Influence of habitat factors on economic traits of cows of different lines

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Abstract. Influence of maintenance conditions of cows of different genealogical lines on milk productivity and physiological parameters of animals is studied. Different maintenance conditions of cows in the hulks affected the level of milk yield of animals of all lines: with yard housing there is a difference in the index of milk yield for 305 days of lactation from 59.4 to 252.3 kg compared to the indexes for tie-up housing. Minimum difference in the index was observed in first-calf cows of the Reflection Sovering line (59.4 kg), which indicates the better adaptability of animals of this line to less favorable housing conditions. The relationship between high-altitude measurements and measurements determining the milk type of animals (between the height at the withers and the chest width - a positive average interrelation (0.3), and between the height at the withers and the chest girth - a positive weak (0.11)) was revealed during the study. Also, a weak positive relationship between some measurements of cows and their milk productivity (between milk yield of cows and chest depth (0.11), chest width (0.13), chest girth (0.15) was found. Comparison of the physiological parameters of cows of different genealogical lines in different housing conditions showed that significant differences were found only in terms of "respiration rate" and "pulse frequency": when the tie-up housing, the aforecited indicators for cows of the Reflection Sovering line are significantly higher than those for herdmates. This suggests more intensive physiological processes that ensure better development and a higher level of milk productivity. Tendency to increase the number of erythrocytes and hemoglobin level in the blood of cows of the Reflection Sovering line, found during the study of influence of housing conditions of cows on the morphological and biochemical composition of blood, is preserved both in tie-up and yard housing.

1. Introduction

The issue of increasing the milk and dairy products production is becoming more relevant in conditions of accelerated import substitution, and since currently livestock is intensive, the problem solution largely depends on breeding [1, 2].

Since the genetic potential of livestock is already at a high level, breeders face the task of revealing it. At present it is necessary to control the genealogical structure taking into account linear affiliation and determine prospects for their development in order to determine the direction of selection situation in herds and populations of animals [3-5].
Each of the economic traits has a different degree of causality by genetic and phenotypic factors. Therefore, the study of influence of housing conditions and feeding cows on the exteriors, milk production and cows’ health, depending on the linear affiliation, is a topical issue [6-7].

2. Experimental research
The research was carried out in the JSC "Put' Ilyicha" Zavyalovsky district of the Udmurt Republic - a pedigree farm for the breeding of Kholmogory cattle. The studies included analysis of the content system, the exterior particularities of cows and their physiological state, the dynamics of quantitative and qualitative indicators of dairy productivity. The study of maintenance conditions of animals was carried out by estimating the microclimate parameters and describing the structural features of the cattle-breeding premises. To study the microclimate in the cowshed, conventional zoohygienic methods were used. The temperature, relative humidity and air velocity were determined using the "TKA-PKM-60" thermo-anemometer at three points: at the level of 50, 120 and 160 cm, the illumination at the level of 120 cm from the floor by the "Argus-01" luxmeter. The studied indicators were measured 3 times a day: in the morning - 7.00, in the afternoon - 12.00, in the evening - at 19.00 for two adjacent days once a month. The points of measuring the microclimate parameters are combined into the northern, southern and central zones, depending on the location of the buildings on the terrain.

Four groups of cows with the first complete lactation, depending on their linear affiliation, seven heads in each, were formed by the method of groups-analog in each building (yard and tie-up housing). The evaluation of the exterior was carried out on 2-3 months of lactation. Measurements of body temperature rectally (mercury thermometer), pulse (tail vein), and respiratory rate (the number of respiratory movements) were performed in the study of physiological parameters. The study of morphological composition and biochemical parameters of the blood was carried out once a month: an analysis the number of erythrocytes and leukocytes, level of hemoglobin, total protein, and albumin were made. Milk productivity of cows was studied by results of the first lactation: milk yield for 305 days of lactation, fat and protein content in milk. Analysis of current milk production (average daily milk yield, mass fraction of fat and protein in milk of cows of different lines) was carried out on the basis of control milking (once a month).

As an indirect indicator of the physiological state of animals, the multiplicity of insemination, the ease of the past calving was studied. An analysis of the parameters of dropout cows of the studied lines (lifetime, economic use and reasons for the withdrawal of cows from the herd (over the last five years)) was also carried out. Analysis of the multiplicity of insemination, the ease of calving, and the duration of economic use of cows was carried out according to the data of bonitation and the "Selex" program. The data obtained during the research was processed by biometric processing using Microsoft Excel.

3. Results and considerations
In this farm the main milk flock is kept by yard housing in 2 buildings with 170 heads in each. Two-time milking is done with the “Euro parallel” milking machine. Also there are three buildings with 200 heads in each with tie-up housing, milking twice in a milk pipe. The microclimate of livestock buildings, as well as the features of structural solutions of buildings during construction is an important aspect in assessing the housing conditions. The air temperature in winter in a cowshed with tie-up housing of animals was within the norm, but at point 7 there was a significant deviation from the optimum parameter - the temperature was 7.0°C, the maximum value is noted at points 1 and 2 - 10.6 and 10.5°C. In the spring and autumn periods, the air temperature was within the norm, or slightly exceeded the norm. During the year, regardless of the season, the relative humidity was within the norm: 70.5 - 85.5%, but the maximum humidity was noted at 7 and 6 points in the southern zone. The indicator of air speed in winter was above the norm: from 0.50 to 0.76 m / s, in the spring and autumn periods the indicator was within optimal limits. The illumination in the cowshed in winter was
below the norm: from 7.8 lux to 21.7 lux, in the spring and autumn periods, deviations from the norm were also observed.

In winter, in a cowshed with yard housing, the temperature varied from 6.7 to 9.7°C, with minimum values observed at points 4 and 7. In the spring and autumn periods the indicator is within the permissible temperature: from 7.2 to 14.9°C. In winter, the relative air humidity was above the norm: fluctuations in the indicator from 86.5 to 98.3%. In the spring and autumn periods, there was no clear trend in change in this indicator: the range of change was from 63.3 to 87.2%. In summer, the air humidity was below the norm: it varied from 32.4 to 34.7%, with the minimum value at points 1 and 7. The air velocity in winter was higher than normal, the fluctuation from 0.41 to 0.67 m/s, with the maximum air mobility being observed at points 4 and 7. In the spring and autumn periods, the air movement speed varied from 0.30 to 0.70 m/s. In summer, changes in the air movement speed in housing were in range from 0.56 to 0.78 m/s. In winter, the illumination was below the norm: from 5.9 to 22.9 lux, with the lowest illumination observed at points 4 and 5. In spring, the illumination varied from 19.2 to 164.5 lux, and the low index was preserved only at points 1, 2 and 3. In summer, the trend of change in illumination remains: low illumination, at points 1: 10.0 and 11.1 lux, the maximum at 4 and 5 points - from 60.1 to 166.9 lux.

Thus, some microclimate parameters in the cowsheds with tie-up and yard housing deviate from the norm. However, in general, the most favorable conditions of the air environment are formed throughout the year in cowshed of tie-up housing, then in cowshed with yard housing of animals. In cowshed with yard housing was a significant deviation in the relative humidity and speed of air movement from the norm, which could adversely affect the development of animals, their milk production and health.

Milk productivity according to indicators (milk for 305 days of lactation, fat and protein content in milk of cows) was studied after the first lactation in all cows under investigation.

Cows of the Reflection Sovering line (milk yield for 305 days of lactation made up 6073.3 kg of milk, with fat and protein content, respectively, 3.84 and 3.09%) have the highest live weight (533.77 kg) and milk productivity. However, it is noted that cows of the Pabst Governer and Montvik Chieftain lines are slightly inferior to animals of the Reflection Sovering line in productivity parameters (the difference in milk yield does not exceed 38.0 kg and is not reliable), while cows of the Pabst Governer line have a higher live mass (532.33 kg).

Influence of the method of housing cows and air conditions on their milk productivity was revealed (table 1).

| Indicators          | With Back Ideal | Montvik Chieftain | Pabst Governer | Reflection Sovering |
|---------------------|-----------------|-------------------|----------------|---------------------|
| **Tie-up housing**  |                 |                   |                |                     |
| Milk yield for 305 days, kg | 6010.7±119.21  | 6161.0±153.41    | -              | 6103.0±102.35       |
| Fat content,%       | 3.76±0.02       | 3.80±0.03         | -              | 3.82±0.02           |
| Protein content,%   | 3.07±0.01       | 3.07±0.01         | -              | 3.09±0.01           |
| **Yard housing**    |                 |                   |                |                     |
| Milk yield for 305 days, kg | 5758.44±131.32 | 5923.4±202.24    | 6035.20±189.35 | 6043.6±84.21 |
| Fat content,%       | 3.82±0.04       | 3.82±0.03         | 3.81±0.07      | 3.86±0.03           |
| Protein content,%   | 3.09±0.01       | 3.07±0.01         | 3.08±0.03      | 3.08±0.02           |
Different conditions of housing cows in the buildings had an effect on the milk yield level of animals of all lines. With yard housing, there is a difference in index of milk yield for 305 days of lactation from 59.4 to 252.3 kg, as compared to the indexes with tie-up housing. In this case, the smallest difference in index was observed in the first-calf cows of the Reflection Sovering line (59.4 kg), which indicates the adaptation of animals of this line to less favorable conditions of maintenance.

Analysis of the correlation coefficients by dairy productivity indicators was carried out in the study of cows' exteriors, depending on the linearity. Weak positive relationship between milk yield of cows and chest depth (0.11), chest width (0.13), chest girth (0.15) is noted. In the analysis, it was found that first-calf cows with a greater chest depth (Reflection Sovering and Pabst Governer lines - 187.9 and 188.190 cm) showed better milk production by the results of the first lactation.

Thus, differences in the exterior measurements of different types of cows have been found: cows of the Reflection Sovering and Pabst Governer lines (body build indexes correspond to the dairy cattle type) have the best exterior measurements. The correlation between the height measurements and the measurements determining milk type of animals (between height at the withers and chest width - a positive average interrelation (0.3), and between height at the withers and chest girth - a positive weak (0.11)) is defined. Also, a weak positive relationship between some measurements of cows and their milk productivity (between milk yield of cows and chest depth (0.11), chest width (0.13), chest girth (0.15)) is found. In this connection, methods of indirect selection can be effectively applied in this herd. It is also possible to influence the development of animals and their milk productivity by improving the microclimate parameters in cowsheds.

Analysis of the obtained results on study of physiological parameters of cows was carried out in comparison with optimal physiological parameters: body temperature 37.5-39.5 °C, pulse rate 50-70 bpm, respiratory rate 25-30 times/min. It is established that the physiological parameters of cows of all lines were within the optimal parameters. The body temperature varied from 38.0 to 39.3 °C, the pulse rate – from 55.3 to 68.3 bpm, and the respiratory rate – from 24.1 to 29.7 times/min. However, the highest pulse rate (68.3 bpm), and respiration rate (29.7 times/min) was observed in the Reflection Sovering line cows, while the minimum values were recorded in the Montvik Chieftain line animals. When comparing the physiological parameters of the first-calf cows of studied lines under different conditions of housing, significant differences were found only in respiratory rate and pulse rate. With the tie-up housing, the above indicators for the Reflection Sovering line cows are significantly higher than those of herdmates. This suggests more intensive physiological processes that ensure better development and a higher level of milk productivity.

One of the indicators determining physiological state and metabolism of animals is morphological and biochemical blood composition. All the studied indicators were in the optimal range: the number of erythrocytes varied depending on the linear affiliation from 6.68 to 7.87 * 10^12/l (norm 5.0 - 7.5 * 10^12/l), the number of leukocytes - from 6.11 up to 6.93 * 10^9/l (norm 4.5 - 12.0 * 10^9/l), the level of hemoglobin varied in the range from 105.7 to 114.3 g/l (the norm of 90.0 to 120.0 g/l), the total protein content is from 76.9 to 83.1 g/l (the norm is 72.0 to 86.0 g/l), the albumin is from 32.0 to 37.2 g/l (the norm is 26.0 - 43.0 g/l). At the same time, a significant increase in the erythrocytes number and hemoglobin level in the Reflection Sovering line cows (7.87 * 10^12/l and 114.3 g/l) is observed, compared to the similar indicators of the Montvik Chieftain line animals.

The multiplicity of insemination and the ease of past calving in first-calf cows, depending on the line, also indirectly indicate the physiological state of cows. Cows of the Montvik Chieftain (1.15 times) and Pabst Governer (1.18 times) lines had a minimum index of the calving number, but mild and severe pathology met in the animals of these lines among all calving. At the same time throughout the study only normal calving was observed in cows of the Reflection Sovering line, multiplicity of insemination was 1.24 times.

Physiological animal state influences the duration of economic use of cows, which is determined by many factors, including hereditary factors (the influence of predisposition of animals to various diseases, including the reproductive system). In this regard, the analysis of age of dropout cows, period of economic use, and reasons for their withdrawal, depending on their belonging to the line,
was carried out. The longest life and economic use of cows is observed among the Reflection Sovering line animals (70.2 months / 3.6 calving), the smallest among the Montvik Chieftein line cows (59.1 months / 3.0 calving), cows of the lines With Back Ideal and Pabst Governer - intermediate results: 62.9 months (3.26 calving) and 63.7 months (3.39 calving), respectively.

An analysis of the causes of animal dropout has revealed the most common causes, among them: low productivity, difficult births, yeldness (typical for cows of all lines), genitals diseases, legs diseases (With Back Ideal, Reflection Sovering, Pabst Governer), mastitis, birth palsy (With Back Ideal, Montvik Chieftain), metabolic diseases (Montvik Chieftain).

The findings are consistent with foreign research. Many foreign researchers pay great attention to the relationship between linear affiliation, the cows' lifespan and the exterior measurements. Foreign authors note that most of the exterior signs are closely related to health and longevity of the cow [8-10]. According to foreign sources, genetic selection has led to a sharp increase in milk yield in dairy cows for many years. This led to an increase in the frequency of reproductive disorders and infertility of cows in the United States [10-12].

4. Conclusion

In general, the most favorable conditions of the air environment throughout the year are formed in cowshed of tie-up housing, rather than in cowshed with a yard housing of animal, where the relative humidity and speed of air movement deviated significantly from the norm. Different conditions of housing cows in buildings affected the level of milk yield of animals of all lines: the difference in the milk yield over 305 days of lactation from 59.4 to 252.26 kg is observed with yard housing compared to the indicators at tie-up housing. The minimum difference was observed in the Reflection Sovering line cows (59.4 kg), which indicates the adaptability of animals of this line to less favorable maintenance conditions.

The study of influence of conditions cows' housing on the morphological and biochemical blood composition showed that the number of red blood cells and the hemoglobin level in blood of the Reflection Sowing line cows increase both in tie-up and yard housings.

The best physiological condition of first-calf cows of the Reflection Sovering line (according to pulse and respiration rate, number of red blood cells and level of hemoglobin, and the ease of calving) is established as a result of research. The lowest multiplicity of insemination was observed in the Montvik Chieftain line cows. It was found that cows with the best physiological parameters had the maximum milk yield, mass fraction of fat and protein in milk according to the results of first lactation. The analysis of dropout animals confirmed the superiority of cows of the Reflection Sovering line over animals of other lines by life expectancy and economic use in the farm. Thus, the selection of animals taking into account linearity is recommended to achieve the aim - the increasing the dairy productivity of animals, and can be used as a method of improving the physiological state of herd as a whole.

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