ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Using Holstein Cattle in Conditions of the Krasnodar Territory

I. N. Tuzov, V. G. Ryadchikov, A. N. Ratoshniy, N. I. Kulikova, A. G. Koshchaev

Kuban State Agrarian University
Kalinina Str., 13, Krasnodar, 350044, Russian Federation

Abstract

A comparative study of economic characters of Holstein cattle breed produced by heifers imported from Canada and Australia was carried out in climatic conditions of the Krasnodar Territory. Over the entire raising period gross increment from heifers of Canadian breeding amounted to 372.6 kg, while in peers of Australian breeding, it was lower by 12.4 kg and amounted to 360.2 kg. In terms of the milk yield over 305 days of first-calf heifers in the first group, lactations exceeded those of peers of Australian breeding by 848 kg of milk. Their milk yield amounted to 6968 kg against 6120 kg (td = 2.9). In terms of fat content in milk, cows of the first group were significantly superior to peers of Australian selection. The differences in protein content in milk were not reliable. Animals of Canadian origin were better adapted to the climatic conditions of the Krasnodar Territory. According to the nature of lactation curves, the cows of the studied groups were referred to animals with high stable lactation activity. The obtained data allow concluding that in conditions of the Krasnodar Territory it is more expedient to breed animals imported from Canada, in which the studied indicators were more preferable.

Keywords: adaptation, coefficient of milkness, fat content, gains, genetic potential, Holstein breed, milk productivity.

Introduction

The main importance of cattle breeding is that it plays a significant role in ensuring the needs of the population in the most valuable food products such as milk and beef [1, 2]. Dairy breeding is one of the most important branches of animal husbandry providing mankind with milk, which serves a source of replenishment of the human body with full-fledged proteins, essential amino acids, vitamins, minerals, and many other nutrients. Milk is also a source of raw materials for industry. It is an almost irreplaceable basis of nutrition in childhood, for both people and animals, and has been used for thousands of years. It contains all the necessary nutrients. None of the food products known to man can compete with milk in terms of its diverse composition [3, 4].

Materials And Methods

The research objects were calves of the Holstein cattle breed produced by heifers imported from Canada and Australia. To conduct the experiment, two groups of 15 animal analogues in each were formed. The first group consisted of animals from Canada while the second one included Australian animals.

The research task consisted in a comparative study of economic characters of these animals. We studied growth, development, and further, lactation performance of cows. The study of weight gain provided for control weighing at birth, at the age of 6, 10, and 12 months, and at the age of the first insemination. All animals were in the similar feeding and handling conditions. Cows were kept based on loose housing system in sections with an automated system of manure removal, watering, and feeding. Weighing of the animals from experimental groups was carried out in the morning before feeding on two adjacent days. Based on weighing, the gross and average daily gains were calculated.

After successful insemination, experimental animals were transferred to the group of heifers. After calving, lactation performance was determined for 305 days. Milking was carried out in the milking parlor using the Europarallel 2x24 milking unit with capacity of 180 heads per hour. Throughout the whole experiment, the following indicators were taken into account: milk yield, milk quality, coefficient of milkness, milk flow rate, the nature of the lactation curves, and the live weight.

Milk yield per lactation was determined by summing up milk yields for each month of lactation. The chemical composition of milk was determined in the Dairy Laboratory at the Department of Farm Animals Breeding and Animal Technology. Milk flow rate was determined in the second month after calving. Milk flow rate is the amount of milk secreted by the animal per unit time (kg/min). Next, the coefficient of milkness, i.e. the amount of milk obtained for standard or shortened lactation per 100 kg of live cow weight, is calculated in kg according to the formula:

$$CM = \frac{U}{LW} \times 100 \quad (1)$$

where *CM* is the coefficient of milkness, %; *U* is the yield of milk during lactation, kg; *LW* is the live weight of a cow on the 2nd to 3rd months of lactation, kg.

All the data obtained were processed by the variation statistics method using the Microsoft Office Excel-biometrics with filtering of elements and calculating the following main biometric indicators: *M* (arithmetic mean), *m* (arithmetic mean error), σ (mean square deviation from the arithmetic mean), *Cv* (coefficient of variability), *td* (test validity), and *P* (probability level). All the obtained values were summarized in Tables.

Discussion

To eliminate the deficiency in dairy products in different regions of the Russian Federation in the recent decades the gene pool of the Holstein breed has been successfully used since it is characterized by the highest potential of dairy efficiency and a set of technological qualities that led to its widespread use in the agricultural sector. A characteristic feature of the animal industry development is the implementation of modern industrial technology [5, 6]. World experience of improving breeding and increasing the productive qualities of dairy breeds of livestock is very versatile and diverse, and sometimes ambiguous. This is primarily due to the conditions of feeding, handling, and exploitation of animals of different intermediate genotypes in the specific conditions of implementation of the biological genotype-environment chain [7, 8].

Breeding of area-specific Holstein cattle species gave positive results in the Southern Federal District. Milk yields of Holstein cows in the best farms of the Rostov Region and the Krasnodar Territory approach to 10 thousand kg. However, breeding of Holstein cattle species with domestic breeds that ensured the steady growth of animals' productivity put a number of problems before breeders. In integrated form these problems are reduced to a decrease in the period of economic use of these cows and the cost of their raising [9, 10]. Red Steppe breed of dairy cattle, traditionally bred in the North Caucasus in the recent two decades, has undergone significant changes in its structure. Insufficient competitiveness of this breed among dairy breeds with high genetic productivity potential and adaptation to intense production technologies was the reason for the use of sources of progressive hereditary cattle material of foreign selection. Further successful work to improve Red Steppe cattle as the most common in the region and well adapted to the local climatic conditions, by crossing with Holstein red-motley breed of cattle, is possible on the basis of generalized experience in the breeding of a new type of Kuban Red Steppe breed. The same applies to Holstein-based black-motley cattle. [11, 12]. Key trend in further development of dairy cattle breeding in the Krasnodar Territory is its enhancement by breeding animals and the implementation of advanced technologies for milk production. In the Krasnodar Territory, the bulk of the Holstein cattle inventory was created by the accumulation cross breeding method.

To preserve the adaptive qualities of the original breed, the reproductive crossing is used, while obtained hybrids of 2nd and 3rd generations are bred "inter se" to improve the breed. The countries of Europe, North America, and Australia have significant reserves of breeding highly productive dairy cattle [13, 14]. More than 20 thousand heifers from different countries, including Canada and Australia, were purchased by the farms of the Krasnodar Territory to faster improve genetic potential of the cattle. Animals purchased abroad, combine high productivity, they are able to give high milk yields, and have good health. However, the acclimatization and adaptive capabilities of these animals in our conditions are studied insufficiently. Acclimatization of animals is an important stage in the import of genotypes. [15, 16]. If climatic and fodder conditions of new areas sharply differ from those in which breed was bred, then the animals' acclimatization proceeds difficultly, causing a decrease in productivity and the increased mortality [17-19].

RESULTS

To study the growth and development of replacement heifers produced by cows of Canadian and Australian selection, they were grown in the similar conditions according to the generally accepted feeding and handling technology. In the created feeding and handling conditions the live weight of experimental animals changed differently. Data on these indicators are presented in Table 1.

We have not established significant differences in live weight of experimental animals at their birth. At the age of 6 months, heifers of Canadian selection exceeded their peers in terms of live weight by 6.5 kg. These differences were statistically highly reliable at *td* = 3.8, P >0.999. At the age of 10 months, differences in live weight amounted to 12.5 kg, while at the age of 12 months – to 12.3 kg. At *td* =1.7 and 1.8, respectively, the established differences were statistically little reliable. At the age of the first insemination, we have revealed increasing trend in the live weight of heifers of Canadian selection in comparison with peers of Australian selection. In this age period, differences in live weight were 13 kg in favor of animals of the first group. These differences were significant at *td* =2.5.

Based on the data on live weight for studied periods, we have established gross and average daily gains' dynamics for these periods, which are presented in Table 2.

Analyzing the obtained data, we have determined that the animals of the first group since the date of birth to the age of 6 months were superior to the animals of the second group in terms of live weight by 6.2 kg. In the next age period from 6 up to 10 months this trend continued: heifers of the first group were superior to their peers from the second group by 6 kg.

Starting from 12 months until the age of the first insemination, no significant differences in gross gains between the animals of the experimental groups were found, they were equal to 59.0 kg and 58.6 kg, respectively. Over the entire raising period gross gain in heifers from Canada amounted to 372.6 kg, while in peers from Australia this figure was lower by 12.4 kg and amounted to 360.2 kg.

Based on the data on gross gain, the average daily gains were determined for each of studied age periods. In the period since birth to 6 months, the average daily gains in the replacement heifers of the first group exceeded that of their peers of the second group by 34 g; in the age group from 6 to 10 months, this difference was 50 g. Starting from 10 months and up to the age of the first insemination there were no significant differences in the studied indicator between the animals of the studied groups.

Table 1 – Change in live weight of test heifers, M±m, kg, n=25

Group	Age, months				
	At birth	6	10	12	at first inseminations
1	32.7±1.1	173.9±1.4	300.9±5.1	346.3±2.8	405.3±3.1
2	32.4±0.09	167.4±0.98	288.4±5.5	334.0±6.5	392.6±3.9

Table 2 – Dynamics of gross (GG) and average daily (ADG) gains

Age period, months	Group			
	1		2	
	GG, kg	ADG, g	GG, kg	ADG, g
0 - 6	141.2	784.4	135.0	750.0
6 – 10	127.0	1058.3	121.0	1,008.3
10 – 12	45.4	756.7	45.6	760.0
At the first insemination	59.0	655.6	58.6	651.1
Throughout the whole period	372.6	828.0	360.2	800.4

Table 3 – Lactation performance and milk quality of experimental cows, M±m, n=25

Indicator	**Group**	
	1	**2**
Milk yield for 305 days of lactation, kg	6,968.0±181.8	6,120.0±218.2
Milk flow rate, kg/min	2.55±0.09	2.50±0.1
Fat content, %	3.89±0.01	3.79±0.05
Protein content, %	3.32±0.02	3.35±0.05
Amount of milk fat, kg	271	232
Nonfat milk solids, %	10.01	9.68
Dry matter, %	13.9	13.47
Density, °A	30.2	31.3
Live weight, kg	549.7±9.3	536.4±7.2
Coefficient of milkness, kg	1,267.6	1,140.9

When heifers reached live weight equal to about 70% of the live weight of an adult animal, at the age of 15 months, they were subjected to insemination. After reaching pregnancy, they were transferred to the next age-sex group, namely heifers. Lactation performance was determined by the control milking method. The quality of milk was determined in the Dairy Laboratory at the Department of Farm Animals Breeding and Animal Technology.

Milk contains all the nutrients necessary for the growth of a young body in an easily digestible form. The value of milk as a food product is determined by the content of a large amount of protein, fat, and other highly valuable components. As it is known, milk productivity of animals of the same breed varies within large limits. All animals result from two sources - the environment and the heredity. Environmental conditions affect productivity by 70%, while 30% depend on the animal's genotype. In order to achieve maximum milk production, it is necessary to create optimal animal welfare. One of the most important factors affecting the level of lactation performance is the animal health. Animal health is natural physiological condition of the body, characterized by its balance with the environment, and the absence of disease. The relationship between milk yield indicators and live weight is of great importance. Numerous studies have revealed a positive relationship between milk yield and live weight. The larger is the animal, the better are developed all the main internal organs that allows converting a large amount of nutrients into milk. But the optimum live weight of the cows showing the highest lactation performance is different. Increasing the live weight of cows provides an increase in milk production as long as the animal retains the type of dairy cattle. A good dairy cow is the one whose milk yield exceeds its live weight by 8-10 times. Conducted studies [20] have revealed a positive correlation between live weight of cows and lactation performance. Lactation performance and milk quality of experimental animals of different lines are presented in Table 3. In the second month after calving, we determined the morphological and functional properties of the udder.

Data in Table 3 show that in terms of milk yield for 305 days of lactation, first-calf heifers of the first group exceed their peers of Australian selection by 848 kg of milk. Their milk yield amounted to 6,968 against 6,120 kg. These differences are highly reliable that is confirmed by the presented criterion of reliability (*td* = 2.9). Selection of animals by morphological features of the udder fully contributes to the production of cows that meet the requirements of machine milking. Therefore, along with the assessment of morphological features of the cows' udder, their functional properties were studied as well.

Study of the milk flow rate is of interest when creating biologically sound conditions for the operation of highly productive cows. Milk flow rate is an important breeding trait, which is a part of the appraisal system. Milk flow rate is a strictly inherited trait, by which selection is carried out. In terms of milk flow rate, cows of the first group were superior to their peers from the second group by 0.05 kg/min. This indicator amounted respectively to 2.55 and 2.50 kg/min, the established differences were not reliable, *td* = 0.37.

The butterfat percentage of cows is understood as their ability to produce milk with a certain fat content. This property is hereditary and fairly stable. The butterfat percentage, as a property of the breed and an individual cow, is less variable than the milk yield.

The fat content in milk affects its nutritional value. Studying this indicator, we revealed that in terms of fat content in the milk, cows of the first group were superior to their peers of the Australian selection. The superiority amounted to 0.1% that was proved statistically, *td* = 2.0.

The protein content in cow milk depends on many factors and averages between 2.8% and 3.6%. There is a close relationship between the amount of protein and fat in milk. The more protein is contained in milk, the more fatty it is. The protein content in the milk of cows in both experimental groups was approximately the same, the difference was just 0.03% in favor of cows of Australian selection, but this difference was not reliable.

During the lactation period, milk fat produced by the cows of Canadian selection was by 39 kg greater than that obtained from cows of Australian selection.

After studying the chemical composition of milk, we revealed that in terms of this indicator, animals of the first group exceeded those of the second group. The content of dry matter in the milk of Canadian selection cows was by 0.17% higher, while figure indicating nonfat milk solids content was higher by 0.33%. Milk density met the requirements in both groups and was 30.2 A^o and 31.3 A^o, respectively. The coefficient of milkness in animals of the first group was 1,267 kg, while that of peers in the second group amounted to 1,140 kg that characterized animals of both groups as high yielding cows of dairy productivity.

Animals purchased in Canada showed a good increase in lactation performance for the first 2-3 months reaching maximum by 5-6th month of lactation. This allows us to conclude that these cows have good genetic potential. In cows of Australian origin, high milk yields were noted in the months of the first lactation, but the average milk yield per lactation turned out to be slightly lower than that of Canadian peers.

Consequently, animals of Canadian origin were better adapted to the climatic conditions of the Krasnodar Territory. By the nature of lactation curves, cows of the studied groups were attributed to the animals with high sustained lactation activity. Cows of this type give a lot of milk, paying well by milk products for consumed fodder.

CONCLUSIONS

Milk productivity of animals of Canadian and Australian selection amounted to 6,968 kg and 6,120 kg, respectively, i.e. first-calf heifers of Canadian selection surpassed herdmates by 848 kg. These distinctions were reliable. In terms of live weight, as established, Canadian heifers were superior to their peers by 13 kg.

The coefficient of milkness turned out to be the highest in animals of Canadian origin and amounted to 1,267.6 kg, which was by 126.7 kg more as compared to peers of Australian origin. In terms of this indicator, the cows of both experimental groups are characterized as intense milk-type animals.

In terms of milk flow rate, cows imported from Canada were superior to cows imported from Australia by 0.05 kg per minute. In terms of fat content in milk, significant differences were revealed in favor of cows of Canadian origin. The obtained data allow concluding that in conditions of the Krasnodar Territory it is more advisable to breed animals imported from Canada since they are characterized by the best studied indicators.

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