Production typicality of cows depending on their linear affiliation

E A Alekseeva
Krasnoyarsk State Agricultural University, Krasnoyarsk, Russia
E-mail: alexeeva0503@yandex.ru

Abstract. The dependence of production typicality of cows on their linear in JSC “Tubinsk” of Krasnoyarsk region was studied. The coefficient of production typicality of first-lactation cows averaged 3.71. Descendants of Reflection Sovereign 198998 line and the Pabst Governor line referred to the high-milk type. The milk productivity of the daughters of the Reflection Sovereign 198998 line bulls is 3 % higher than the average. The largest mass fraction of fat in milk of the cows of the Pabst Governor line was 4.35 %. The indicators of cows of other lines were from 4.14 % to 4.20 %. The average mass fraction of protein in milk was 3.16 %, the cows of the Roseif Citation 267150 line had the indicator of 3.23 %, of the Pabst Governor line – of 3.21 %. The daughters of the Sure-View Auburn 133893605 bull of the Reflection Sovereign 198998 line marked the highest milk productivity of 7318 kg, the daughters of the Topaz 1239 bull of the Pabst Governor 882933 line marked the lowest milk productivity of 4783 kg. The mass fraction of fat in milk is the highest by the daughters of the Venets 3216 bull of the Pabst Governor line (4.40 %). The lowest fat content had the daughters of the Vympel 2234 bull of the Vice Back Ideal 1013415 line (3.85 %) and the Repey 9927 bull of the Roseif Citation 267150 line (3.99 %). The Rhythm 417329 bull of the Roseif Citation 267150 line has the highest protein mass of 3.31 %. The protein milk content of other bulls-producers varied from 3.25 % to 3.10 %. The profitability of production will be up to 65.3 % when converted to basic fat content (3.4 %).

1. Introduction
Increasing the productivity of dairy cows is inextricably linked with changing the gene pool. The effectiveness of breeding work depends on the correctly planned genealogical structure of the herd. Currently, in breeding work with dairy cattle, much attention is paid to the affiliation of bulls used in the herds of the bulls-producers and their daughters to the lines, since each of them has its own valuable qualities [1; 2; 3]. Hereditary qualities of the bull determine the level of productivity of the herd only 4-5 years after the beginning of its use. Therefore, the rate of increase in the genetic potential of the herd depends on the breeding value of the bulls used [4; 5].

Cows of the Yenisei intra-breed type of red-mottled breed are characterized by precocity, strong constitution, and adaptability to breeding under intensive technologies [6; 7]. When transferring dairy cattle breeding to an industrial basis, the groups same of the same type are of particular importance, taking into account productivity, live weight, exterior and constitutional features, which allows organizing appropriate feeding and maintenance in production conditions. Determining the production typicality of cows allows optimizing the technological structure of the herd by creating similar groups.
taking into account productivity, body weight, exterior, constitutional features and selection and genetic parameters, and ensuring appropriate feeding technology [8].

In this regard, the issue of studying the dependence of production typicity on the linear affiliation of cows is very relevant.

The purpose of this work is to study the dependence of production typicity of cows on linear affiliation. In connection with the purpose, there were set the next objects:

- to determine the coefficient of production typicity of cows;
- to analyze the milk productivity of cows depending on the linear affiliation.

2. Research materials and methods

The research was conducted in JSC "Tubinsk" of Krasnoturansky district of Krasnoyarsk region. The evaluation of milk productivity and calculation of the coefficient of production typicality depending on the linear affiliation were made according to the data of 379 cows of the first lactation. Taking measurements and weighing was carried out in the third month after calving, in the morning hours. The productivity of cows is provided with full-fledged feed at the rate of 67-70 feed units per head.

The coefficient of production typicity of cows was calculated using the formula proposed by Lefler T. F. (2007). There were distinguished the next production types of cows of the dairy productivity: plentiful milk (4.01 and higher); high milk (3.71 – 4.0); dairy (3.61 – 3.70); low-milk (2.51 – 3.60); dairy-meat (2.01 – 2.5); meat-milk type (1.50 – 2.0) [9]. The cows were evaluated for milk productivity for 305 days (kg), mass fractions of fat (%) and protein (%). Processing of the results was carried out on the basis of generally accepted statistical methods of Merkurieva E. K. (1970) using the MS Excel software package, the reliability of indicators was evaluated by the Student software [10].

3. Research results

The herd of JSC "Tubinsk" at the time of the experiment had cows affiliating to five lines. The most numerous was the Reflection Sovereign 198998 line, which included 183 first-born cows, and three cows affiliated to the Ceiling Trydjun Rokit 252803 line (table 1). The coefficient of production typicity of cows of the first lactation was on average 3.71, which corresponds to the high-milk type. Cows of the Reflection Sovereign 198998 line and the Pabst Governor line were classified as high-milk type, they had the highest coefficient of production typicity (3.78 and 3.74, respectively).

The analysis of the coefficients of production typicity of cows showed that the animals of the Vice Back Ideal 1013415 lines were of the dairy type and had indicators of 3.7. The lowest value for this indicator was observed in cows of the Ceiling Trydjun Rokit line 252803 of 3.25 and the Roseif Citation 267150 line of 3.12, which is 12% and 16% less than the average (P>0.999). The production typicity of these lines’ cows corresponded to the dairy type (table 1).

Table 1. The coefficient of production typicity (CPT) and milk productivity depending on the linear affiliation.

| Line            | Indicator | Cows populati on | CPT       | Milk productivity for 305 days, kg | Mass fraction of fat, % | Mass fraction of protein, % |
|-----------------|-----------|------------------|-----------|-----------------------------------|------------------------|-----------------------------|
| Average for all lines | M±m σ    | 380              | 3.71±0.04 | 6352±57.8                         | 4.20±0.01              | 3.16±0.001                  |
| Reflection      | M±m σ    | 183              | 3.78±0.05 | 6547±80.5                         | 4.17±0.01              | 3.13±0.001                  |
| Sovereign 198998 | M±m σ    | 183              | 0.74     | 1089                              | 0.15                   | 0.04                        |
| Vice Back Ideal 1013415 | M±m σ | 89               | 3.70±0.08 | 6259±114                          | 4.14±0.02              | 3.15±0.01                  |
| Pabst Governor  | M±m σ    | 81               | 3.74±0.10 | 6415±128                          | 4.35±0.02              | 3.21±0.06                  |

Note: a – P<0.001; b – P>0.001; c – P>0.001.
First-born cows of the Reflection Sovereign 198998 line had the highest milk productivity for 305 days of lactation of 6574 kg, which is 195 kg (3 %) more than the average for the herd (P>0.95). The milk productivity of cows of the Vice Back Ideal 1013415 and the Pabst Governor lines was close to the average and to the herd and was 6259 and 6418, respectively. Milk productivity below the average by 4.5 % (P>0.95) and 21% (P>0.999) was shown by cows of the Ceiling Trydjun Rokit 252803 and the Roseif Citation 267150 lines, respectively.

Mass fraction of fat in milk was the highest in cows of the Pabst Governor line (4.35 %) with an average of 4.20 %. Indicators of cows of the other groups ranged from 4.14 % to 4.20 %.

On average, the mass fraction of protein in milk along the lines was 3.16 %. The cows of the Roseif Citation 267150 and Pabst Governor lines had the most protein milk content, accounting for 3.23 % and 3.21 %, respectively.

Considering the dependence of production typicity and milk productivity of the bull-producer, it was found that the herd has descendants from 42 bulls. But some bull-producers had only 1 or 2 daughters. So, there were only three cows affiliating to the Ceiling Trydjun Rokit 252803 line, which were the daughters of different bulls. These cows were not taken into account when processing the received data. Table 2 shows the results of calculations for bulls with 3 or more daughters.

Among the descendants of bulls of the Reflection Sovereign line 198998, the majority affiliated to the desirable production types (plentiful-milk, high-milk and dairy) and only 4.9 % to low-milk types. Daughters of the bull-producers of the Vice Back Ideal 1013415 line were classified as plentiful (20.5 %), high-milk (49.3) and low-milk (30.2%) types.

**Table 2.** The coefficient of production typicity (CPT) and milk productivity of cows depending on the bull-producer.

| Bull's nickname and number | n  | CPT     | Milk productivity for 305 days, kg | Mass fraction of fat, % | Mass fraction of protein, % |
|----------------------------|----|---------|-----------------------------------|-------------------------|----------------------------|
| **The Reflection Sovereign 198998 line** |    |         |                                   |                         |                           |
| Design 2317                | 38 | 3.84±0.1| 6661±148                          | 4.12±0.02               | 3.13±0.01                  |
| Duet 1942                  | 34 | 3.65±0.12| 6358±169                          | 4.22±0.03               | 3.13±0.01                  |
| Sure-View Aubern           | 25 | 4.14±0.08| 7318±141                          | 4.10±0.02               | 3.13±0.01                  |
| 133893605                  |    |         |                                   |                         |                           |
| 134760810                  | 12 | 4.02±0.21| 7013±313                          | 4.11±0.03               | 3.11±0.01                  |
| Agri 44325                 | 5  | 3.31±0.55| 6174±811                          | 4.19±0.11               | 3.14±0.02                  |
| Braddock 7355181           | 5  | 4.44±0.35| 7343±391                          | 4.27±0.06               | 3.14±0.01                  |
| Dopro 1344                 | 3  | 4.23±0.14| 7018±274                          | 4.02±0.02               | 3.10±0.04                  |
| Uno 44280                  | 3  | 3.34±0.43| 6070±522                          | 4.23±0.07               | 3.15±0.01                  |
| **The Vice Back Ideal 1013415 line** |    |         |                                   |                         |                           |
| Double 1479                | 37 | 3.84±0.12| 6356±172                          | 4.16±0.03               | 3.11±0.01                  |
| Mannix 7355175             | 17 | 4.03±0.2 | 6763±231                          | 4.20±0.04               | 3.13±0.01                  |
| Aport 3492                 | 9  | 3.20±0.23| 5378±346                          | 4.19±0.11               | 3.25±0.03                  |

*a* - P≥0.95, *b* - P≥0.99, *c* - P≥0.999 relatively line average.
An analysis of the production typicity coefficient for the descendants of the Pabst Governor line showed that 80.8 % affiliating to the desired type. All the daughters of the bull-producers of the Roseif Citation 267150 line had a low-milk production type.

The daughters of the bull Braddock 7355181 of the Reflection Sovereign 198998 line had the highest coefficient of production typicity (4.44). On the Vice Back Ideal 1013415 line the best daughter indicator of 4.03 had the bull-producer Mannix 7355175, on the Pabst Governor line the bull-producer Duchess 3193 had the indicator of 4.11. The daughters of the bulls-producers of the Roseif Citation 267150 line had the highest production typicity coefficient of 3.26, all the daughters affiliated to the low-milk type.

The daughters of the Topaz 1239 bull of the Pabst Governor line had the lowest production typicity coefficient at 2.49, which corresponds to the dairy-meat type. The highest coefficient of production typicity had the daughters of the bull Braddock 7355181 of the Reflection Sovereign 198998 line, this indicator was 4.44. On the Vice Back Ideal 1013415 line the best daughter indicators had the Mannix 7355175 bull-producer (4.03), on the Pabst Governor line the best daughter indicators had the Duchess 3193 bull-producer (4.11). The daughters of the bulls of the Roseif Citation 267150 line had the highest production typicity coefficient of 3.26, all the daughters affiliated to the low-milk type.

The daughters of the Topaz 1239 bull of the Pabst Governor line had the lowest production typicity coefficient at 2.49, which corresponds to the dairy-meat type.

The highest productivity had the daughters of the Sure-View Auburn 133893605 bull of the Reflection Sovereign line 198998 (7318 kg), the lowest had the daughters of the Topaz 1239 bull of the Pabst Governor line 882933 (4783 kg), the difference of 2535 kg is highly reliable.

Analysis of the mass fraction of fat in milk showed that this indicator had the daughters of the Venets 3216 bull of the Pabst Governor line (4.40 %). The lowest indicators of the mass fraction of fat in milk at 3.85 % and 3.99 % were the descendants of the Vympel 2234 bull of the Vice Back Ideal 1013415 line and the Repey 9927 bull of the Roseif Citation 267150 line, respectively.

The highest mass fraction of protein (3.31 %) had the daughters of the Rhythm 417329 bull of the Roseif Citation 267150 line. The descendants of other bulls showed this indicator from 3.25 % to 3.10 %.

It was found that in the herd of JSC "Tubinsk" the indicators of milk productivity of first-born cows of different origin were at different levels and the efficiency of their use was not the same (table 3).

|                   |          |          |          |          |
|-------------------|----------|----------|----------|----------|
|                   |          |          |          |          |
| Rokot 22062       | 9        | 3.37±0.2 | 6064±271 | 4.05±0.1 |
| Vympel 2234       | 4        | 3.37±0.07| 6181±381 | 3.85±0.12|
| M. Rusty 8496680  | 4        | 3.71±0.29| 6118±390 | 4.24±0.06|
| Kurort 4716       | 3        | 3.07±0.47| 5565±698 | 4.16±0.08|

|                   |          |          |          |          |
|-------------------|----------|----------|----------|----------|
|                   |          |          |          |          |
| The Pabst Governor line |          |          |          |          |
| Duchess 3193      | 28       | 4.11±0.17| 6837±149 | 4.33±0.03|
| Delets 2021       | 26       | 3.72±0.15| 6401±255 | 4.32±0.04|
| Venets 3216       | 12       | 3.56±0.26| 6615±344 | 4.40±0.05|
| Vidny 3382        | 9        | 3.64±0.27| 5593±282 | 4.39±0.06|
| Vilnius 4637      | 3        | 2.80±0.36| 5902±820 | 4.36±0.06|
| Topaz 1239        | 3        | 2.49±0.12| 4783±284 | 4.32±0.04|

|                   |          |          |          |          |
|-------------------|----------|----------|----------|----------|
|                   |          |          |          |          |
| The Roseif Citation 267150 line |          |          |          |          |
| Repey 9927        | 8        | 3.26±0.33| 5272±294 | 3.99±0.1  |
| Resource 9965     | 7        | 3.11±0.13| 5013±171 | 4.22±0.15|
| Rhythm 417329     | 5        | 2.87±0.33| 4869±404 | 4.31±0.05|

The daughters of the bull Braddock 7355181 of the Reflection Sovereign 198998 line had the highest coefficient of production typicity (4.44). On the Vice Back Ideal 1013415 line the best daughter indicator of 4.03 had the bull-producer Mannix 7355175, on the Pabst Governor line the bull-producer Duchess 3193 had the indicator of 4.11. The daughters of the bulls-producers of the Roseif Citation 267150 line had the highest production typicity coefficient of 3.26, all the daughters affiliated to the low-milk type.

The daughters of the Topaz 1239 bull of the Pabst Governor line had the lowest production typicity coefficient at 2.49, which corresponds to the dairy-meat type. The highest coefficient of production typicity had the daughters of the bull Braddock 7355181 of the Reflection Sovereign 198998 line, this indicator was 4.44. On the Vice Back Ideal 1013415 line the best daughter indicators had the Mannix 7355175 bull-producer (4.03), on the Pabst Governor line the best daughter indicators had the Duchess 3193 bull-producer (4.11). The daughters of the bulls of the Roseif Citation 267150 line had the highest production typicity coefficient of 3.26, all the daughters affiliated to the low-milk type.

The daughters of the Topaz 1239 bull of the Pabst Governor line had the lowest production typicity coefficient at 2.49, which corresponds to the dairy-meat type.

The highest productivity had the daughters of the Sure-View Auburn 133893605 bull of the Reflection Sovereign line 198998 (7318 kg), the lowest had the daughters of the Topaz 1239 bull of the Pabst Governor line 882933 (4783 kg), the difference of 2535 kg is highly reliable.

Analysis of the mass fraction of fat in milk showed that this indicator had the daughters of the Venets 3216 bull of the Pabst Governor line (4.40 %). The lowest indicators of the mass fraction of fat in milk at 3.85 % and 3.99 % were the descendants of the Vympel 2234 bull of the Vice Back Ideal 1013415 line and the Repey 9927 bull of the Roseif Citation 267150 line, respectively.

The highest mass fraction of protein (3.31 %) had the daughters of the Rhythm 417329 bull of the Roseif Citation 267150 line. The descendants of other bulls showed this indicator from 3.25 % to 3.10 %.

It was found that in the herd of JSC "Tubinsk" the indicators of milk productivity of first-born cows of different origin were at different levels and the efficiency of their use was not the same (table 3).
### Table 3. Cost-effectiveness of using first-born cows of different lines.

| Indicator                        | Reflection Sovereign 198998 | Vice Back Ideal 1013415 | Pabst Governor | Roseif Citation 267150 |
|----------------------------------|-----------------------------|--------------------------|----------------|-------------------------|
| Milk productivity for 305 days, kg | 6547                        | 6259                     | 6415           | 5053                    |
| Milk productivity for 305 days in basic fat content, kg | 8030                        | 7621                     | 8207           | 6197                    |
| Cost of 1 centner of milk, rubles | 1967                        | 2057                     | 2007           | 2548                    |
| Sale price of 1 centner of milk, rubles | 3250                        | 3250                     | 3250           | 3250                    |
| Profit, thousand rubles          | 103                         | 90.9                     | 102            | 43.5                    |
| Level of profitability, %        | 65.3                        | 58.0                     | 61.9           | 27.5                    |

With basic fat content of 3.4 %, the milk productivity of the Pabst Governor line daughters was 8207 kg, which is 178 kg more than that of the Reflection Sovereign 198998 line first-born cows. The cost of one centner of milk is the lowest for cows of the Reflection Sovereign 198998 line (167 rubles). This allowed to make a profit of 103 thousand rubles. The smallest profit was received from the daughters of the Roseif Citation 267150 line (43.5 thousand rubles).

The profitability of production from the sale of milk in terms of basic fat content (3.4 %) ranged from 27.5% to 65.3 %.

### 4. Conclusion

The daughters of the bull-producers affiliating to the Reflection Sovereign 198998 and the Pabst Governor lines were considered as desirable types and had a production typicity coefficient of 3.78 and 3.74, respectively. The milk productivity for 305 lactation days of the daughters of the Reflection Sovereign 198998 and the Pabst Governor lines is higher than the average for the lines 6547 kg and 6415 kg respectively. At the same time, the daughters of the Pabst Governor line had a high fat content at 4.35 %. The daughters of the Sure-View Auburn 133893605, Willamore Berkeley 134760810, Braddock 7355181, Dopros 1344 bulls of the Reflection Sovereign 198998 line, the Mannix 7355175 bull of the Vice Back Ideal 1013415 line and the Duchess 3193 bull of the Pabst Governor line were of the plentiful type. The descendants of the bull-producers of the Roseif Citation 267150 line had the highest coefficient of production typicity (3.26), all the daughters affiliated to the low-milk type. The highest profitability of 61.9-65.3 % had the daughters of the bulls of the Reflection Sovereign 198998 and the Pabst Governor lines. Thus, to increase the milk productivity and the cows population of the desired production types (plentiful, high-milk and dairy), it is necessary to use bulls-producers who have significantly increased indicators of milk productivity of cows.

### References

[1] Alekseeva E A 2018 Dairy productivity of cows of different production types of JSC “Tubinsk” Science and Education: Experience, Problems, Prospects of Development 217-22

[2] Babkova N M, Bodrova S V and Muradyan N A 2016 Comparative evaluation of milk productivity of red-pied cows of different lines in JSC “Tubinsk” Bulletin of Krasnoyarsk State Agrarian University 1 141-5

[3] Samusenko L 2011 Dairy productivity of cows depending on their linear affiliation Dairy and Beef Cattle Breeding 2 30-1

[4] Esmagambetov K K and Andreeva N A 2014 Influence of origin on milk productivity of first-born cows Dairy and Beef Cattle Breeding 8 15-7
[5] Lyubimov A I, Yudin M and Chukavin A S 2016 Duration of economic use of daughters of bulls-producers of different lines Actual Issues of Livestock Intensive Development 19(1)

[6] Lushchenko A E and Golubkov A I 2004 *Red-Mottled Breed of Dairy Cattle in Siberia* (Krasnoyarsk: Publishing house of Krasnoyarsk State Agrarian University) p 196

[7] Lefler T F, Chetvertakova E V, Shadrin S V and Stroganova I Ya 2017 Breeding in the development of livestock of the Krasnoyarsk region *Bulletin of Krasnoyarsk State Agrarian University* 12 44-50

[8] Alekseeva E A and Eremina I Yu 2020 Assessment of cows of Yenisei intra-breed type of red-mottled breed on a complex of signs *IOP Conference Series: Earth and Environmental Science* 4 21 052015

[9] Lefler T F 2007 *Selection and Genetic Methods of Improving the Red-Mottled Breed of Dairy Cattle in the Conditions of the Eastern Zone of Krasnoyarsk region* (Krasnoyarsk)

[10] Merkurieva E K 1970 *Biometrics in Breeding and Genetics of Farm Animals* (Moscow: Kolos)