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Differential diagnosis of chronic infertility in high-yield cows

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Abstract. The infertility of cows and heifers has been the most pressing problem in the livestock sector. The genitals and mammary gland have an increased functional load associated with pregnancy, childbirth, and lactation. The purpose of this study was to determine the prevalence of symptoms of chronic irreversible infertility in Ayrshire cows culled as a result of multiple artificial inseminations. The study employed analytical, structural-comparative, and statistical methods, as well as a modified

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differential palpation diagnosis of the clinical state of the reproductive organs in the ovary+oviduct area with lateral localisation was consistently applied in two stages. The findings of the study showed that cows with in vivo diagnosed symptoms of chronic adherent salpingitis and oosalpingitis (52.17%), i.e., irreversible form of infertility, had significantly higher (+28.05%; $P < 0.01$) milk production and better lactation compared to those without these pathologies. Furthermore, in the group of cows culled due to numerous ineffective inseminations, related gonadopathies were detected: from 4.35% to 10.87% of ovarian hypotrophy, 4.35% of gonadal sclerosis symptoms and 17.39% of cystic follicular degeneration cases. In 73.91% of females, the presence of sexual cyclicity with unchanged ovarian function in the follicular phase and in 84.78% – in the luteal phase of the cycle was established. The use of differential palpation diagnostics in production conditions allows in vivo predicting the tendency to loss of genetic resources (the ability of cow ovaries to maintain generative and secretory functions) in highly productive cows due to chronic inflammatory gynecological pathologies, which will contribute to the improvement of drug and biotechnological schemes of therapeutic measures for the prevention of infertility in the dairy herd

Keywords: dairy cows; genetic resources; chronic infertility; ovaries; oviducts; chronic inflammatory gynecological processes; salpingitis; adhesions

INTRODUCTION

Reproduction of dairy herds is one of the principal areas of veterinary medicine and reproduction biotechnology in countries with developed agriculture. Considering the long period of rearing a first-calf cow, the retirement of dairy cows due to gynaecological diseases and chronic infertility is a substantial factor in reducing the production costs of each dairy enterprise. The data obtained by D.A. Vallejo-Timaran *et al.* (2021), C.E. Cardoso Consentini *et al.* (2021) show that these losses become much more significant if the culling of a high-yielding cow occurs during the first or second lactation. The number of daughters produced by a high-yielding cow directly and indirectly affects not only the sustainability and profitability of dairy production, but also the overall breeding progress of the breed and the formation of high-yielding dairy herds as the biological basis of the dairy cattle industry (Madureira *et al.*, 2023).

A. Praxitelous *et al.* (2023), Z. Várhidi *et al.* (2024) provide a variety of therapeutic and stimulating schemes for the treatment and prevention of gynecological diseases of dairy cows, but the results of the analysis of production data indicate a lack of effectiveness of the recommended veterinary measures. Based on experimental studies, P. Yama *et al.* (2022) found that the production life of dairy cows of modern dairy breeds is constantly decreasing. According to J.-K. Jeong and I.-H. Kim (2022), chronic cow infertility is common among the livestock of all dairy farms, with prevalence ranging within 16-80%. It is necessary to address the negative impact of chronic infertility of dairy cows, which is often not recorded by veterinarians, namely, a significant reduction in the effect of breeding progress of the breed due to the elimination of the best genotypes of cows. As a result of the absence of offspring in the culled first-breeding heifer, it is impossible to further form a qualitative mechanism for the selection improvement of the gene pool, as evidenced by the publications of Ukrainian researchers (Klimkovetskaya *et al.*, 2024).

Insufficient study of the causes of chronic, especially irreversible infertility in dairy cows may contribute to the use of inadequate gynecological therapeutic and hormonal stimulation regimens that have negative consequences for production. The initial and key stage in the prevention and treatment of gynecological pathologies in female cattle is the differential diagnosis of gynecological diseases, which forms the basis for the development of effective therapeutic and stimulating regimens. According to W. Chaikol *et al.* (2022), the key factors of decreasing the profitability of milk production in industrial complexes are directly or indirectly related to diseases of the reproductive system of cows and heifers. Comprehensive morphological studies on the morphological, functional, or pathological analysis of the reproductive tract in the ovary-oviduct region are only fragmentary in the literature, and as a rule, the studies were performed on slaughtered pathological organs (Kudo *et al.*, 2021). H.M. Kyaw *et al.* (2021) conducted a pathological examination of ovarian follicles and corpus luteum to confirm chronic infertility.

In connection with the above, the study attempted to determine the clinical and morphological manifestations of reproductive organs pathology in the important, but difficult to access in vivo in real time, anatomical structure "ovary + oviduct". This approach allows accurately identifying the pathological processes that cause the cow infertility. The analysis of literature sources demonstrates the contradictions in the interpretation of symptoms of gynecological pathologies using different methodological schemes, which indicates the need for detailed study of the pathogenesis of the formation of the symptom complex "irreversible chronic infertility" in real production conditions. That is why the purpose of this study was to determine the prevalence of clinical symptoms of irreversible pathomorphological changes in tissues in reproductive tract "ovary + oviduct" among highly productive culled cows.

MATERIALS AND METHODS

The experimental part of the study was conducted in 2022-2023 at a leading breeding farm that was part of the association of dairy enterprises in the agricultural sector of Poltava Oblast of Ukraine. The farm uses intensive milk production technology (550 heads of a dairy herd of Ayrshire cows of domestic breeding) and breeds young animals for breeding. The average annual productivity of the herd was 6,000 kg of milk base fat per standard lactation.

The cattle were kept in a mixed type of housing: in winter – keeping livestock on a leash, in summer – loose livestock keeping in a summer camp. The in-house produced fodder base was stable, and the daily ration was compiled following modern zootechnical standards in terms of ingredients and nutritional value, considering the level of milk production and the physiological state of the animals. According to the variable nature of the housing, full-mixed feed rations were changed using feed produced in-house and purchased by the seasons. The farm used three times a day machine milking with individual accounting of milk yields from each cow using a computer system with the Buryonka breeding programme. All livestock were provided with sanitary

and veterinary support by the farm's specialists, with a planned schedule of participation of scientists from research institutions in Poltava and Kharkiv oblasts to improve the skills of the staff. According to the current veterinary guidelines, the farm carried out scheduled measures to prevent cattle diseases and scheduled vaccinations against infectious diseases.

The breeding stock was covered by obstetric and gynecological dispensary, but the problem of increasing the yield of newborn breeding heifers, the demand for which was constantly growing for sale to other farms, needed to be addressed. The premature culling of high-yielding cows due to chronic infertility (with a history of multiple ineffective artificial inseminations) required an innovative methodology to solving the problem. Considering the numerous gynecological disease treatment regimens and hormonal stimulation of sexual cycles used on the farm, which were of low efficiency, a preliminary conclusion was made about the need to conduct an adequate diagnosis of the causes of chronic infertility in cows. An innovative methodology for using differential diagnosis of key organs of the reproductive system with the palpation is presented in Figure 1.

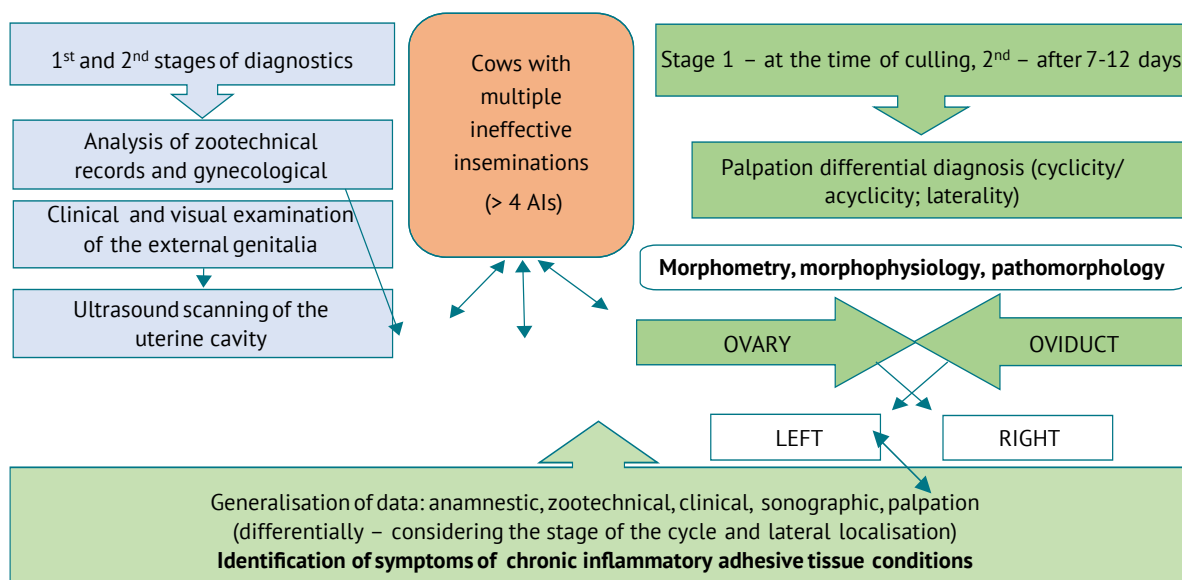


Figure 1. Methodical scheme of conducting a scientific and production experiment in a group of cows with chronic infertility

The experimental group of cows was formed on the principle of "small herd" – cows aged from the 1st to the 8th lactations, of normal fatness were selected for examination, the first examination was carried out immediately after culling (according to anamnesis, namely: 4 or more infertile artificial inseminations (AIs) were performed). The data of the general gynecological examination (clinical and visual observation of the external genitalia, ultrasound scanning of the uterine cavity to exclude

pregnancy and pathological exudate) were conducted. Cows with symptoms of acute or subacute inflammatory pathologies of the uterus were excluded from the experimental group, which included only animals with visually asymptomatic (latent) chronic infertility.

Using the method of periods, each cow was examined palpably twice: at the time of culling and after 10-12 days, which made it possible to establish the dynamics of morphological and functional ovarian

formations in cycling females, i.e., to determine the morphometric and morphological parameters of the ovaries in the follicular and luteal phases of the sexual cycle, a modified method was presented in the publication by S.O. Sidashova *et al.* (2022). The structures of the reproductive system “ovary-oviduct” was carefully palpated, considering that the oviduct canal is an

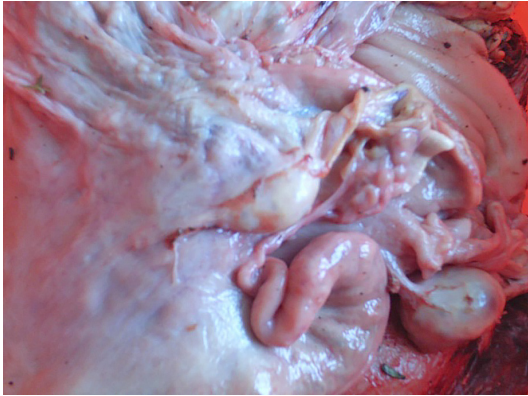


Figure 2. Macrospecimen of the reproductive system of a cow with a physiological state of the ovary-oviduct

Notes: Macrospecimen of the cow's reproductive system with the physiological state of the ovary-oviduct area (right-sided location): palpation of all organ contours corresponds to the anatomical norm, mobility of the ovary connection with adjacent tissues is not changed, tissue elasticity is typical, the ovary has a morphological and functional formation of the follicular phase of the cycle (maturing follicle)

Source: developed by the author of this study

After summarising all the accumulated data (according to the sequential implementation of the survey scheme), the analytical part of the study was conducted at the Department of Surgery, Obstetrics, and Small Animal Diseases of the Faculty of Veterinary Medicine of Odesa State Agrarian University using structural-comparative and statistical methods. All experimental studies were conducted following the modern methodological approaches and corresponding requirements and standards that follow DSTU ISO/IEC 17025:2005 (2006). Animal husbandry and all manipulations were performed according to the provisions of the Procedure for conducting tests and experiments on animals by scientific institutions (Law of Ukraine No. 249, 2012), and of the European Convention for the protection of vertebrates used for experimental and other scientific purposes (1986).

RESULTS

At the first stage of the palpation study of a culled group of highly productive cows ($n = 46$) of the Ayrshire breed, a differential examination of the physiological or pathological state of the ovaries was

inaccessible part for hardware ultrasound diagnostics, and tactile data provide a description of the symptoms of adhesive chronic inflammatory processes of various tissues and organs, namely altered physiological mobility of the ovary, deformed and compacted tissues of the oviducts and ovaries, connective tissue adhesions and altered organ contours (Figs. 2 and 3).



Figure 3. Ovarian macrospecimen (dissected) with signs of hypotrophic state of the follicular layer

Notes: Macrosection of the reproductive system of a cow with chronic infertility (right-sided localisation): the anatomical contours of the organs are displaced, the tissues are hard with adhesions, and the typical ovarian mobility is not preserved. Ovary (in section) with signs of hypotrophic state of the follicular layer, no maturing follicles or functional corpus luteum, reduced morphometric size

Source: developed by the author of this study

performed with the identification of females with gonadopathies. Due to the presence of significant morphometric and morphological and functional differences in the size, contours, and consistency of cow ovarian tissues in different phases of the sexual cycle, the stage characteristics of the cow were immediately recorded in relation to the follicular or luteal phase formations (with additional comparison of data on zootechnical accounting of sexual activity in the last cycle for cows that showed clinical and visual cyclicity). Animals with signs of anaphrodisia and no signs of sexual cyclicity were separately identified, taking into account the symptoms of gonadopathy (Tables 1 and 2). Table 1 shows that among the 46 cows under study, 34 females with signs of the follicular phase of the sexual cycle (73.91%) were found, and there were 12 cows without cycling and corresponding functional ovarian formations (26.09%). The second stage of the study was to determine the functional state of the ovaries of females that had entered the luteal phase of the sexual cycle (palpation examination was performed 7-12 days after the previous one, Table 2).

Table 1. Results of *in vivo* diagnostics of morphofunctional or morphopathological states of ovaries of cows with multiple ineffective inseminations, $n = 46$ (follicular phase of the cycle)

Indicators		heads	% (M ± m)
Cows in the follicular phase of the cycle*	Mature (maturing) follicle	34	73.91 ± 2.93 ^a
Cows with anaphrodisia, total**		12	26.09 ± 10.43 ^b
Of which separate gonadopathies:	Gonadal hypotrophy	2	4.35
	Follicular cystic fibrosis***	8	17.39
	Sclerotic condition	2	4.35

Note: * – for females with a fixed sexual cycle; ** – for females with an acyclic state; *** – single large cysts or small multiple cysts – polycystic disease; $a-b$ ($P > 0.05$)

Source: developed by the authors of this study

Table 2. Results of *in vivo* diagnostics of morphofunctional or morphopathological states of ovaries of cows with multiple ineffective inseminations, $n = 46$ (luteal phase of the cycle)

Indicators		heads	% (M ± m)
Cows in the luteal phase of the cycle*	Morphometrically and morphologically typical corpus luteum	39	84.78 ± 3.85 ^a
Cows with anaphrodisia, total		7	15.22 ± 10.47 ^b
Of which separate gonadopathies:	Gonadal hypotrophy	5	10.87
	Lutein cyst	0	0.00
	Sclerotic condition	2	4.35

Note: * – for females with a fixed sexual cycle; $a-b$ ($P > 0.05$)

Source: developed by the authors of this study

At this stage of the investigation, 39 cows (84.8%) with functional ovaries were identified (a temporary endocrine gland (corpus luteum) was palpated on the

right or left ovary, Fig. 4). In 5 animals (10.87%), no functional ovarian masses were palpated, which was indicative of anaphrodisiac symptoms (Fig. 5).



Figure 4. Macrosection

of functionally active corpus luteum of the ovary

Notes: Macrosection of the cow's reproductive system with a functional morphologically typical mid-cycle corpus luteum (physiological state of ovarian tissue)

Source: developed by the authors of this study

Thus, differential *in vivo* diagnostics, considering the timing of the stages of the sexual cycle, showed that among cows culled due to chronic infertility, 73.91% had an actively functioning ovary in the follicular phase and 84.78% in the luteal phase, respective-



Figure 5. Macrosection of morphological structure of the active corpus luteum in the middle of the cycle

Notes: Macrosection: morphological structure of the mid-cycle corpus luteum – the luteal tissue is typical in consistency and colour, the contours are clearly visible, the cavity in the middle is consistent with the physiological norm and the stage of development of the temporal gland

Source: developed by the authors of this study

ly, and there were morphological features of ovarian maturation and ovulation and preservation of the early embryo (generative and hormonal). The lateral localisation of morphological and functional formations is presented in Table 3.

Table 3. Lateral localisation of functional morphological formations in cows with preserved sexual cyclicity, n = 39*

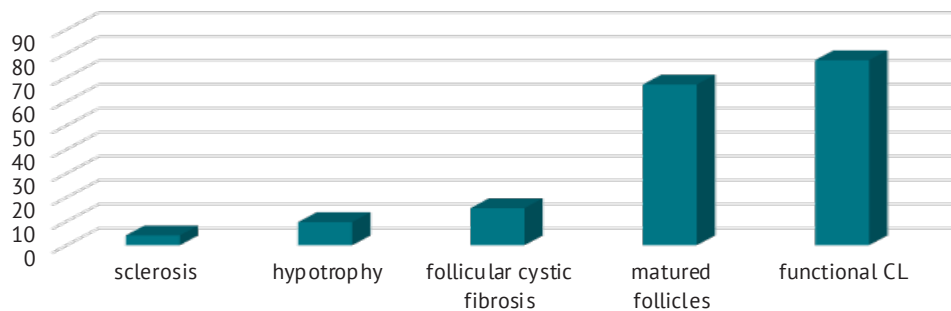
Phase of the sexual cycle	Lateral localisation			
	Left ovary		Right ovary	
	heads	%	heads	%
Follicular	18	52.94	16	47.08
Luteal	21	53.8 ± 18	46.15	46.15
(M ± m)	39	53.39 ± 0.46	34	46.62 ± 0.47

Note: * – only cows with clinically and visually recorded sexual behaviour with physiologically appropriate timing of sexual activity periods were considered

Source: developed by the authors of this study

The in vivo diagnostic profile of the percentage frequency of various gonadopathies and morphological

and functional states of the ovaries in a group of culled high-yield cows is graphically demonstrated (Fig. 6).

**Figure 6.** Morphofunctional/pathological profile according to

in vivo palpation differential diagnosis of ovaries of cows (%) culled due to multiple ineffective inseminations, n = 46

Source: developed by the authors of this study

The ratio of ovarian functioning activity in cows both in the follicular and luteal phases of the sexual cycle, in terms of lateral location, was very close, but no correlations between the data were determined. The nature of the functional asymmetry of the ovaries indicated the presence of pathological processes in the gonadal tissues. During the study, functional formations were noted only on one side of the location: either on the left or on the right (the inactive ovary was in a hypotrophic state according to morphometric parameters). No cases of bilateral arrangement of morphofunctional formations were found. During the two stages of the study, from 4.35% to 10.87% of cases of significant hypotrophic changes in the ovarian tissues bilaterally were palpated. These pathologies have been associated with symptoms of acyclicity and chronic anaphrodisia. In this case, the ovaries were palpably reduced in size, of flattened contour, flaccid or hard consistency, with a lack of elasticity and firmness of the tissues.

In the follicular phase, 8 (17.39%) cows with cystic ovarian pathologies (single follicular cysts or polycystic ovary – multiple small cysts on the surface of the ovary) were identified. The specific feature of follicular cysticity in the group of cows studied was the palpation diagnosis of a very dense cyst membrane that did not lend itself to mechanical pressure. In the luteal phase of the cycle, no corpus luteum cysts were palpated in the group, which indicated a decrease in the level of

hormonal secretion in the stage of sexual rest, namely progesterone. This may have been the cause of early embryonic death due to gonadal hormonal dysfunction, but this issue requires further investigation. In 2 females (4.35%), bilateral characteristic sclerotic changes in ovarian tissues were palpated, which completely excluded the morphological and functional activity of these organs (Fig. 7).

**Figure 7.** Ovarian macrosection for cows with chronic ovarsalpingitis

Notes: Macrosection (right lateralisation): ovary of a cow with chronic ovarsalpingitis – sclerotic tissues, hard consistency, limited mobility of the organ, adhesions with the tissues of the right oviduct

Source: developed by the authors of this study

As a result of the examination, the group of culled cows was divided into two parts: the physiological state of the ovary + oviduct area and the pathological state of the tissues of this area.

Considering the lateral location of paired organs, pathological changes were distinguished as located only on one side (left or right) or bilateral localisation (Table 4).

Table 4. Results of differential in vivo diagnosis of symptoms of adhesive processes in the area of the reproductive tract "ovary + oviduct" in cows culled due to multiple infertile inseminations, $n = 46$

Indications/symptoms	Physiological or pathological conditions of the ovary+oviduct part of the reproductive tract					
	Physiological state*			Pathomorphological condition		
	Lateral***		Bilateral			
	heads	%	heads	%	heads	%
Chronic salpingitis or its absence	22	47.83	11	23.91	13	28.26
Gonadopathies**	27	58.69	11	23.91	8	17.39
(M±m)	68.26 ± 9.57 ^a		23.91 ± 0.00 ^b		22.83 ± 5.44 ^c	

Note: * – morphological and functional ovarian formations (follicle or corpus luteum); ** – including pathological conditions of the ovaries with hypotrophic or degenerative tissue changes (severe hypotrophy, cysticity, sclerotic changes); a–b ($P < 0.05$)

Source: developed by the authors of this study

In 22 cows (47.83%), palpation did not reveal any adherent chronic changes in the oviductal tissues, which suggests potential patency of the organ cavity for gametes and zygotes. In 11 and 13 cows (23.91% and 28.26%, respectively), characteristic adhesive changes in the structure of organs and tissue elasticity were palpated. Thus, 52.17% of the culled cows had no or little chance of physiological pregnancy, and it is likely that multiple artificial inseminations were unnecessary and only increased semen costs. The diagnosis of unilateral conditions of chronic

salpingitis should have alerted veterinarians to the presence of chronic inflammatory processes in the deep parts of the genital tract, which substantially reduce the efficiency of insemination. The established symptoms of in vivo diagnostics had positive correlations between the indicators ($P < 0.05$). Comparison of milk production for the best lactation in the group of culled cows showed a high probability of the influence of chronic infertility on the premature retirement of dairy cows with the best breeding potential (Table 5).

Table 5. Milk production of cows culled due to multiple infertile inseminations, $n = 46$

Groups based on in vivo diagnostic results	Number of cows		Performance in the group for the best lactation, kg of milk
	heads	%	
Symptoms of chronic salpingitis (ovosalpingitis) identified*	24	52.17	8,928.75 ± 411.75 ^b
No symptoms of adhesive processes identified*	22	47.83	6,972.14 ± 218.11 ^a

Note: * – palpatory differential diagnosis in vivo in the area of the reproductive tract "ovary+oviduct" with lateral localisation of adherent tissue conditions; a–b ($P < 0.01$), at $\bar{\delta} = 1023.91$; $CV = 14.688$; $td = 2.969$

Source: developed by the authors of this study

In 22 cows (47.83%) from the group of culled cows due to repeated ineffective inseminations, chronic adherent salpingitis (ovosalpingitis) was not palpably detected by in vivo diagnostics. The average milk yield for the best lactation in these females was 6,972 kg of milk. In the group with a milk yield of 8,928 kg (+28.05%; $P < 0.01$) for the best lactation, all cows were diagnosed with irreversible infertility caused by chronic adherent salpingitis (ovosalpingitis). That is, in 52.17% of cows, gynaecological diseases became chronic and led to adhesive pathologies in the ovary + oviduct, which resulted in irreversible infertility of high-yield cows.

DISCUSSION

Based on the correlation of data from zootechnical accounting of milk production for better lactation in the group of Ayrshire cows culled due to chronic infertility, the authors concluded that the reproductive system of high-yield cows is much more vulnerable. Probably due to a decrease in the natural resistance and polymorbidity of the organism of high-yield cows, gynaecological inflammatory diseases in them become chronic, diffuse through the haematogenous and lymphogenous pathways into the deep layers of the reproductive tract, which causes for the development of adhesive

processes in the tissues, namely chronic salpingitis and oosalpingitis. In the group of cows, which on average had a higher expectation of better lactation, 28.05% (8,928.75 kg) of each female was diagnosed with symptoms of adherent salpingitis ($P < 0.01$), which excluded the participation of their genotypes in the further selection progress of the herd. K.M. Glosson *et al.* (2020) and S. González Moreno *et al.* (2022) obtained comparable results when assessing the reproductive potential of a dairy cow herd.

In the group of cows with lower productivity for better lactation (6,972.14 kg), no symptoms of adherent chronic salpingitis were detected during the study, which indicated the need to investigate the factors that contributed to the culling of these females due to repeated infertile inseminations in greater detail. Thus, based on the results of differential *in vivo* diagnostics of pathological tissue conditions in the ovary+oviduct, the researchers identified one of the factors of reducing the supply of breeding heifers with high productive potential to the herd due to premature retirement of cows with the best genotypes. In the surveyed farm, when using sperm from valuable Ayrshire sires (with a sire's mother's milk yield of 14,000-15,000 kg per lactation), no increase in dairy herd productivity was observed for a long period (about 10 years).

According to R.K. Kasimanickam and V.R. Kasimanickam (2020), extending the production life of dairy cows and increasing milk yields stays a vital component of the genetic improvement of dairy cattle in all developed countries. For both breeding and production, the most valuable animals are those that successfully combine the characteristics of long-term productive use with high milk yield and economic efficiency. Excessive early retirement of high-yielding cows that do not produce enough daughters to replenish the herd leads to the elimination of the best genotypes from the breed's gene pool, which results in large economic losses for the industry as a whole. The application of the differential palpation diagnostics proposed by the authors of the study enables zooveterinary specialists of farms to carry out preventive work and improve therapeutic gynaecological schemes to reduce the loss of highly productive cows due to chronic inflammatory gynaecological diseases.

The results of the diagnosis of 17.39% of follicular cysticity detection are alarming, which may suggest a hormonal imbalance in the body of highly productive cows, especially considering the absence of corpus luteum cysts. It is probable that hormonal dysfunctions in cows can be observed during the period from the stage of sexual cycle excitation to the stage of sexual rest, which may be a consequence of a violation of protein and fat metabolism due to a deficiency of a number of biologically active components of the diet (vitamins, microelements, etc.). The findings obtained by R. Lapp *et al.* (2020) confirm the experimental data

presented in the current study and suggest that the problem of degenerative cystic changes in the gonads of cows and heifers has been understudied.

The detection of 4.35% of cases of sclerotic changes in ovarian tissue based on the studies indicated long-term inflammatory processes in the gonads and adjacent organs that were latent and not covered by therapeutic intervention in time. Usually, females with this pathology are kept in artificial insemination groups for a long time, but the significant costs of sperm doses in these cases stay useless and substantially increase the cost of the final product of dairy production. S.S. Pérez-Marín *et al.* (2023) and X. Xu *et al.* (2023) obtained analogous results when conducting repeated infertile inseminations of cows, which considerably increased the cost of the products obtained.

According to S. Sidashova *et al.* (2022), it was clinically and gynecologically established that imported cows more often have ovarian dysfunction, accompanied by pathology of the uterus and oviduct. The most common diagnosis is ovarian hypofunction. Moreover, ovarian hypofunction can occur in 73% of cows against the background of pathologies of other organs. This pathology is evidenced by signs of prolonged anaphrodisia and irreversible atrophy of the uterus and ovaries. The data obtained by the scientists showed that ovarian hypofunction is the most common gynecological disease of high-yielding cows of different breeds. According to T. Tasara *et al.* (2023), K. Khoirani and I. Karni (2023), the principal causes of ovarian dysfunction are unbalanced feeding and unfavourable housing conditions. The results of the current studies showed hypotrophic ovarian tissue lesions in high-yield cows in 4.35% and 10.87% of cases, which indicated considerable plasticity of organs for restorative trophic processes in cows that stop giving energy and nutrients to milk secretion.

Veterinary reproductive specialists C.R. Seely *et al.* (2021) and K. Tanimura *et al.* (2022) discuss the effectiveness of *in vivo* diagnosis of physiological or pathological conditions of the cow's ovaries, specifically during palpation. Current studies have proven sufficient prognostic efficiency of differential palpation of cow gonads *in vivo*, with a simultaneous positive factor of promptness in determining the symptoms of pathologies subject to therapeutic intervention. Thus, Ukrainian researchers H. Hryshchuk *et al.* (2023) found that tissues of cows with a chronic anaphrodisia exhibit characteristic pathologies, namely: a considerable reduction in gonadal size, absence of corpus luteum, primary follicles are located singly, some of them have a curved shape, vesicular follicles show uneven growth of follicular cells, complete or partial absence of follicular layer folding and lutealisation of theca cells. This was indicative of the course of chronic dystrophic processes observed *in vivo* during our study to determine morphometric and morphofunctional parameters. The

conclusion on the histological determination of the presence of blood vessel sclerosis in the tissues of the follicular layer suggests a violation of the haemodynamics of organ function and a decrease in the trophism of the tissues of the generative and secretory layers. The formation of collagen fibres in blood vessels, according to researchers, can lead to a decrease in their elasticity, a decrease in the nutritional function of ovarian tissues, which was confirmed by the nature of the palpation data of the present study. The issue of differentiating in vivo morphological differences in the symptoms of cow ovarian hypotrophy or hypoplasia stay controversial, but this difference cannot affect the correctness of therapeutic regimens (Sidashova *et al.*, 2024).

The establishment of in vivo symptoms of adhesive changes in ovarian tissues, which is often accompanied by larger adhesive processes together with the adjacent ovary, is insufficiently revealed in the literature, and therefore the present study has been the first to show the prognostic value of irreversible infertility in cows with morphologically destroyed ovarian patency, which results in the accumulation of negative effects of the selection of the best genotypes of dairy breeds.

CONCLUSIONS

Using a differential two-stage palpation technique in a group of high-yield Ayrshire cows ($n = 46$), which were culled due to repeated ineffective inseminations, 52.17% of cases of chronic adhesive salpingitis were diagnosed (23.91% – unilateral localisation – left or right; 28.26% – bilateral), which highlighted the causes of irreversible infertility of females due to the loss (complete or partial) of oviductal patency for gametes and zygotes. Cows with symptoms of irreversible infertility had significantly higher milk production (8,928.75 kg) compared to those without such symptoms (6,972.14 kg; $P < 0.01$), which indicated a greater vulnerability of high-yield cows to chronic gynecological pathologies of a latent nature.

Experimentally, in vivo palpatory diagnostics in real time highlighted the causes of multiple infertile inseminations in 52.17% of high-yielding cows, which were directly related to chronic irreversible gynecological pathology that arose as a result of incorrect use of therapeutic regimens earlier after calving, at the stage of acute and subacute endometritis. The applied method of differential in vivo palpation diagnostics allows correcting gynecological treatment regimens in a dairy farm to reduce the effects of chronic inflammatory pathological processes of the mucous membranes of various parts of the reproductive tract, specifically, deep areas of the oviduct-ovary, which is poorly interpreted.

In the group of culled cows with chronic infertility, 73.91% of functioning ovaries were diagnosed (in the follicular phase of the sexual cycle) and 84.78% – in the luteal phase, which indicated the preserved generative and hormonal status of culled cows potentially suitable for donating embryos (genetic resources). In the group of culled cows, the following gonadopathies were found: follicular cysticity – 17.39%; ovarian sclerosis – 4.35%; hypotrophy of significant severity – 4.35-10.87%, which together aggravated other gynaecological chronic pathologies. The findings of the study showed that the use of differential in vivo palpation diagnostics can contribute to the development of more effective therapeutic gynecological regimens and reduce wasted sperm and veterinary drugs after prompt diagnosis of symptoms of irreversible infertility due to adhesive processes in the ovary+oviduct section of the reproductive tract.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

REFERENCES

- [1] Cardoso Consentini, C.E., Wiltbank, M.C., & Sartori, R. (2021). Factors that optimize reproductive efficiency in dairy herds with an emphasis on timed artificial insemination programs. *Animals*, 11(2), article number 301. doi: 10.3390/ani11020301.
- [2] Chaikol, W., Yadmak, C., Yama, P., Jitjumnong, J., Sangkate, M., Ukrit, W., Promsao, N., Suriard, A., Mektrirat, R., Panatuk, J., Van Doan, H., Wang, Ch.K., Tang, P-Ch., & Moonmanee, T. (2022). Ovarian luteal category at the time of exogenous progesterone treatment alters preovulatory follicle size and pregnancy outcome but not initial GnRH treatment in repeat-breeder crossbred dairy heifers submitted to the 7-day fixed-time AI protocol. *Veterinary and Animal Science*, 17, article number 100257. doi: 10.1016/j.vas.2022.100257.
- [3] European convention for the protection of vertebrate animals used for experimental and other scientific purposes. (1986). Retrieved from <https://rm.coe.int/168007a67b>.
- [4] Glosson, K.M., Zhang, X., Bascom, S.S., Rowson, A.D., Wang, Z., & Drackley, J.K. (2020). Negative dietary cation-anion difference and amount of calcium in prepartum diets: Effects on milk production, blood calcium, and health. *Journal of Dairy Science*, 103(8), 7039-7054. doi: 10.3168/jds.2019-18068.
- [5] González Moreno, C., Torres Luque, A., Galvao, K.N., & Otero, M.C. (2022). Bacterial communities from vagina of dairy healthy heifers and cows with impaired reproductive performance. *Research in Veterinary Science*, 142, 15-23. doi: 10.1016/j.rvsc.2021.11.007.

- [6] Hryshchuk, H., Kovalyova, L., Huralaska, S., Yevtukh, L., & Kovalyov, P. (2023). Histological changes in the uterine and ovarian walls in pyometra. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences*, 25(109), 59-66. doi: [10.32718/nvlvet10910](https://doi.org/10.32718/nvlvet10910).
- [7] ISO/IEC 17025:2005. (2006). Retrieved from http://online.budstandart.com/ua/catalog/doc-page.html?id_doc=50873.
- [8] Jeong, J.-K., & Kim, I.-H. (2022). Risk factors for repeat breeder dairy cows and their impacts on reproductive performance. *Korean Journal of Veterinary Research*, 62(2), article number e15. doi: [10.14405/kjvr.20220003](https://doi.org/10.14405/kjvr.20220003).
- [9] Kasimanickam, R.K., & Kasimanickam, V.R. (2020). IFNT, ISGs, PPARs, RXRs and MUC1 in day 16 embryo and endometrium of repeat-breeder cows, with or without subclinical endometritis. *Theriogenology*, 158, 39-49. doi: [10.1016/j.theriogenology.2020.09.001](https://doi.org/10.1016/j.theriogenology.2020.09.001).
- [10] Khoirani, K., & Karni, I. (2023). Identification of reproductive disorders in female cattle at local farms in woha sub-district, bima Regency. Lukman HY. *Jurnal Kedokteran Hewan*, 17(3), 96-99. doi: [10.21157/j.ked.hewan.v17i3.26553](https://doi.org/10.21157/j.ked.hewan.v17i3.26553).
- [11] Klimkovetskaya, L., Karpovskiy, V., Gutyj, B., & Hryshchuk, I. (2024). Relationship of calcium and phosphorus content with indicators of reproductive ability in cattle. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences*, 26(113), 184-188. doi: [10.32718/nvlvet11328](https://doi.org/10.32718/nvlvet11328).
- [12] Kudo, H., Sugiura, T., Higashi, S., Takahashi, M., Kamiya, Sh., Tamura, Yu., & Usu, M. (2021). Characterization of reproductive microbiota of primiparous cows during early postpartum periods in the presence and absence of endometritis. *Frontiers in Veterinary Science*, 18(8), article number 736996. doi: [10.3389/fvets.2021.736996](https://doi.org/10.3389/fvets.2021.736996).
- [13] Kyaw, H.M., Sato, H., Tagami, T., Yanagawa, Y., Nagano, M., & Katagiri, S. (2022). Effects of milk osteopontin on the endometrial epidermal growth factor profile and restoration of fertility in repeat breeder dairy cows. *Theriogenology*, 184, 26-33. doi: [10.1016/j.theriogenology.2022.02.008](https://doi.org/10.1016/j.theriogenology.2022.02.008).
- [14] Lapp, R., Rottgen, V., Viergutz, T., Weitzel, J.M., & Vernunft, A. (2020). Induction of cystic ovarian follicles (COFs) in cattle by using an intrafollicular injection of indomethacin. *The Journal of Reproduction and Development*, 66(2), 181-188. doi: [10.1262/jrd.2019-107](https://doi.org/10.1262/jrd.2019-107).
- [15] Law of Ukraine No. 249 "On the Procedure for Carrying out Experiments and Experiments on Animals by Scientific Institutions". (2012, March). Retrieved from <https://zakon.rada.gov.ua/laws/show/z0416-12#Text>.
- [16] Madureira, A.M.L., Burnett, T.A., Boyd, C.T., Baylão, M., & Cerri, R.L.A. (2023). Use of intravaginal lactic acid bacteria prepartum as an approach for preventing uterine disease and its association with fertility of lactating dairy cows. *Journal of Dairy Science*, 106(7), 4860-4873. doi: [10.3168/jds.2022-22147](https://doi.org/10.3168/jds.2022-22147).
- [17] Pérez-Marín, C.C., & Quintel, L.A. (2023). Current insights in the repeat breeder cow syndrome. *Animals*, 13(13), article number 2187. doi: [10.3390/ani13132187](https://doi.org/10.3390/ani13132187).
- [18] Praxitelous, A., Panagiotis, D.K., Tsaousioti, A., Brozos, C., Schmicke, M., Boscós, C., & Tsousis, G. (2023). Comparison of uterine involution and the resumption of ovarian cyclicity between lame and sound holstein cows. *Animals* 13(23), article number 3645. doi: [10.3390/ani13233645](https://doi.org/10.3390/ani13233645).
- [19] Seely, C.R., Leno, B.M., Kerwin, A.L., Overton, T.R., & McArt, J.A.A. (2021). Association of sub-clinical hypocalcemia dynamics with dry matter in-take, milk yield, and blood minerals during the peri-parturient period. *Journal of Dairy Science*, 104(4), 4692-4702. doi: [10.3168/jds.2020-19344](https://doi.org/10.3168/jds.2020-19344).
- [20] Sidashova, S., Gutyj, B., Martyshuk, T., & Shnaider, V. (2024). Chronic latent inflammatory processes of reproductive organs of dairy cows. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Veterinary Sciences*, 26(113), 202-211. doi: [10.32718/nvlvet11330](https://doi.org/10.32718/nvlvet11330).
- [21] Sidashova, S.O., Popova, I.M., Roman, L.G., & Chorniy, V.A. (2022). Use of supervision in vocationally oriented (dual) training of veterinary professionals and students. *Special Humanitarian Issue of Ukrainian Scientists. European Scientific e-Journal*, 2(17), 60-65. doi: [10.47451/ped2022-03-03](https://doi.org/10.47451/ped2022-03-03).
- [22] Tanimura, K., Uematsu, M., Kitahara, G., Osawa, T., & Sasaki, Y. (2022). Longitudinal effect of repeat breeding in Japanese Black beef cattle at a low parity on subsequent fertility in commercial cow-calf operations. *Theriogenology*, 189, 177-182. doi: [10.1016/j.theriogenology.2022.05.016](https://doi.org/10.1016/j.theriogenology.2022.05.016).
- [23] Tasara, T., Meier, A.B., Wambui, J., Whiston, R., Stevens, M., Chapwanya, A., & Bleu, U. (2023). Interrogating the diversity of vaginal, endometrial, and fecal microbiomes in healthy and metritis dairy cattle. *Animals* 13(7), article number 1221. doi: [10.3390/ani13071221](https://doi.org/10.3390/ani13071221).
- [24] Vallejo-Timaran, D.A., Reyes, J., Gilbert, R.O., Lefebvre, R.C., Palacio-Baena, L.G., & Maldonado-Estrada, J.G. (2021). Incidence, clinical patterns, and risk factors of postpartum uterine diseases in dairy cows from high-altitude tropical herds. *Journal of Dairy Science*. 104(8), 9016-9026. doi: [10.3168/jds.2020-18692](https://doi.org/10.3168/jds.2020-18692).
- [25] Várhidi, Z., Csikó, G., Bajcsy, Á.C., & Jurkovich V. (2024). Uterine disease in dairy cows: A comprehensive review highlighting new research areas. *Veterinary Sciences*, 11(2), article number 66. doi: [10.3390/vetsci11020066](https://doi.org/10.3390/vetsci11020066).
- [26] Xu, X., Bai, J., Lu, K., Xiao, L., Qin, Y., Gao, M., & Liu, Y. (2023) Association of metabolic and endocrine disorders with bovine ovarian follicular cysts. *Animals*, 13(21), article number 3301. doi: [10.3390/ani13213301](https://doi.org/10.3390/ani13213301).

[27] Yama, P., et al. (2022). In vivo follicular and uterine arterial indices as an indicator of successful hormonal stimulation for inactive ovaries in repeat-breeder crossbred dairy cows using a short-term progesterone-based programme. *Animals*, 12(3), article number 292. doi: [10.3390/ani12030292](https://doi.org/10.3390/ani12030292).

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Анотація. Непліддя корів та телиць було і залишається найбільш актуальною проблемою скотарства. Статеві органи і молочна залоза несуть підвищене функціональне навантаження, яке пов'язане з вагітністю, родами і лактацією. Метою науково-виробничого дослідження було визначення поширення симптомів хронічної незворотної неплідності у корів айрширської породи, вибрактованих внаслідок багатократних штучних осіменінь. У ході дослідження було застосовано аналітичний, структурно-порівняльний і статистичний методи, а також послідовно використано впродовж двох етапів модифіковану диференційну пальпаторну діагностику клінічного стану органів репродукції у ділянці «яєчник+яйцевід» з латеральною локалізацією. Результати дослідження показали, що корови, у яких *in vivo* діагностовано симптоми хронічних злипливих сальпінгітів та овосальпінгітів (52,17 %), тобто незворотну форму неплідності, мали достовірно вищу (+28,05 %; $P < 0,01$) молочну продуктивність за кращу лактацію, у порівнянні з тими, у яких цих патологій не встановлено. Крім того в групі вибрактованих внаслідок численних неефективних осіменінь корів було виявлено суміжні гонадопатії: від 4,35 до 10,87 % виражено гіпотрофічних станів яєчників, 4,35 % симптомів склерозу гонад і 17,39 % випадків кістозних фолікулярних дегенерацій. У 73,91 % самиць було встановлено наявність статевої циклічності з незміненою функцією яєчників у фолікулярну фазу та у 84,78 % – у лютеїнову фазу циклу. Застосування в умовах виробництва диференційної пальпаторної діагностики дозволяє в умовах *in vivo* прогнозувати тенденцію до втрати генетичних ресурсів (здатності яєчниками корів зберігати генеративну і секреторну функції) у високопродуктивних корів внаслідок хронізації запальних гінекологічних патологій, що сприятиме удосконаленню медикаментозних і біотехнологічних схем терапевтичних заходів з профілактики неплідності поголів'я дійного стада

Ключові слова: молочні корови; генетичні ресурси; хронічна неплідність; яєчники; яйцеводи; хронічні запальні гінекологічні процеси; сальпінгіти; спайки