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COW HOUSING UNDER SANITARY AND HYGIENIC CONDITIONS OF MILK PRODUCTION

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ABSTARCT

It is established that in the stall period (November - March) the microclimate of the cowshed is 4.0 points, which complies with the engineering design conditions, to improve the parameters it is necessary to optimize the conditions regarding the concentration of harmful gases in the air and microbial contamination. Well-timed faeces disposal and air ventilation control will optimize these parameters.

It is proven that the thermal balance of the building depends on the created conditions of comfortable keeping of cows and their number in the building, as well as heat loss through the enclosing structures: gates, windows, ceiling, floor and walls, the thermal balance in the cowshed is made for the outside temperature of (-4,3 ° C).

Since sanitary and hygienic conditions of cow housing do not meet the optimal design and technological regime, and the amount of microorganisms in the air of the room is above norm and negatively affects the health of cattle, it is necessary to implement integrated elements of technology in the process of commercial milk production and rationalize the schedule while maintaining standards of technological design.

Key words: cowshed, maintenance, building, microclimate, stall period, evaluation, efficiency.

Introduction. In accordance with the state regulations of scientific and technical measures of livestock facilities exploitation in the production of cattle industry at the level of the European Union requirements and in compliance with international standards. Today, a significant increase in energy prices causes concern among producers of livestock products due to the inability of using the modern means of mechanization and automation, the use of innovative heating systems of barns and especially calving barns, in the stall period with insufficiently insulated buildings occurs heat loss through the enclosing structures, and this badly affects the microclimate, sanitary and hygienic properties.

Relevance of the study. Production of dairy cattle products is one of the most important and problematic issues currently. Nowadays it requires the introduction of innovative approaches and solutions that can be easily and quickly integrated into the production process and would provide an opportunity to comply with veterinary and sanitary requirements and norms of technological design. One of the ways to accelerate the increase in the amount of commercial milk production is the introduction of energy-saving technology, with the rational use of production area of the barn for accommodation of dairy cattle. This will allow increasing the cost-effectiveness of production, gaining profit and improving the rationality of area usage in several times.

Review of literary sources. According to scientists R.L. Varpikhovsky [1], T.V. Popala [4], L.V. Polevoy, A.S. Yaremchuk [5] and O.S. Yaremchuk [6], violation of technological links led to problems in creating a normative air environment in livestock buildings, such as: an increase in thermal resistance of building enclosures without the use of artificial heating and ventilation; additional expenses on heating systems and air ventilation in livestock buildings; installation of equipment to maintain the necessary microclimate using heat exchange ventilation systems (if possible without the use of heating and increasing the thermal resistance of enclosures). Solving these issues increases the energy-efficiency of the production, but require a scientific justification of the reasonability of the use of significant material expenses.

Therefore, one of the ways of increasing productivity is the use of modern technologies of milk production, which implies the improvement by replacing methods and ways of keeping cattle, i.e. transferring cows from tethered to loose housing, which will reduce labor costs, and increase the index of fodder payment.

The aim of the research was a theoretical and experimental analysis of the impact of livestock building on the productivity of cattle on sanitary and hygienic conditions and compliance with the norms of technological design.

Research methodology. Production inspection was carried out in the farm where there are highly productive cows of Ukrainian black and gray dairy breed with annual milk yield of 6000 kg of milk.

Given that the buildings for keeping cows on the territory of milk production agricultural enterprise are equipped with modern technology, and energy-saving facilities are absent, it is rational to carry out reconstruction and technical re-equipment, taking into account the purpose of research.

The study of the microclimate of the cowshed was conducted in the period December 2019 - March 2020, measuring the parameters at 6, 10, 14, 18 and 22 o'clock. The sample points were the points on the diagonal of the room and its center at a height of 1-1.2

m. Hygienic assessment of the air environment was performed on the basis of generally accepted methods and according to the summary score scale.

Biometric data processing was carried out by the method of variational statistics according to V.S. Patrov and co-authors (2000) using a computing machine [3].

Results of the research. Today in Vinnitsa region there is a significant number of livestock buildings, requiring restoration, reconstruction and technical re-equipment, which is necessary to carry out according to the standards under the condition of the leftover cost of about 40%.

Therefore, it is advisable to provide reconstruction for the livestock production, which requires a minimum amount of technological processes.

Placement of milking cows is provided in the building of 21 m width, where eight technological groups of milking cows of 25 heads in each section are to be placed. Technological groups are kept untethered on deep bedding. Feeding table is equipped for each technological group. Distribution of fodder is carried out by mobile fodder dispenser.

The building provides paddocks with hard surface. In the building, there is space for staff room, bedding and fodder reserve. Manure is removed twice a year using a bulldozer with a grapple. Milking is done in the milking section. All parameters of group sections are in accordance with the requirements (VNTP - APK - 01.05) [2].

The cows will enter the building after 10th day in the calving barn. The technological scheme provides for keeping cows on deep bedding (Fig. 1).

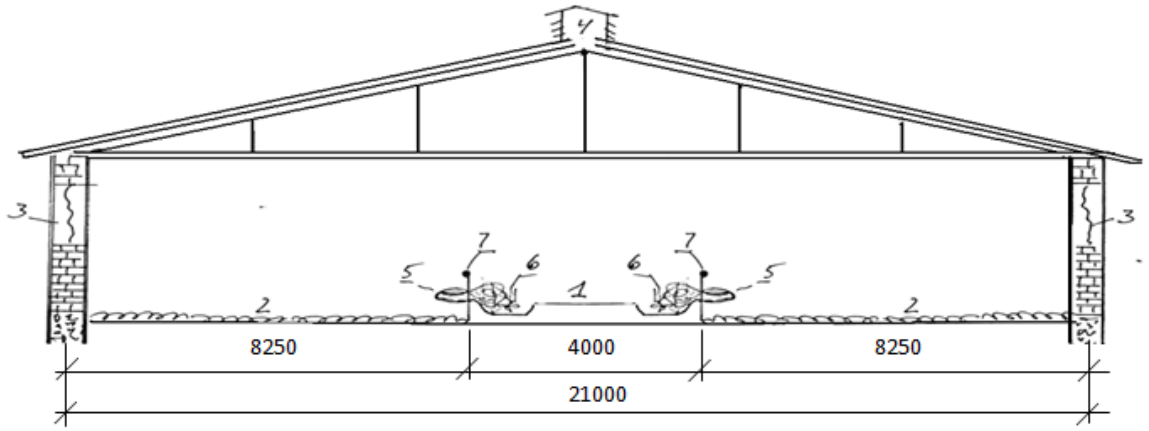

Fig. 1. Cross-section of a barn for 200 cows (21 m wide)
1 – feeding table; 2 – resting place for cows; 3 – ventilation shutters; 4 – ventilation roof lantern 5 – automatic waterer; 6 – fodder reserve; 7 – fodder grate.

A group section of 8.25 m width, 15.2 m length was created for 25 cows. The cage has two zones: an area for feeding cows from the feeding table and an area for resting on deep bedding. There are 5.0 m^2 per head, which corresponds to the minimum floor area for a cow. There are three automatic waterers in the group cage.

The cows have free space for movement in the rest area and if they want, they can freely go to the feeding table where coarse, succulent and concentrated fodder is always available. The building is equipped with paved pasture areas - 375 m^2 or 15 m^2 per cow. The room is designed in 8 sections - 25 cows in each, which allows to take turns to complete the technological groups and to make additions and re-completions.

During the maintenance period, specialists have time to evaluate behavioral reactions of animals and to regroup them in order to isolate aggressive animals, or to select similar animals for more productive use. Thus, the research will allow to optimize sanitary and hygienic conditions of keeping cows, their feeding and milking as well as to influence behavioral reactions when they are put into groups.

So, the new integrated cow keeping technology model in the building 21 m wide with the equipment of feeding, resting and walking areas as well as the use of the feeding table increases the possibility of normalizing the conditions of the maintenance, care and regulation of the behavioral reactions during the grouping and regrouping of cows as well as reduces the costs of cow maintenance.

There are 200 cows in the barn of 21x78 m with four-row stalls for cows, mobile distribution of feed, manure removal by transporter TCG-160, milking by "Milk pipeline" and leash housing. Evaluation of the building and technological equipment showed that the cows are not kept in the building. In the period of agricultural sector reforms, the animals were sold to processing companies, and the equipment for milking cows, manure removal, microclimate equipment, and wooden floors were dismantled. The condition of the foundations, walls, frame structure, floor and roof are in satisfactory condition and can be used to reconstruct the building.

One of the options for the reconstruction of the barn is the use of new energy-saving technological solutions: loose housing on deep bedding; milking cows in the milking-milking unit of "Herringbone" type; feeding animals from the feeding tables; on the walking-feeding platforms, equipment of sheds over the feeding table; automatic feeders for roughage: stall approach and stall access along the building contour.

As a result of such technological solutions 264 dairy cows are housed in the building of 21x78 m.

Cows are kept in 8 sections without restraint on deep bedding of 32 head per section, there is free access to feeding table for them. For each technological group were developed productivity rations of 4000, 5000, 6000, 7000 kg of milk per year.

Each technological group of cows (32 cows) is provided with a feeding front of 17 m length, or 53 cm per head. This allows the cows to freely approach the table during the day and get fed.

For resting there is a section with deep bedding of 17 × 8,5 m, which is 144,5 m^2, or 4,52 m^2 per head. In addition, there are feeding and walking areas near the building, where the cows are provided with a platform for washing and feeding. In the winter period, the feeding ground is equipped with self-feeders for roughage, and in the summer period - for feeding cows with the enlisted norms from the feeding table, which has a canopy to prevent rainwater from getting into it. Overall area of the walking and feeding grounds with hard covering for technological group of 32 cows is 495 m^2 or 15,47 m^2 per hea , which corresponds to the norms of technological design [2].

Researches showed that air conditions in the cow-keeping premises correspond to the norms for adult cattle in terms of: temperature, movement speed, concentration of ammonia and carbon dioxide.

The effectiveness of using low-cost technologies has shown that in the existing buildings of 21x78 m frame construction it is possible to rationally use the production area when keeping dairy cows. Before the reconstruction, 200 cows were kept tethered, and after the reconstruction - 264 cows, or 32% more (Table 1).

Table 1

Effectiveness of using technological solutions of the barn 21 × 78 m (per head)

Parameter	Befoure reconstruction	After reconstruction	Ratios after reconstruction compared in % to ratios before reconstruction
Number of livestock places, heads	200	264	132,0
Productivity of cows, kg	6000		-
Gross milk production, q	12000	15840	132,0
Fodder costs per 1kg of milk per fodder unit	0,98	0,96	97,96
Average number of core employees, person	14,2	10,6	74,65
Profitability of milk, %	86		-
Milk sold, q	10320	13622,4	132,0
Price per 1 kg of milk, hrn	6,40		-
Revenue from the sale of milk, thous.	6604,8	8718,3	132,0
Production costs, thous.	5872	5664	96,46
Income from the realization of milk, thous. hrn.	732,8	3054,3	416,8
Level of profitability, %	12,48	53,92	432,0

Table 1 shows that the rates of milk production after the reconstruction of the building compared with indicators before the reconstruction - 3054,3 thousand UAH profitability - 53,92%, which is higher at 41,44% due to the larger number of animals per area of the premises due to free stall housing. It is proved that the costs of reconstruction will be paid back in 3.4 years.

The research of the microclimate in the stabling period is necessary with the purpose of compliance of maintenance conditions of young cattle during production of beef from over-repair young cattle of Ukrainian black-motley milk breed at different age periods.

During the reform of the agricultural sector of Ukraine the capacity of milk production enterprises significantly decreased, which led to an increase in non-working production facilities.

Depending on the air temperature in the stabling period, the animals' organism adapts and readjusts the body heat exchange. When the air temperature drops, there is a need for additional energy from the fodder. This increases the cost of feed, and if it is not compensated for, it leads to a decrease in productivity.

In livestock buildings, optimal amounts of carbon dioxide play a significant role in the welfare of animals and is a physiological irritant to respiratory centers. Increased concentration of carbon dioxide in the air of the facilities reduces oxidative processes, lowers body temperature, increases tissue acidity and intensifies other metabolic processes that are not desirable for animal health. Increased concentration of carbon dioxide negatively affects animals. Productivity and resistance to disease decreases in those animals.

Therefore, it is important to equip ventilation systems that ensure optimal carbon dioxide (CO2) levels.

Ammonia (NH3) is intensively soluble in water; a significant amount of ammonia accumulates in cold, high-humidity environments. Its high concentration leads to poor health, insufficient digestion of food, death can occur when the concentration of ammonia in the air increases to 3 mg / l, pulmonary edema or respiratory paralysis.

Temperature of air environment in premises for keeping different groups of cattle (Table 2).

Table 2

Zoohygienic conditions of Ukrainian black and gray dairy cattle of different ages (December-January)

Microclimate parameter	Hours of conducted research					Avarage	Score
	6	10	14	18	22		
Cowshed 21×78 m							
Air temperature,°C	14,6	14,3	14,7	15	15,2	14,76	5
Relative humidity, %	76,4	77,2	76,4	75,2	74,5	75,94	4
CO2 concentration, %	0,23	0,22	0,19	0,17	0,17	0,196	4
Concentration of ammonia, mg/m3	21,4	21	20,3	19,4	17,8	19,98	3
Total microbial infestation, CFU	158	148	152	150	142	150	3
Permissible technological design mode							3,8
Calf barn for calves and replacement heifers 12×72 m							
Air temperature,°C	15,5	15,1	14,8	14,2	14,8	14,88	5
Relative humidity, %	75	74,3	74,1	73,2	74,5	74,22	5
CO2 concentration, %	0,16	0,17	0,19	0,17	0,16	0,17	4
Concentration of ammonia, mg/m3	17	16	15	15	16	15,8	3
Total microbial infestation, CFU	134	145	142	138	136	139	3
Permissible technological design mode							4,0

From Table 2 we can see that in the stall-winter period of 2019-2020 (December - January) the microclimate in the buildings 21 × 78 m for keeping cows corresponds to - 3.8 points or acceptable design and technological regime, where it is necessary to improve conditions for the content of harmful substances and microbial contamination through the timely removal of manure and ventilation of the building.

Microclimate in the building of 12 × 72 m for the calf housing and young cattle of different age groups corresponds to - 4,0 points or acceptable technological regime, where it is necessary to improve conditions for the content of ammonia and microbial contamination as well.

According to the evaluation of the indoor indicators of thermoregulatory processes of heat exchange of the internal environment of buildings and cold fresh air from the outside leads to a heat balance, which affects the metabolic energy processes of the living organism of animals and the environment (Table 3).

Table 3.

Thermal balance of buildings

Parameter	Cowshed 21×78 m	Cowshed 12×72 m
Amount of free heat energy released by animals, kcal/h	152000	244020
Total heat loss through the enclosing structures, kcal/h	2517,77	1736,78
Level of unpredictable heat loss (13%), kcal/h	327,31	225,78
Moisture evaporation rate in the room (10%), kcal/h	6033,30	9683,63
Thermal balance	0,88	1,01
The temperature difference at which the heat balance would be zero	12,28	14,22
Possible maximum room temperature under the conditions of the given thermal balance	6,28	8,22
Outdoor temperature, for which the typical project is designed	-4,28	-6,22

The number of microorganisms in indoor air (CFU) is 50-100 or more times higher than in outdoor air. Microorganisms in excess of the maximum allowable limit have a negative effect on the cattle body and lead to diseases of the respiratory and digestive systems.

Thermal balance depends largely on the number of animals in the room, heat loss through the enclosing structures: gates, windows, Stella, floor and walls.

So, in the barn 21 × 78 m heat balance - 0,88, the building is designed for outside temperature - (-4,28 ° C), in the calf barn 12 × 72 m for the maintenance of repair heifers of different ages - 1,01 and the outside temperature - (-6,22 ° C).

Conclusion. A sketch research of placement of milk cows in the 21 m wide cattle-breeding building provides for keeping animals in a group section with the following dimensions: width - 8,25 m, length - 15,2 m with allocation of two zones in the cage: a zone for feeding from the yearling table and a zone - resting on a deep bedding.

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РЕЗУЛЬТАТЫ ПРИМЕНЕНИЯ БИОКОМПОСТОВ НА ДЕГРАДИРОВАННОЙ ДЕРНОВО-ПОДЗОЛИСТОЙ ПОЧВЕ

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RESULTS OF THE APPLICATION OF BIOCOMPOSTS ON DEGRADED SODDY-PODZOLY SOIL

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