-Mullerian hormone in the blood of dairy cows with different functional state of the ovaries in the postpartum period, Reproduction in Domestic Animals, **57**, **S1**, 120 (2022)
5. I. Ventsova, V. Safonov, Biochemical screening of lipid peroxidation and antioxidant protection in imported cows during adaptation, Advances in Animal and Veterinary Sciences, **9**, **8**, 1203-1210 (2021)
6. I. Ventsova, V. Safonov, Biochemical criteria for the development mechanisms of various reproduction disorders in dairy cows, Biodiversitas Journal of Biological Diversity, **22**, **11** (2022)
7. A.M. Sinyova, V.A. Lukina, M.I. Adodina, Dehydroepiandrosterone, testosterone and 17β-estradiol in the blood of dairy cows with postpartum ovarian hypofunction, Veterinary Pharmacological Bulletin, **4**, **9**, 77–83 (2019)
8. S.N. Semenov, I.V. Proskurina, A.V. Aristov, Veterinary and sanitary indicators of livestock products using innovative feed additives for farm animals and poultry (Voronezh State Agrarian University named after, Emperor Peter I, Voronezh, 2022)
9. N.E. Bogdanova, The effectiveness of the use of placental and pituitary gonadotropic drugs to restore the fertility of cows with ovarian hypofunction: abstract. dis. ...cand. vet. Sciences, Voronezh, 22 (2006)
10. K.A. Lobodin, Reproductive health of highly productive dairy cows of the red-motley breed and biotechnological methods for its correction: abstract of thesis. dis. ... doc. vet. Sciences, Voronezh, 32 (2010)
11. T.A. Moroz, Regulation of folliculogenesis in highly productive cows, Young scientist, **5**, **2**, 30–32 (2015)
12. S.T. Nelson, A.D. Martin, O. Osteras, Risk factors associated with cystic ovarian disease in Norwegian dairy cattle, Acta Veterinaria Scandinavica, **52**, 60 (2010)

13. M.A. Crowe, E.J. Williams, Triennial lactation symposium: Effects of stress on postpartum reproduction in dairy cows, Journal of Animal Science, **90**, **5**, 1722–1727 (2012)
14. T. Baba, Direct actions of androgen, estrogen and anti-Müllerian hormone on primate secondary follicle development in the absence of FSH in vitro, Hum. Reprod., **12**, 167–174 (2017)
15. F.M. Rhodes, B.A. Clark, D. P. Nation, Factors influencing the prevalence of postpartum anoestrus in New Zealand dairy cows. Proc. N. Z., Soc. Anim. Prod., **58**, 1–12 (1998)
16. V. Mikhalev, A. Sineva, V. Lukina, Ovarian Hypofunction and its Relationship to Serum Hormonal and Cytokine Profile in Cattle, Advances in Animal and Veterinary Sciences, **10**, **1**, 20-26 (2022) DOI 10.17582/journal.aavs/2022/10.1.20.26