UDC: 351.779:636.2:17.023.35
DOI: 10.56407/bs.agrarian/3.2024.32

Ukrainian Black Sea Region Agrarian Science
Vol. 28, No. 3

Sanitary and hygienic assessment of the welfare of Ukrainian Black-and-White cattle breedy

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Abstract. Dairy farming is one of the most important areas in the agricultural sector, which regularly provides the country's population with valuable nutritionally and hygienically safe food products. However, for proper functioning and ensuring a high level of animal productivity, it is essential to take into account such elements as maintaining a consistently high level of sanitary and hygienic conditions in livestock premises, as well as optimising feeding and housing conditions. The purpose of the study was to evaluate different ways of keeping cattle in terms of sanitary and hygienic conditions, taking into account the physiological state of cows. The study was based on zootechnical and breeding records for the previous years of the enterprise's operation. The research data were calculated using MS Excel 2013. The results of the study indicate that the air in those livestock buildings where dairy cows were kept next to dry cows on a tether had the highest percentage of carbon dioxide at 6 am (0.32%), then during the day this figure decreased to 0.19% and increased again closer to the evening and night time, during which period its value was 0.28%. This indicates that the efficiency of the ventilation system is imperfect in the above method of cattle housing. In addition, the air contamination with microorganisms during the day in different ways of keeping animals had quite clear changes. This is due to the fact that it is during the day that all the most significant technological processes of milk production take place, and this in turn automatically leads to an increase in the number of microorganisms in the air. Thus, taking into account the study of microclimate parameters (air composition, the number of microorganisms in the air, the amount of water vapour), the best option is to separate cows during the dry period from the dairy herd into a specially isolated section equipped with combined boxes, with a free-standing method of housing, which

Article's History:
Received: 08.04.2024
Revised: 14.07.2024
Accepted: 27.08.2024

Suggested Citation:
Karatieieva, O., Posukhin, V., & Borusiewicz, A. (2024). Sanitary and hygienic assessment of the welfare of Ukrainian Black-and-White cattle breed. *Ukrainian Black Sea Region Agrarian Science*, 28(3), 32-40. doi: 10.56407/bs.agrarian/2.2024.32.

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will provide better conditions for keeping dry cows. Thus, compliance with cow housing standards will reduce healthcare costs, increase life expectancy, improve animal welfare and contribute to higher milk production

Keywords: technology; containment methods; relative humidity; carbon dioxide; ammonia content; microbial contamination

INTRODUCTION

Intensification of agriculture and dairy farming in general, as well as maintaining its stable sustainability over a significant period of time, is one of the key points for the effective development of the country's economic potential in the agricultural sector.

According to M.R.H. Rakib *et al*. (2020), the financial efficiency of dairy farming is a close consolidation of the following elements: high efficiency of the agricultural process, maximum productivity of the use of production resources, a positive correlation between the obtained labour costs and increased profitability of production by obtaining a large number of high-quality agricultural products. This, in turn, is not possible without creating optimal conditions for keeping cows, providing them with comfortable climate and microclimate conditions depending on their physiological state.

A. Shevchenko & O. Petrenko (2020) argue that if an environment is not created for animals that meets all zoohygienic and veterinary and sanitary standards, it will be impossible to obtain the highest possible level of productivity from them and maintain good health. According to S. Brodovsky (2021), in cows that are record holders in terms of milk production and calf birth, if the relevant microclimate parameters are not met, the resistance of the immune system and the resistance of the body as a whole begins to decrease sharply, and as a result, causes various diseases, the development of pathological processes, and in the most severe cases, even the death of animals.

M. Zakharenko *et al*. (2023) also point out that in order to prevent the occurrence of diseases and subsequently obtain the maximum number of dairy products and solve a number of other pressing issues that will arise as a result of the work, it is necessary to know and strictly adhere to the basic tenets of animal health, respond in a timely manner to any deviations and solve them correctly. Particular attention should be paid to the study of the environment in which the animals are kept and at the same time to take all necessary measures to improve the health of the cow herd.

According to R. Bleizgys *et al*. (2023), one of the important conditions for keeping cows is to ensure the necessary microclimate parameters in the barn. At the same time, elevated temperature and humidity in the room can cause heat stress in cows, which negatively affects their physiological state and productivity, and can even cause a deterioration in the quality of milk produced. In addition, according to C. Kipp *et al*. (2021), an increase in humidity and temperature in barns leads to an increase in greenhouse gas emissions.

Monitoring of data in the world practice of dairy farming shows that a number of authors cite non-compliance with the recommendations of standards for animal welfare indicators and the creation of comfortable microclimate conditions for animals. For example, G.E. Dahl *et al*. (2020) report that indoor temperature, humidity and ventilation conditions do not always meet the standards and are often the cause of heat stress in summer, especially in dry cows and cows during calving. In turn, C.B. Tucker *et al*. (2021) found that unfavourable conditions, including poor ventilation, insufficient gas exchange, heat and rain, lead to the accumulation of large amounts of harmful gases in the air and contribute to microbial contamination of the air.

Creating comfortable conditions during late pregnancy in dry cows is beneficial for both the cow and the developing calf. And violation or non-compliance with sanitary and hygienic standards of keeping such animals has a number of negative consequences, not only for the cow itself, but also for calves that will be in unsatisfactory conditions during intrauterine development. Therefore, the issue of studying the welfare of pregnant cows during dry periods does not lose its relevance, which aroused interest in assessing the conditions of keeping Ukrainian Black-and-White cows during dry periods in the Southern region of Ukraine.

LITERATURE REVIEW

In the conditions of agricultural enterprises, cattle can be kept in quite different ways and systems. The main methods include tethered and untethered, and among the housing systems there are four main types – fattening grounds, walking and non-walking, and pasture systems. Therefore, depending on the above methods and systems, appropriate climate and microclimate conditions should be created in the premises where animals are kept, depending on their age and physiological condition.

According to M.R. Mondaca (2019) and D. Lovarelli *et al*. (2020), housing in a free-range system usually

takes place either on deep bedding or can be replaced by housing on a slotted floor. When cows are kept tethered, floor space is an important issue, with 1.7-2.1 m^2 per animal always being allocated. When cattle are kept untethered, the area of the animal's location increases, which in turn leads to an increase in the motor activity of cows, according to the standards, the area ranges from 3 to 7 m^2 per animal. Feeding is provided either through a feed trough or a feed table. In this case, the feeding front per head should be at least 70 cm.

G.E. Dahl *et al*. (2020) found that the importance of such an important issue as microclimate from a veterinary and sanitary point of view can vary significantly depending on the systems and methods of housing. Thus, in the premises where animals are kept in the untethered system, the ambient temperature is the lowest compared to other systems and is 6-8°C. Of all the age and sex groups of animals, young animals are the most sensitive and vulnerable to cold, which can cause diseases. Therefore, the temperature indicators for them are the highest, reaching 12-18°C. For tethered housing, the room temperature is between 8-12°C.

Both temperature and humidity levels in livestock housing are quite broad concepts. Typically, the optimum humidity level should be 75%, with a permissible limit of 85%. R.F. Cooke (2019) found that air composition and air quality in barns is also important in creating good cow welfare. One of the most common elements of the air environment in livestock buildings is ammonia. Ammonia is a colourless gas characterised by a strong pungent odour and is highly irritating to mucous membranes. It is most often found in the air in the form of carbon dioxide, nitrogen dioxide and nitric acid salts. It is released into the atmosphere through the decay of substances with a high nitrogen content, and penetrates the soil from various manure storage facilities and industrial enterprises. In livestock buildings, the main source of ammonia is nitrogen-containing substances that undergo decomposition (faeces and urine). Studies have shown that extremely high levels of ammonia can be detected in poorly functioning sewage and ventilation systems, as well as in places where animals are crowded in tethered housing.

A. Shuliar *et al*. (2020) believe that if all sanitary and hygienic standards are met at a high level in livestock buildings: manure is removed and disposed of in a timely manner, sewage and ventilation systems operate systematically, and a consistently clean floor is maintained, then the ammonia content in the air can be reduced to a minimum. S. Voitenko & I. Zheliznyak (2019) confirmed that the permissible ammonia content for cowsheds is a fairly broad concept and has a close correlation between the age and physiological state of the animal. For example, adult cattle are fully formed in terms of growth and development and are more resilient, so a level of up to 20 mg/m^3 is a satisfactory indicator for them. Young cattle are more vulnerable and sensitive, so this value is lower for them and is up to 10 mg/m^3.

Another important element found in the air environment is hydrogen sulphide. This type of gas is the most harmful and often causes the death of animals due to the toxicity of waste on the farm. It spreads extremely quickly over the ground and indoors and reaches its peak concentration in manure storage areas. According to M. Maasikmets *et al*. (2015), the most dangerous feature of hydrogen sulphide is that it causes paralysis of the nerve cells in the nose, leading to a suppression of the sense of smell. At higher concentrations, loss of consciousness occurs quickly enough, and death can occur in a few minutes. However, even a short stay in an environment filled with hydrogen sulphide results in a slow reaction, which can result in death of a person or animal from pulmonary edema in 24 hours.

Thus, the assessment of the conditions of keeping Ukrainian Black-and-White cows using different methods will help to identify the best sanitary and hygienic criteria and factors of keeping, which in turn will allow to manage the indicators related to the welfare of dairy cattle, and as a result, will improve the health of cows and directly affect the level of their milk production.

MATERIALS AND METHODS

The research was carried out in the conditions of the State Enterprise "Plemreproductor 'Stepove", Mykolaiv district, Ukraine, in the period 2023-2024. To achieve the task, three groups of Ukrainian Black-and-White cows were formed, which were in the period of dryness. In further work, 10 animals were selected for the experiment, and in each group, the comparison was formed according to the principle of analogue pairs.

The experimental groups differed in the way they were kept, with the control group cows being kept on a tether next to lactating cows. For the cows of the first experimental group, a tethered method of housing with separate sections was used. Animals of the second experimental group were kept in a separate section without tethering in combined boxes.

In the premises where cattle were kept, the microclimate parameters were studied every ten days in three sections, this work was carried out with a frequency of four times a day, with an interval of 6 hours. The time of material collection was as follows: at 6 am, at 12 pm, at 6 pm, at 12 am. For a clearer analysis and more detailed coverage of the results of the work carried out,

biometric data processing was carried out using MS Excel 2013 according to the methodology of S. Kramarenko *et al.* (2019).

The rules for handling animals in the experiment fully complied with European legislation (Council Directive of the European Union No. 98/58/EC, 1998; Nalon & Stevenson, 2019). The protocol of the experiment on blood sampling from cows was approved by the local bioethics committee of Mykolaiv National Agrarian University, Ukraine, in accordance with the Good Clinical Practice (GCP) for the protection and humane treatment of experimental animals.

RESULTS

Investigating the level of humidity in livestock buildings where cattle are kept, it can be observed that the data obtained are quite different. For example, when dry cows are kept on a tether together with lactating cows, the humidity level varied slightly during the day and slightly exceeded the norms (Demchuk *et al.*, 2006). When animals were kept on a tether in a specially designated separate section, as well as when they were kept in combine cubicles without ties in an isolated section, the level of relative humidity was much lower and did not exceed the values established by the norm (Table 1).

Table 1. *Relative humidity level of livestock premises in different ways of keeping cows, %*

Method of keeping	Time of the day				The average indicator
	6 am	12 pm	6 pm	12 am	
Tethered (together with cows during lactation)	82.9 ± 2.21	87.9 ± 2.20	88.0 ± 2.05	84.3 ± 2.58	85.77 ± 2.26
Tethered (in a separate section)	68.9 ± 1.00	72.1 ± 1.01	72.4 ± 1.28	68.6 ± 1.21	70.50 ± 1.13
Untethered (in a separate section with combined boxes)	64.4 ± 1.54	69.3 ± 1.53	69.8 ± 1.80	65.7 ± 1.51	67.30±1.59

Source: *authors' development*

In the daytime (from 6 am to 12 pm), when animals were kept tethered, the relative humidity increased quite significantly, while remaining steadily at the same level until 6 pm, and only after that it decreased by 3.8%. This point can be explained by the fact that it is during this period of time that physiological processes of urine and faeces excretion are actively taking place, as well as the intensive process of air gas exchange, since animals are one of the main sources of water vapour in the room. It is also during this period that the main production and technological processes take place. Relative air humidity during the day in the livestock premises where cows were kept in a separate section with combined boxes without tethering was 18.2-18.6% lower compared to animals kept on a tether next to the milking cows. The company also studied the carbon content in the air of livestock premises depending on the way cows are kept. Thus, it was found that the highest level of CO_2 was observed when dry cows were kept together with dairy cows (Table 2).

Table 2. *Carbon dioxide content in the air of the premises in different ways of keeping cattle, %*

Method of keeping	Time of the day				The average indicator
	6 am	12 pm	6 pm	12 am	
Tethered (together with cows during lactation)	0.32 ± 0.022	0.19 ± 0.012	0.19 ± 0.008	0.28 ± 0.020	0.25 ± 0.015
Tethered (in a separate section)	0.18 ± 0.007	0.12 ± 0.006	0.12 ± 0.005	0.23 ± 0.009	0.16 ± 0.006
Untethered (in a separate section with combined boxes)	0.22 ± 0.009	0.14 ± 0.007	0.15 ± 0.003	0.22 ± 0.006	0.18 ± 0.006

Source: *authors' development*

The air in the room where the dairy cows were kept next to the dry cows had the highest carbon dioxide level at 6 am (0.32%). During the day, it gradually decreased to 0.19%, and in the late afternoon and at night it increased again to 0.28%. One of the main reasons for these changes is that when cows of different physiological groups (dairy and dry cows) are kept, the efficiency of the ventilation system is relatively unsatisfactory.

In the second method of cow housing, the average carbon content was 0.16%, which was the best indicator and was characterised by somewhat stable values during the day – 0.12% from 12 pm to 6 pm. It slightly increased at 6 am to 0.18% and reached its maximum value at 12 am – 0.23%. This is probably due to the low mobility of animals and their rest period at this time. The third method of keeping cows in combined boxes revealed average carbon dioxide values of 0.18%, which were characterised by dynamics during the day. The highest level was observed, again at 6 am and at 12 am – 0.22%. At the same time, during the day, from 12 pm to 6 pm, the carbon level fluctuated between 0.14 and 0.15%.

An important indicator that characterises the sanitary condition in the livestock building and is also important when assessing the operation of the sewage system is the concentration of ammonia in the air. Studies have shown that the method of keeping cattle did not significantly affect the ammonia content in the air (Table 3).

Table 3. *Ammonia content in livestock premises in different ways of keeping cows, mg/m³*

Method of keeping	Time of the day				The average indicator
	6 am	12 pm	6 pm	12 am	
Tethered (together with cows during lactation)	23.0 ± 1.08	16.6 ± 1.05	15.9 ± 0.65	22.9 ± 0.90	19.6 ± 0.92
Tethered (in a separate section)	20.2 ± 0.67	14.8 ± 0.93	15.3 ± 0.56	22.4 ± 0.79	18.2 ± 0.74
Untethered (in a separate section with combined boxes)	18.7 ± 0.62	14.8 ± 0.74	13.9 ± 0.83	24.0 ± 0.75	17.8 ± 0.74

Source: *authors' development*

In the study of the tethered method of keeping cattle in stalls together with dairy cows, despite the fact that the concentration of ammonia in the air was quite fluctuating, it was within normal limits, and the only exception was the night period (from 12 am to 6 am) when the ammonia content in the air exceeded the maximum permissible level – 22.9-23.0 mg/m³. When dry cows were kept in a separate section with combined boxes without being tethered, the concentration of ammonia in the air reached its lowest values during the day, during the active period of animals (from 12 pm to 6 pm) – 13.9-14.8 mg/m³. Under the tethered method, when dry cows were kept in separate sections, the ammonia content in the air was average, and its highest concentration occurred during the period of reduced cow activity, i.e. at night – 20.2-22.4 mg/m³. At the same time, during the day, this indicator fluctuated at the level of 14.8-15.3 mg/m³. This is due to the lower air mobility in the barn when animals are resting than during their physical activity and during the main production processes.

As of 2024, one of the least studied issues in livestock farming is the study of the level of air pollution by microorganisms, which has aroused interest in studying this aspect as an important indicator of animal welfare. A significant role in this issue is given to the study of the main technological processes, such as feeding and watering animals, milking, ventilation system operation, as well as the quality of building materials used for stalls and floors, as they affect the degree of contamination of livestock premises with various microorganisms (Table 4).

Table 4. *The level of microbial contamination of indoor air depending on the way cows are kept, thousand microbial bodies/m³*

Method of keeping	Time of the day				The average indicator
	6 am	12 pm	6 pm	12 am	
Tethered (together with cows during lactation)	74.5 ± 1.31	82.2 ± 1.41	83.0 ± 1.29	77.1 ± 1.27	79.2 ± 1.32
Tethered (in a separate section)	36.2 ± 0.81	40.2 ± 1.00	41.2 ± 0.76	35.6 ± 0.70	38.3 ± 0.82
Untethered (in a separate section with combined boxes)	33.5 ± 1.25	35.8 ± 1.13	36.2 ± 0.94	29.8 ± 1.03	33.8 ± 1.08

Source: *authors' development*

The research results clearly show that the level of microbial contamination of the air in livestock premises during the day, where animals were kept in different ways, had significant fluctuations. Thus, the lowest contamination was recorded in the air of those rooms where cows were kept untethered in a separate section equipped with combined boxes. The highest values were observed during the day – 35.8-36.2 thousand/m³, i.e. during the hours of the highest activity of cows. In the mixed housing of dry cows with lactating cows in a tethered manner, this indicator was the highest and averaged 45.4 thousand/m³ more cells compared to animals kept separately in combined boxes. Comparing the microbial contamination of the air in the rooms where dry cows were kept in an isolated section in a tethered manner, it should be noted that there were 13.5% fewer microorganisms in the room compared to the first variant of housing.

Thus, the results obtained give grounds to assert that the analysis of sanitary and hygienic conditions of cows is the basis for the creation of an integrated system for assessing the welfare of dairy cows on the farm, which will take into account the biological component of technological processes and create such conditions that will fully correspond to the physiological state of the animal, its health status and provide comfort, which in combination will affect the high level of milk production.

DISCUSSION

Increasingly, global practice pays great attention to assessing the welfare of dairy cows and creating comfortable living conditions for them that are in line with natural ones. Even in 2017, the issue of comfortable conditions for dairy cows was considered in the European Parliament in a report by the Directorate-General for Internal Policy, which noted that the welfare of dairy cows is considered the second biggest problem of animal welfare in the EU (Broom, 2017). Therefore, most scientists, for example, I. Halachmi *et al*. (2019), believe that there is an urgent need to improve the conditions of cows on farms. A.R. Frost *et al*. (1997) and F. Napolitano *et al*. (2009), when assessing the welfare of farm animals, pay attention to three important aspects – "How well does the animal's body function physiologically, how well does the animal feel, and do the given living conditions correspond to the animal's natural environment?". But here, too, the authors' opinions differed. Thus, scientists T. Jóhannesson & J.T. Sørensen (2000) and L.M. Leliveld & G. Provolo (2020) have different interpretations as to which of these problems is the most important and universally recognised. At the same time, E. Galán *et al*. (2018) and X. Wang *et al*. (2018) believe that none of these three issues can fully address all aspects related to animal welfare.

According to L.M. Leliveld & G. Provolo (2020), it is not possible to create ideal conditions for the animal, as in tethered housing, dairy cows will have a lower risk of injury, lameness and hoof diseases, but at the same time they will be limited in movement and social contact, and thus they will somehow have poor welfare that does not correspond to natural conditions. Studies by M. Bagath *et al*. (2019) and M. Besler *et al*. (2021) show that keeping animals in cool, damp, insufficiently ventilated rooms with drafts leads to a decrease in their productivity by up to 15%, an increase in feed consumption by 12-35%, which leads to a 2-3-fold increase in morbidity. An inappropriate microclimate also affects the general condition of the livestock building, its durability and thermal conditions in the building. At air temperatures above 25°C, cows eat less, and their milk yield and weight gain decrease. The most unfavourable combination of parameters is a set of high temperatures with high humidity (over 80%) and low air exchange. In this case, cattle may experience so-called heat stress. Relatively high humidity prevents animals from releasing heat into the environment by evaporation from the body surface. If the indoor air is heavily polluted due to low air exchange, the humidity will usually be high. Such conditions lead to the increased development and spread of bacteria and viruses. Relatively high humidity also requires more bedding, as the area is difficult to keep dry. Wet indoor surfaces also shorten the life of the building and increase maintenance costs in winter.

One of the indicators of animal welfare is the assessment of the composition of the air in cowsheds, as excessive levels of harmful gases have a negative impact on the animal's body. One of these gases is ammonia. Experimental studies by R. Bleizgys & I. Bagdoniene (2016) showed changes in ammonia concentration and the factors that most affect it in different periods of the year. Thus, according to the authors, the process of ammonia evaporation from manure is influenced by many different and interrelated factors, among which temperature and air ventilation intensity are the most critical. An increase in temperature leads to an exponential increase in ammonia emissions, while the dependence of emissions on air velocity is best expressed by a second-degree polynomial.

Particulate matter in the air can be a potential risk factor for human and animal health. For example, E. Galán *et al*. (2018) studied the concentration of particulate matter and the concentration of harmful gases in the air during the free-range housing of cows. The authors found correlations between indoor particulate matter, concentrations of harmful gases and other microclimate parameters. There were clear seasonal variations between measurements in summer and winter. Particulate matter (all fractions) and CO_2 concentrations were higher and ammonia concentrations were lower in winter.

M. Maasikmets *et al*. (2015) consider hydrogen sulphide to be another important harmful gas found in livestock buildings. H_2S is produced during anaerobic manure decomposition as a result of mineralisation of organic sulphur compounds, as well as the reduction of oxidised inorganic sulphur compounds such as sulphate by sulphur reducing bacteria. Higher manure sulphate content leads to higher H_2S emissions. The reduced content of sulphurous compounds and volatile fatty acids also contributes to the production of odours that can cause negative physical and psychological reactions in animals and humans.

Thus, a study on dairy welfare on dairy farms should be evaluated for at least two main reasons: to identify unsatisfactory housing conditions and to eliminate them, as they affect the health of the animal. This will generally contribute to the production of more and better quality products.

CONCLUSIONS

It was found that in the premises where pregnant dry cows were kept together with dairy cows, the air humidity during the day did not fall within clearly established norms. Significantly lower values of relative air humidity in livestock premises were found when cows

were kept in a separate section with combined boxes. At the same time, higher humidity values were observed during the day during the greatest physiological and motor activity of cows, because it is during this period of time that intensive gas exchange and physiological processes of urine and faeces excretion occur. Also, the effect of the method of keeping dry cows on the carbon and ammonia content in the air was found to be ambiguous. Thus, the best carbon levels were observed in the tethered method when cows were kept in separate sections, while lower ammonia values were inherent in the untethered method in a separate section with combined boxes. The lowest concentration of harmful gases in both housing methods was observed during the day, when animals were actively moving and the main technological processes were taking place, which contributed to air circulation in the room.

The air contamination with microorganisms under different methods of keeping during the day had significant changes. This is due to the fact that most of the technological operations and milk production processes at the enterprise take place during the daytime, which actually lead to an increase in the number of microorganisms in the air. And, accordingly, they have a much greater impact on this indicator than at night, when animals are resting and no technological operations are taking place. A comprehensive assessment of the sanitary and hygienic conditions for the welfare of Ukrainian Black-and-White dairy cows showed that it is not desirable to keep animals of different physiological groups, namely lactating and dry cows, in a mixed way in one room. Thus, to improve cow welfare, it is necessary to comprehensively assess the conditions of cow housing, climate and microclimate in the building and create conditions where animals feel comfortable and natural. After all, only a healthy animal that is free from stress and in conditions close to natural ones is able to realise its potential for high milk production. The prospect of further research on this topic may be the creation of comprehensive models of cow welfare depending on the method, housing system and physiological state of the cows, which will help to improve not only their health but also prevent the occurrence of stressful phenomena in animals and influence the level and quality of milk production.

ACKNOWLEDGEMENTS

The authors are grateful to the owner and staff of the state agricultural enterprise where the experimental studies were conducted – State Enterprise "Plemreproductor 'Stepove", Mykolaiv region, Ukraine, as well as to the editorial staff for the English version of the manuscript.

CONFLICT OF INTEREST

None.

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Анотація. Молочне скотарство є одним з найважливіших напрямків в агропромисловому секторі, який на регулярній основі дає можливість постачати населенню країни цінні в харчовому та безпечні в санітарно-гігієнічному плані продукти харчування. Але для належного функціонування та забезпечення високого рівня продуктивності тварин обов'язковим аспектом є врахування таких елементів, як: підтримання стабільно високого рівня санітарно-гігієнічних умов у тваринницьких приміщеннях, а також оптимізація умов годівлі та утримання корів. Мета дослідження – оцінка різних способів утримання великої рогатої худоби за санітарно-гігієнічними умовами з урахуванням фізіологічного стану корів. Для проведення дослідження було використано дані зоотехнічного та племінного обліку за попередні роки роботи підприємства. Дані досліджень було обчислено за допомогою програми «MS Excel 2013». Результати досліджень вказують, що повітря в тих тваринницьких приміщеннях, де дійні корови утримувалися поруч з сухостійними на прив'язі, мало найвищий відсоток рівня вуглекислого газу саме о 6-й годині ранку (0,32 %), в подальшому протягом доби цей показник зменшувався до 0,19 % і знову зростав ближче до вечірнього та нічного періоду часу, в цей період його значення дорівнювало 0,28 %. Це вказує на те, що за наведеного способу утримання великої рогатої худоби ефективність роботи системи вентиляції є недосконалою. Окрім того, забрудненість повітря мікроорганізмами протягом доби при різних способах утримання тварин мала достатньо кількісні зміни. Це пов'язано з тим, що саме в день відбуваються всі найбільш значні технологічні процеси виробництва молока, а це в свою чергу автоматично призводить до підвищення кількості мікроорганізмів в повітрі. Таким чином, враховуючи дослідження параметрів мікроклімату (склад повітря, чисельність мікроорганізмів в повітрі, кількість водяної пари), найкращим варіантом є відокремлення корів в період сухостою від дійного стада в спеціально ізольовану секцію, яка оснащена комбінованими боксами, з безприв'язним способом утримання, що забезпечить кращі умови утримання сухостійних корів. Тож, дотримання норм утримання корів має зменшити витрати на їх охорону здоров'я, збільшити тривалість життя, покращити добробут тварин і буде сприяти більш високій молочній продуктивності

Ключові слова: технологія; способи утримання; відносна вологість; вуглекислий газ; вміст аміаку; мікробне забруднення