Relationship between milk productivity and live weight of red-and-white cows in JSC "Krasny Mayak"

T F Lefler, A A Nagibina, A G Volkova, T A Kurzyukova and I V Sidorenkova

FSBEI HE Krasnoyarsk State Agrarian University, 90 Mira Ave., Krasnoyarsk, 660042, Russia

E-mail: lesyn.82@mail.ru

Abstract. In the Krasnoyarsk Territory, a genetically young red-motley breed of cattle has become widespread, which requires further improvement of the breed structure, creating diversity, increasing variability for the effective use of breeding and productive qualities. In the breeding factories of the region, specializing in raising this breed, milk yield per cow has been 5.8-6 thousand kg in recent years. However, the period of economic use of cows does not exceed 2.9 lactations. In the conditions of industrial milk production technology, characterized by a high level of mechanization and automation of labor-intensive processes, only animals with strong body composition are able to realize their high genetic potential in terms of productive qualities while maintaining good reproductive abilities and increasing productive longevity. Therefore, studies on the development of a type of cows with body conformation and composition which are most productive and well-adapted to the conditions of breeding are of particular importance and relevance.

1. Introduction
Milk productivity of cows is due to the complex interaction of breed and individual hereditary characteristics of animals, physiological state, conditions of feeding, housing and use.

According to Zh.G. Loginov et al. [8], T.F. Lefler, A.A. Nagibina et al. [1,5,6,7], the variability of a cow milk yield of is 35% dependent on feeding and maintenance, 25-30% on genetic characteristics, 25% on health and 15% on the year and lactation season.

B.A. Bagriy and M.G. Spivak [2] state that it will take a breeder 30 years of hard work to increase the genetic potential of a cow by 1000 kg of milk. A.A. Baryshev [3] cites the following data: the realized genetic progress in different breeds varies in milk yield from 20 to 50 kg, in milk fat content from 0.005 to 0.01% per year.

The purpose of the research is to determine the relationship between milk productivity and somatotypes of red-motley cows bred in the Krasnoyarsk Territory.

The research objectives are:

- to conduct an exterior-constitutional assessment of cows and highlight the main exterior-constitutional types of livestock;
- to analyze the relationship of the exterior and somatotypes with the milk productivity of the studied livestock.
2. Materials and methods
The studies were conducted on the basis of the breeding factory of JSC "Krasniy Mayak" of the Krasnoyarsk Territory. A linear assessment of the exterior of cows by a variety of characteristics was carried out at 2-3 months of the first lactation in accordance with the "Rules for assessing the somatotypes of daughters of dairy and meat breeding bulls".

Milk productivity of cows was determined by milk yield, the mass fraction of fat, protein, amount of milk fat, protein for standard 305 days of lactation according to control milking data in accordance with the Rules for Evaluation of Milk Productivity of Dairy Cows SNRbreedR-22-97 [4].

3. Results and discussions
The red-motley breed of cattle raised at the Krasniy Mayak breeding factory is distinguished by a fairly high milk yield. Milk yield in the studied livestock for the first lactation averaged 6021.4 kg of milk, the mass fraction of fat (MFF) - 4.0%, the mass fraction of protein (MFP) - 3.0% (Table 1). During lactation, on average, 240.8 kg of milk fat and 180.6 kg of protein were obtained from a cow.

To characterize cows in terms of milk productivity, the lactation index, which shows the sum of the amount of milk fat and milk protein received from the animal during lactation, is frequently used. In our studies, the value of this indicator was 421.4 kg.

The greatest variability was determined in such characteristics of the milk productivity of animals (Table 1, figure 1) as milk yield (Cv = 16.7%, Lim = 5140-7245 kg), the amount of milk fat (Cv = 16.0%, Lim = 211.4-282.6 kg), protein (Cv = 16.4%, Lim = 134.9-186.61 kg), lactation index (Cv = 16.1%, Lim = 345.7-437.3 kg). Consequently, the use of these indicators in the selection of cows will increase the efficiency of selection in the herd of the Krasniy Mayak breeding factory.

Table 1. Milk productivity and live weight of first-calf cows (n = 120).

| Characteristic       | M±m       | Lim          | Cv, % |
|----------------------|-----------|--------------|-------|
| Milk yield, kg       | 6021.4 ±79.81 | 5140-7245     | 16.7  |
| MFF, %               | 4.0±0.013 | 3.7-4.4      | 3.5   |
| Milk fat, kg         | 240.8±3.06 | 211.4-282.6  | 16.0  |
| MFP, %               | 3.0±0.009 | 2.8-3.3      | 3.2   |
| Milk protein, kg     | 180.6±2.34 | 134.9-186.6  | 16.4  |
| Lactation index, kg  | 421.4±5.38 | 345.7-437.3  | 16.1  |
| Live weight, kg      | 533.5±3.29 | 450-594      | 6.8   |
| Milk production index| 1128.6±9.59 | 820.6-1311   | 10.7  |

Figure 1. Variability of traits of milk productivity and live weight in red-motley cows.
Cows of different exterior-constitutional types had significant differences in the level of milk productivity (table 2, figure 2). The largest amount of milk for the first lactation was obtained from animals of the leptosomal (narrow-bodied) type (6679.6 ± 73.37 kg). Their superiority over their peers of the mesosomal (in-between) type was 789.2 kg (11.8%). The difference with peers of the airysome (broad-bodied) type was even more significant - 1200.8 kg, or 18%. In all cases, the difference was characterized by a high degree of reliability (P <0.001).

There were no significant differences in the mass fraction of fat (4.0-4.1%) and protein (2.99-3.0%) in milk between the types. However, due to the large difference in milk yield, more milk fat by 30.4 kg (11.4%), milk protein by 23 kg (11.5%) was obtained from cows of the leptosome type than from peers of the mesosomal type and 42, 6 kg (15.9%) and 35.3 kg (17.7%), respectively, than from the eirysome type (P <0.001).

| Characteristic | Somatotype | leptosome | mesosomal | eirysome |
|----------------|------------|-----------|-----------|----------|
| n              |            | 34        | 59        | 27       |
| Milk yield, kg |            | 6679.6±73.37 | 5890.4±67.46 | 5478.8±31.51 |
| Lim            |            | 5831-7245 | 5295-6250 | 5140-5900 |
| Cv, %          |            | 6.8       | 10.2      | 3.9      |
| MFF, %         |            | 4.0±0.03  | 4.02±0.017 | 4.1±0.025 |
| Lim            |            | 3.7-4.3   | 3.8-4.4   | 3.9-4.4  |
| Cv, %          |            | 4.1       | 3.3       | 3.1      |
| Milk fat, kg   |            | 267.2±2.33 | 236.8±2.65 | 224.6±0.97 |
| Lim            |            | 252.7-282.6 | 224.3-266.9 | 211.4-233.2 |
| Cv, %          |            | 5.4       | 9.9       | 3.0      |
| MFP, %         |            | 2.99±0.015 | 3.0±0.015  | 3.0±0.011 |
| Lim            |            | 2.8-3.2   | 2.8-3.3   | 2.9-3.1  |
| Cv, %          |            | 3.0       | 3.7       | 1.9      |
| Milk protein, kg|            | 199.7±2.04 | 176.7±1.98 | 164.4±1.20 |
| Lim            |            | 186.6-218.8 | 141.5-195.2 | 134.9-183.6 |
| Cv, %          |            | 6.3       | 10.0      | 4.9      |
| Lactation index, kg | | 466.9±4.18 | 413.5±4.57 | 389.1±1.88 |
| Lim            |            | 437.3-501.4 | 356.5-451.9 | 345.7-417.1 |
| Cv, %          |            | 5.6       | 9.8       | 3.3      |

The lactation index of cows of the leptosome type was 11.4% higher than that of the peers of the mesosomal type, and 16.7% of the eirysome type.

Animals of the mesosomal type occupied the second ranking position in terms of milk productivity. Their superiority over cows of the airysome type was 411.6 kg in milk yield (7%), milk fat - 12.2 kg (5.2%), milk protein - 12.3 kg (6.9%), lactation indicator - 24, 4 kg (5.9%), P <0.01.
Figure 2. The amount of milk fat and protein received during the first lactation from cows of different somatotypes.

According to the results of assessing the variability of milk productivity indicators, the greatest variability was observed in the mesosomal type cows in milk yield (Cv = 10.2%; Lim = 5295-6250 kg), amount of milk fat (Cv = 9.9%; Lim = 224.3-266.9 kg), protein (Cv = 10.0%; Lim = 141.5-195.2 kg), lactation index (Cv = 9.8%; Lim = 356.5-451.9 kg). Among peers of the airysome type, the variation coefficient of milk production indexes was the lowest.

Cows assigned to different exterior-constitutional types also differed in live weight (table 3). The heaviest animals were of the leptosome type. Their live weight was 565.6 kg, which is more than the peers of the mesosomal type by 7.5%, or 42.5 kg (P <0.01), and eirysome - by 9.4% or 53.1 kg (P <0.001). The difference in live weight between the groups of cows of the mesosomal and eirysome somatotypes is not reliable.

| Characteristic                  | Leptosome | Mesosomal | Eirysome |
|--------------------------------|-----------|-----------|----------|
| n                              | 34        | 59        | 27       |
| Live weight, kg                |           |           |          |
| M±m                            | 565.6±2.46| 523.1±3.67| 512.5±3.18|
| Lim                            | 539-594   | 465-580   | 450-528  |
| Cv, %                          | 2.5       | 5.3       | 4.4      |
| Milk production index, kg      |           |           |          |
| M±m                            | 1180.9±9.91| 1126.1±6.99| 1069.3±4.64|
| Lim                            | 999.1-1311| 972.2-1244.2| 820.6-1201|
| Cv, %                          | 5.2       | 5.6       | 2.8      |
The cows of the leptosome somatotype had the most pronounced milk type: their milk production index was 1180.9, which is by 4.6 - 9.5% or 54.8 - 110.7 abs.units higher than that of their peers. The difference is valid. The cows of the mesosomal somatotype surpassed the animals of the airysome somatotype in terms of milk production by 56.8 abs.units, or 5.1% (P <0.05).

In general, it should be noted that the cows of the leptosome somatotype were superior to their peers from other groups in terms of milk productivity and live weight. The second rank position was taken by the cows of the mesosomal somatotype.

4. Conclusion
Thus, cows of different exterior-constitutional types had significant differences in milk productivity and live weight. Animals with a strong leptosome somatotype significantly (P <0.05-0.001) surpassed their peers in milk yield (by 4.3-20.7%), the amount of milk fat (by 3.6-18.3%), protein (by 3, 6-20.7%), lactation index (3.9-19.4%). The cows of the delicate leptosome somatotype had the highest milk production index (KM = 1188.2) and, in terms of milk productivity, were inferior only to their peers with a strong leptosome somatotype.

References
[1] Alekseeva E 2014 KrasSAU Bulletin 5 L 124
[2] Bagriy B and Spivak M 1987 Vestnik agricult Sciences 1 L 72
[3] Baryshev A 1997 Creation of the dairy type of the Kostroma cattle breed (St. Petersburg: Pushkin) p 36
[4] Dunin I and Prudov A 2005 The use of the Holstein breed for the intensification of the selection of dairy cattle L 34
[5] Lefler T and Lesun A 2010 Bulletin of KrasSAU 1 L 302
[6] Lefler T and Nagibina A 2020 Science and Education: Experience, Development Prospects: Materials of Intern. scientific–practice. Conf. II. (Krasnoyarsk) 243-7
[7] Lefler T, Nagibina A, Strogonova I and Sidorenkova I 2020 Bulletin of KrasSAU 5 L 106
[8] Nekrasov A A, Popov N A and Nekrasov N A 2013 Bulletin of the Krasnoyarsk State Agrarian University 4 2-4