World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Adaptation-acclimatization issues of introduced Holstein cattle in Georgia

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World Journal of Advanced Research and Reviews, 2023, 19(01), 1358–1362

Publication history: Received on 17 June 2023; revised on 24 July 2023; accepted on 27 July 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.19.1.1492

Abstract

The presented article introduces the issues of adaptation and acclimatization of the introduced Holstein breed in the intensive farming zone of the Kakheti region in Georgia. In particular, the results of the research regarding the factors that are foremost for the Holstein breed's successful breeding in the local natural climate conditions are highlighted.

Specifically, physiological indicators of adaptation, clinical status, and milk productivity after giving birth based on data from three lactations and milk composition were studied on cattle introduced during our study. We also studied the indicators of food convention.

Based on the results obtained from the research and the conclusions drawn, practical suggestions and recommendations were developed for the correct management of fodder nutrition for the cows during heat stress. This is a valuable material for farmers and enables them to conduct targeted activities effectively.

Keywords: Holstein; Adaptation; Productivity; Heat Stress

1. Introduction

Among the global issues in the world today, food supply is the most pressing problem. It is known that livestock products take the leading place in the population's food supply - milk and dairy products, as well as meat is the most important part of the population's daily diet. Georgia is a part of the global economy and, of course, cannot remain outside the processes occurring globally in real-time. Despite the fact the production and consumption of dairy products in our country has long-standing traditions, the production of natural milk has long been the most urgent problem, for the solution of which the extensive system of cattle breeding currently existing in our conditions urgently requires the intensification of the sector and the breeding and adaptation of intensive, industrial breeds of cows along with various necessary measures. [1-4]

There are many breeds of cattle registered in the world, but only a few are popular in industrial cattle breeding, and the Holstein breed stands out among them. The mentioned breed is considered to be a monopoly breed of dairy cattle, which is characterized by high productivity, live weight, early maturity, rather pronounced type of dairy production ability, and great ability of feed convention. [5-8]

In recent years, European cattle breeds have been imported into Georgia, more than 50% of which are Holstein breeds. However, due to the peculiarity of the homeostatic abilities of the imported animals, several physiological disorders have been noted, which lead to undesirable results. As is known, the Holstein breed, unlike other breeds, is sensitive to the conditions of the living environment. Since the new living environment has the greatest impact on the organism of

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the introduced animals and during the adaptation process the animal changes its agricultural and biological properties, the process of introduction is all the more difficult, as long as the cattle's ability to acclimatize and the relevant knowledge and experience related to it are low [9-13]. Therefore, breeding imported varieties in different areas of the country without taking into account the ability to acclimatize is wrong.

It must be noted that until now the Holstein breed in the intensive farming area of the Kakheti region has not been scientifically studied and there are no relevant recommendations. Therefore, it is advisable to import breeds and execute their regional transfer on the basis of zonal testing of imported high-yielding breeds.

Taking into account all the above, the zonal test of the Holstein breed in the Kakheti region, which was the subject of our research, is relevant and has public-agricultural and scientific importance for the development of intensive farms in the country and the increase of raw milk production.

2. Purpose and methodology of the research

The aim of the study was to test the adaptability and acclimatization ability of the introduced Holstein breed to create industrial dairy cattle in the intensive farming area of the Kakheti region.

Based on the objectives of the research, the following tasks were solved during the trial period:

- study of clinical indicators of imported Holstein cattle in extreme climatic conditions;
- study of both completeness and qualitative indicators of food ration composition given to the experimental animals;
- determination of milk productivity and chemical composition of milk;

To achieve this, we used the following methodology:

- Study of the clinical status of cows in different periods of reproduction.
    - Arterial pulse measurement - by the method of palpation of the subcaudal artery;
    - Breathing frequency - observing the movement of the chest and abdominal cavity during inhalation and exhalation.
    - Body temperature - with a veterinary thermometer, rectally;
    - We studied the resistance of the heifers to high temperatures by calculating the heat resistance index, in accordance with Yu. Rauschenbach;
- Milk productivity was studied individually, once a month, based on control milking;
- Milk productivity = daily milk yield x 30 (days) x number of lactation months (10) = milk productivity;
- Study of milk composition - the analysis of samples of cows' milk at the end of each month, with the help of the milk analyser –, Lactoscan MCCWS.

3. Results and analysis

Environmental conditions are an integral part of the economic management of animal husbandry. The efficiency of cattle breeding of this or that breed depends not only on its genotype but also on how well the biological features of the organism are adapted to the environmental conditions. The increase in livestock productivity is directly dependent on the creation of appropriate living conditions for the said livestock. The productivity of any breed of livestock is one of the indicators of animals' environmental adaptation [14-17].

Visual observation of the behaviour of the animals showed that the introduced animals are less adapted to the scorching summer heat. We conducted the first study in the morning hours (8-9 am) at an air temperature of 16-20°C, and the second study - at 3-4 pm of the hot period of the day at an air temperature of 28-32°C. At a temperature of 20^0C in the morning, the body temperature of heifer cows was 38.80C, as the air temperature increased to 30^0C, the body temperature of heifer cows increased by 0.8^0C during the day. (Table 1)

Observations revealed that the introduced Holstein heifer cows were poorly adapted to the scorching summer heat, which was further complicated by poor ventilation. The first signs of heat stress appeared. Stress was reflected in the arterial pulse and respiration rates, during which animals tried to reduce body temperature both by losing heat from the skin and by breathing more frequently (more than 50 breaths/minute for lactating animals) (Table 1).

Table 1 Average clinical parameters of cows (n = 25)

Month	Respiratory rate per minute	Pulse rate per minute	Rectal temperature, ^{0}c
August	69.2	84.4	39.4
October	26.5	56.3	38.2
Norm	18.5	65	38.5

At the same time, a number of problems in feeding and keeping of the heifer cows were identified. This condition was manifested outwardly by the formation of foam in the saliva during cud-chewing, inflammation of the joints and hooves, thin manure (high urea content) and in some cases the death of cattle. At the same time, productivity dropped - daily yield reached only up to 12-15 kg, acidosis was diagnosed, which without a doubt must have been related to nutrition.

After conducting a zootechnical analysis of the used food portion and its ingredients, we determined:

- The protein content in the portion is low;
- The share of nutritiousness (sustenance) feed is 30-40%;
- When using corn silage, the content of the concentrated feed is 60-70% depending on the sustenance, while it should not exceed 38-40%;
- The portion contains a large amount of carbohydrates (sugars + starch), while the norm for dairy cattle should be 62-108 g. of sugar per serving (290 g per kilogram) and 93-100 g. starch;
- Using 0.7 kg. of soda as a buffer reduces the energy content of the ration, which leads to a decrease in milk yield;
- The grain in corn silage is in an unrefined form, which prevents the digestion and assimilation of nutrients from it;
- The food mixture is ground too finely.

Unbalanced feeding of dairy cattle, usage of a large number of concentrates, the high content of carbohydrates and violation of the sugar-protein ratio had a negative effect on the PH of the first stomach, the formation of volatile fatty acids and their ratio. At this time, the content of acetic acid is reduced to 40%, the content of propionic acid is increased to 40%, and the decrease in the content of acetic acid, in turn, leads to: a decrease in the production of milk and reduction in the fat production in milk, the activity of repeated cud-chewing is difficult, the secretion of saliva is sharply reduced, and the lack of buffer substances (neutralizers) leads to increased acidity [18,19]. This, in turn, is a prerequisite for the reduction of cellulose digestion, prolongation of the mentioned process, in addition to the reduction of productivity in the dairy cows, also leads to cartilaginous inflammation of the hooves and joints and thinning of the manure. Heat stress was reflected in the feeding behaviour of animals; The dairy cattle ate often, but spent less and less time lying down. As it is known, at this time, reduced rumination and altered production of volatile fatty acids (VFA) with a decrease in the ratio of acetate and propionate are observed in cows, which in turn has a negative effect on milk fat production [20-23]. From a "nutritional" point of view, we can help lactating animals to adapt their metabolism to high temperatures by making small changes in the feed/ration. In particular, it is very important to maintain the ratio between forage and concentrates, which may vary according to the stage of lactation, considering the fact that forage increases body temperature as a result of the energy loss of first stomach fermentation (West et al. 1999)[23], a slight increase in concentrates in the total diet is permissible, but to maintain functionality of the first stomach, it is advisable to reduce forage to a minimum amount and replace roughage (hay) with juicy feed (silage).

At the same time, we observed the dairy productivity of cows. The average yield of Holstein cows in the first lactation was 7126 kg, in the second lactation - 8515.58 kg, and in the 3rd lactation - 8563.80 kg (Table 2). The insecurity of the quality and quantity of nutrients in the daily food ration, as well as the norms of their ratio, which was described above, led to the deterioration of health conditions and, accordingly, lower productivity of livestock. The mentioned situation lasted for about one month (28-30 days) before the zootechnical analysis of the food was done and, accordingly, the optimal ration was developed. In this period, the average daily productivity was about 40% less than the average daily yield of lactation (23.35 kg) and the loss was about 285 kg. In addition, the productivity of the animals was affected by high summer temperatures and poor ventilation of the building. Before the preventive measures, the period of heat stress lasted for about 2 weeks (14-15 days) and the milk loss amounted to 140-150 kg. Therefore, the total milk loss during the first lactation was 430-450 kg.

Table 2 Milk productivity of Holstein cows

Lactation period - 305 days	**Biometric indicators** (kg. Milk)				
	Min	Max	M	C	n
Lactation 1	1840	10115	7126	25.08	25
Lactation 2	4608	12827	8515	25.30	25
Lactation 3	6679	12047	8564	26.20	25

Along with the lactation of the cows, the economic value of animal breeding is determined by the quality of the produced milk, which is determined by the output of its main components - protein and fat. In our trials, the average mass fraction of milk fat in the first lactation was 4.12%, in the second lactation - 4.27%, and in the third - 4.23%. As for the average mass share of protein in milk, it was 3.11% in the first lactation, and 3.27% in the second and third lactations (Table 3).

Table 3 Milk composition of Holstein cows

Indicators	**Lactation**								
	1			2			3		
	M	Min	Max	M	Min	Max	M	Min	Max
Fat, %	4.12	4.01	4.3	4.27	4.04	4.41	4.26	4.13	4.49
Protein, %	3.11	3.05	3.24	3.27	3.09	3.35	3.27	3.21	3.4

In general, the comparison of total yield and milk protein in milk provides an opportunity to discuss the energy potential of food. This indicator depends on many factors, and deviations indicate changes in nutrition. In our study, the average rate of protein obtained during the first lactation (3.11%) indicates a lack of energy and crude protein in the food ration, while the indicators of the 2nd-3rd lactation indicate the solution of the mentioned problem.

4. Conclusion

The present study showed that imported heifer cows were less adapted to extreme conditions. As a result, the introduced animals showed severe signs of heat stress, which was aggravated by the poor ventilation of the building and poor nutrition. Serious violations were found in the quality and composition of the portions. Meanwhile maintaining the quality and quantity of nutrients in the daily food ration, as well as their mutual ratio, led to the stabilization of the health condition of the Holstein breed animals and the maintenance of reproductive ability.

As a result of carrying out appropriate measures in the farm, in particular, after introducing an intensive livestock cooling system and adjusting the ration, we did not notice the effects of stress on the animal's body in the imported cattle. At the same time, the clinical parameters of the animals were stabilized within the physiological norm, and Holstein cows showed high milk productivity. All this gives us a reason to conclude that in the intensive farming zone of the Kakheti region, under optimal care and storage conditions, the mentioned variety of cattle showed a high adaptability and it is therefore recommended to breed it.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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