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CORRELATION LINK OF INDICES OF DAIRY PRODUCTIVITY OF COWS OF HOLSTEIN BREED OF DIFFERENT ORIGIN

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Abstract

The article presents the results of a study of the productive qualities of Holstein cows of the Dutch and German breeding, the presence of a correlative relationship between milk yield, the content and amount of milk fat, live weight, average daily milk yield and milk ratio. It is established the superiority of cows of Dutch breeding for milk yield for 305 days of lactation over cows of German breeding by 458 kg of milk (the third lactation), the difference is not significant. A comparative analysis of the results of studies of the productive qualities of cows of the first lactation of the Holstein breed of the Dutch and German breeding showed that the heifers - the descendants of the first generation exceeded their peer sin milk yield by 855 and 1444 kg of milk respectively, the difference is highly reliable (P<0.001). Low correlation coefficients between milk yield and live weight (positive - German breeding and descendants of the first generation) and (negative - Dutch breeding) indicate the non-linear nature of the relationships between them, and characterizes the uniformity of the herd of Joint-Stock Company „Aydyn" in live weight.

Key words*: descendants of the first generation, milk yield, fat, live weight, correlation coefficient.*

INTRODUCTION

At present, in countries with developed dairy cattle breeding, the genetic improvement of herds largely depends on the direction of the strength of the relationship between the signs of productivity. Genes that influence the development of body systems and cause signs of productivity, act interconnected, that is, correlate (Dragotoiu et al., 2015). The study of correlative relationships allows to predict undesirable consequences when conducting selection on one sign or to enhance the effect of selection on others.

When breeding Holstein cattle, it was found that in the selection process the variability of one of the phenotypic indicators depends on the variability of other economically useful signs. The variability of the mass fraction of fat in milk depends on the variability of cows' milk yield per lactation.

In turn, the variability of milk production depends on live weight, the age of the animals at the first calving, the length of the dry and service periods, calving season and other factors (Akhmetzyanova, 2015).

If there is a positive correlation between breeding signs, selection by one sign automatically leads to the improvement of another. With a negative correlation, selection leads to the deterioration of one of the traits. In the absence of communication, it should be considered that the selection of animals according to the main character does not affect the development of other characters. The rate of genetic improvement of herds depends on the direction and strength of the relationship between the signs. Thereby, it is important to establish to what extent these or those signs are interconnected with milk yield of cows (Efimova et al., 2017).

A study of the relationship between breeding signs at cows (Nazarchenko, 2011) between milk yield and percentage of fat in milk, milk yield and amount of protein, percentage of protein and fat showed that a deterioration of one of the signs does not entail a deterioration of the other.

The correlation between milk yield and fat content in milk is most often negative - with an increase of milk yield, the fat content in milk decreases (Efimova, 2010). However, in each herd there are animals at which high milk yield is combined with a high fat content in milk and this feature is inherited by offspring (Beauty et al., 1999). The selection of animals by the total amount of milk fat or milk protein is equivalent to one-sided selection by milk yield, the authors consider. The correlation coefficients between these signs range from 0.84 to 0.99.

Lepyokhina (2012) believes that correlation between productive signs is a biological regularity and is relatively stable inherited in generations. Even with high selection intensities, they did not change for a long time. The heritability of milk yield by the mother (r = + 0.11) in three lactations was very high, and the milk fat content (r = 0.20) was even higher (Rudziev, 2001; 2003; 2006).

There is not always a direct connection between the productive qualities and the breeding qualities of record cows, and therefore the good origin of each cow does not always guarantee its high breeding and productive qualities. However, many authors (Ernst and Chemm, 1970; Vorobyova, 2010) argue that the most productive animals are mainly descended from the same highly productive ancestors and that the best animals give the best offspring. According to Antal (2004), "the most important moment of work is the selection of the most worthy females, from which it is worth and should be received male offspring for its possible use in improving the population of dairy cows".

One of the factors that influence the milk productivity of cows is their live weight. In each breed, in each herd, the best part of animals in productivity, as a rule, has a higher live weight than the average for the breed, the average for the herd (Silver, 2017; Bakay et al., 2016). For the best of breed milk yield recorders is characteristic and higher live weight, the variability of live weight of cows can reach 15% (Adzhibekov, 1995; Kuznetsov, 2002; Vorobyova et al., 2010). But this does not mean that the biggest animals should be high dairy. It has been established that for each breed there is a certain optimum of live weight (Kuziv and Fedorovich, 2014; Pogadaev and Gadzhiev, 2001). The increase of live weight of cows to this indicator has a positive effect on milk productivity. But if the live weight is above the limit of the breed optimum, then its increase does not affect the increase in milk yield.

The research of the herd of the Joint Stock Company "Aydyn" revealed the relationship with dairy productivity of some indicators of the exterior of cows for the third lactation (Konstandoglo et al., 2019).

The aim of these studies was to identify the correlation between the main indicators of dairy productivity of Holstein cows of different origins.

MATERIALS AND METHODS

Studies were carried out in a herd of Joint-Stock Company (J.S.C.) „Aydyn" on Holstein cows imported from Holland and Germany, as well as the first generation descendants received from bulls Kiperush 79, Maker 891 and Leicester DE 05.804.011478. All the analyzed number of cows was kept in optimal conditions of feeding and keeping in accordance with the basic zootechnical and hygiene requirements.

The main data on the milk production of animals were taken from forms of zootechnical and pedigree accounting. Were used zoo-technical research methods with biometric processing of materials by the method of variation statistics according to Plokhinsky (1978) and Merkurieva (1983): arithmetic mean (X), arithmetic mean error (Sx), correlation coefficient (r) and correlation coefficient error (m_r). Phenotypic correlations were estimated using the procedure of the Statistical Analysis System (SAS Version 6.1, 2007). The relation-ship between milk productivity indicators and milk quality, live weight was determined by calculating the correlation coefficient using Microsoft Excel.

The milk coefficient (MC), proposed by Startsev (1966), was calculated by the formula: MC = MY/LW, where: MC is the milk coefficient, kg; MY - milk yield for 305 days of lactation, kg; LW - live weight, kg. The data obtained during the research were processed biometrically on a personal computer using Microsoft Excel programs; the reliability of the indicators was determined by Student.

RESULTS AND DISCUSSIONS

A comparative assessment of the milk productivity of cows, depending on the selection, showed that the highest milk yield for 305 days of lactation was at Dutch cows (Table 1), which is more by 458 kg of milk (the third lactation) than at German cows (Table 2), and on average in the samples - by 434 kg, the difference is unreliable.

Table 1. Dynamics of milk productivity J.S.C. "Aydyn" Dutch origin (X ± Sx)

Lactation	Number of cows, n	Milk yield		Fat		Live weight, kg	Milk ratio, kg
		The average daily, kg	For 305 days, kg	Mass fraction, %	Quantity, kg		
III	30	34.5±0.8	10560±255.5	3.85±0.03	402±9.9	698±4.4	1508±34.5**
IV	31	33.3±0.6	10194±206.5	3.92±0.03	394.2±8.7	697±3.9	1461±30.2
Average	64	34.0±0.5	10370±160.6	3.88±0.02	379.2±6.4	698±2.8	1490±22.1***

Note: ** - P <0.01; *** - P <0.001

Table 2. Dynamics of milk production of J.S.C. "Aydyn" German origin (X ± Sx)

Lactation	Number of cows, n	Milk yield		Fat		Live weight, kg	Milkratio, kg
		The average daily, kg	For 305 days, kg	Mass fraction, %	Quantity, kg		
II	15	28.8±1.1	8794±333.6	3.87±0.04	339±12.8	716±8.1	1219±41.4
III	106	32.7±0.6	10102±185.6	3.92±0.01	384.7±6.6	720±2.4	1387±22.2
Average	125	32.3±0.05	9936±166.1	3.92±0.01	379.6±6.1	721±2.3	1369±20.2

The live weight of cows of German breeding was by 22 kg more than cows of Dutch breeding, the difference was significant at P<0.001.
In terms of milk yield, cows of the Dutch breeding exceeded the cows of the German breeding by 121 kg (in III lactation and on average in the samples), the difference was significant at P<0.01 and P<0.001, respectively.

A preliminary assessment of the milk productivity of the first generation heifers, the descendants of the first generation, obtained from the result of using bulls Kiperush 79, Maker 891 and Leicester DE 05.804.011478 showed that the average milk yield of heifers was 8658 kg of milk with a fat content of 3.77%, milk fat - 324.3 kg (Table 3).

Table 3. Characteristics of cows - descendants of the first generation, as well as heifers of different breeding by milk productivity, the first lactation (X ± Sx)

Indicators		Descendants of the first generation (MD)	Dutch breeding*	German breeding*
Number of cows, n		38	120	129
Milk yield	average daily, kg	28.7±0.5	25.6±0.3	23.6±0.32
	for 305 days, kg	8658±143.6***	7803±90.1	7214±96.3
Fat	mass fraction, %	3.77±0.03	3.76±0.02	3.77±0.04
	quantity, kg	324.3±5.6	293.4±3.44	272.3±3.86
Live weight, kg		625±5.7	637±2.5	638±4.2
Milk ratio, kg		1364±15.1	1228±13.9	1125±25.7

Note: * - Foksha et al., 2017; *** - P<0.001

As it can be seen, the milk yield coefficient averaged 1364 kg. Milking yields of heifers ranged from 7490 kg to 9455 kg of milk, the average daily milk yield 24.5-31 kg of milk.
A comparative analysis of the results of studies of the productive qualities of cows of the first lactation of the Holstein breed of the Dutch and German breeding (Foksha et al., 2017) showed that the heifers - the descendants of the first generation exceeded in milk yield their peers by 855 and 1444 kg of milk, respectively, the difference is highly reliable (P<0.001). It should be noted that the female ancestors of bulls (fathers of heifers of the first generation)

combined high milk yield and butterfat, which is desirable in transferring valuable qualities to offspring. So, mother's milk yield Kiperush 79, averaged 10915 kg of milk with a fat percentage of 4.42; mother of his father, respectively 11485 kg and 3.60%. Mother's milk yield of Leicester DE 05.804.011478 for highest lactation was 15186 kg of milk with a fat content of 3.81%, mother's father - p11017 kg of milk, 4.59% fat, and milk yield of the mother of the bull Maker 891-12572 kg of milk with a fat content of 3.65%, mother of his father - 11842 kg, fat content of 4.66%.

For the relationship character analysis between the main productivity indicators at cows of different lactations and breeds of J.S.C. "Aydyn" herd was conducted a study of the correlation between milk yield, milk fat content and amount, live weight, average daily milk yield and milk ratio (Table 4).

Table 4. Correlation between the main indicators of the productivity of cows of German breeding, r ± m

No	The correlated sign	II lactation	III lactation	IV lactation
1.	milk yield - mass fraction of fat, %	-0.212±0.3	-0.060±0.1	+0.875±0.5
2.	milk yield - the amount of milk fat, kg	+0.964±0.07	+0.970±0.09	+0.882±0.5
3.	live weight - milk yield 305 days	+0.290±0.26	+0.253±0.09	+0.164±0.6
4.	live weight - mass fraction of fat, %	+0.289±0.26	-0.083±0.1	+0.155±0.6
5.	live weight - fat, kg	+0.393±0.25	+0.143±0.09	+0.401±0.5
6.	milk coefficient - milk yield 305 days	+0.972±0.06	+0.904±0.02	+0.912±0.2
7.	milk ratio - live weight	+0.079±0.28	+0.014±0.1	-0.253±0.6
8.	milk ratio - fat, %	-0.281±0.27	+0.013±0.1	+0.779±0.4
9.	milk ratio - fat, kg	+0.911±0.11	+0.849±0.03	+0.710±0.4
10.	average daily milk yield - milk yield 305 days	+0.999±0.01	+0.999±0.0	+0.999±0.03
11.	average daily milk yield - fat, %	-0.053±0.27	-0.053±0.19	+0.876±0.3
12.	average daily milk yield - fat, kg	+0.966±0.07	+0.966±0.01	+0.881±0.3
13.	average daily milk yield - milk ratio	+0.971±0.07	+0.919±0.01	+0.912±0.3

An analysis of the data between the studied indicators of cows of German breeding shows that between milk yield - the amount of milk fat, milk ratio - milk yield for 305 days, milk ratio - the amount of milk fat, the average daily milk yield - the amount of milk fat, the average daily milk yield - the milk ratio is established a very high positive relationship. With each subsequent lactation, the correlation coefficients between the above indicators slightly decreased. The correlation coefficient between the average daily milk yield, milk yield per 305 days of lactation and the fat content in milk is negative, weak and varies from -0.053 to -0.212. The relationship between live weight and milk yield over 305 days of lactation, mass fraction of fat and the amount of milk fat is positive from weak (+0.164) to moderate (+0.401). A weak positive relationship has been established between the milk ratio and live weight.

The results of studied relationship between the main indicators of the productivity of cows of the Dutch breeding are given in Table 5.

Table 5. Correlation between the main indicators of productivity of cows of the Dutch breeding, r±m

No	The correlated sign	The third lactation	The fourth lactation
1.	milk yield - mass fraction of fat, %	+0.122±0.19	-0.160±0.18
2.	milk yield - the amount of milk fat, kg	+0.962±0.05	+0.927±0.07
3.	live weight - milk yield 305 days	-0.294±0.19	-0.136±0.18
4.	live weight - mass fraction of fat, %	+0.343±0.18	-0.121± 0.18
5.	live weight - the amount of milk fat, kg	+0.284±0.18	-0.024±0.18
6.	milk ratio - milk yield	+0.957±0.05	+0.965±0.05
7.	milk ratio - live weight	-0.283±0.18	-0.372±0.17
8.	milk ratio - fat, %	-0.015±0.19	-0.125±0.18
9.	milk ratio - fat, kg	-0.552±0.16	+0.802±0.11
10.	average daily milk yield - milk yield 305 days	+0.999±0.01	+0.999±0.01
11.	average daily milk yield - fat, %	+0.041±0.18	-0.132±0.19
12.	average daily milk yield - fat, kg	-0.501±0.16	+0.824±0.1
13.	average daily milk yield - milk ratio	+ 0.961±0.05	+0.964±0.05

As it is seen from the table, between the milk yield and the mass fraction of fat, was revealed a weak positive relationship (the third lactation) and a weak negative (the fourth lactation), which confirms the difference of 366 kg of milk between lactations. It was established a very high positive relationship between the milk yield for 305 days - the amount of milk fat, the milk yield coefficient - the milk yield for 305 days, the average daily milk yield - the milk yield coefficient. A negative correlation was found between live weight and milk yield for 305 days of lactation, live weight and milk coefficient, the tightness of communication varies from weak (-0.136) to moderate (-0.372).

The correlation between live weight and fat mass fraction, as well as between live weight - the amount of milk fat is weak positive (the third lactation), weak negative (the fourth lactation).

The results of studying the correlation between the productivity indicators of heifers, first-generation, are shown in Table 6.

Table 6. Correlation between the main productivity indicators of heifers of the offspring of the first generation, r ± m

No	The correlated sign	The first lactation
1.	milk yield - mass fraction of fat, %	-0.176±0.16
2.	milk yield - the amount of milk fat, kg	+0.884±0.08
3.	live weight - milk yield	+0.193±0.16
4.	live weight - mass fraction of fat, %	+0.298±0.16
5.	live weight - the amount of milk fat, kg	+0.324±0.16
6.	milk ratio - milk yield	+0.788±0.1
7.	milk ratio - live weight	-0.554±0.13
8.	milk ratio - mass fraction of fat, %	-0.137±0.16
9.	milk ratio - the amount of milk fat, kg	+0.517±0.02
10.	average daily milk yield - milk yield in 305 days	+0.999±0.01
11.	average daily milk yield - fat, %	+0.015±0.17
12.	average daily milk yield - fat, kg	+0.736±0.11
13.	average daily milk yield - milk ratio	+0.828±0.09

A weak negative correlation was found between milk yield - mass fraction of fat (-0.176), milk ratio - mass fraction of fat (-0.137), a noticeable negative relationship between milk ratio - live weight (-0.554). The relationship between live weight and milk yield for 305 days of lactation, as well as the mass fraction of fat and the amount of milk fat, is positive, weakly expressed. It should be noted that among the descendants of the first generation, as well as cows of German and Dutch breeding, the correlation between milk yield and the amount of milk fat, milk yield and milk yield, as well as between the average daily milk yield and milk yield coefficient is positive, the connection tightness is high.

Thus, the established negative relationship between the mass fraction of fat and milk yield, the mass fraction of fat and the milk yield coefficient of cows of German and Dutch breeding and offspring of the I generation indicates that further selection for milk production in herd of J.S.C. “Aydyn” must be carried out taking into account the mass fraction of fat.

Low coefficients correlation between milk yield and live weight (positive - German selection and descendants of the first generation) and (negative - Dutch selection) indicate the non-linear nature of the relationships between them, and characterizes the uniformity of herd of J.S.C. “Aydyn” in live weight.

CONCLUSIONS

Milking for 305 days of lactation (third lactation) at Dutch cows amounted to 10,560 kg of milk, which is by 458 kg of milk more than at German cows, the difference is not significant.

According to the milk yield coefficient, cows of Dutch breeding exceeded German breeding cows by 121 kg (the third lactation), the difference was significant at $P<0.01$.

A comparative analysis of the results of studies of the productive qualities of cows of the first lactation of the Holstein breed of the Dutch and German breeding showed that the heifers-descendants of the first generation exceeded by 855 (Dutch breeding) and 1444 (German breeding) kg of milk in milk yield, the difference is highly reliable (P<0.001).

At cows of German breeding, a negative correlation was found between the average daily milk yield, milk yield per 305 days of lactation and the fat content in milk, the connection tightness is weak and varies from -0.053 to -0.212.

At Dutch cows, between a milk yield and a mass fraction of fat was revealed a weak positive relationship (the third lactation) and a weak negative relationship (the fourth lactation), which confirms the difference of 366 kg of milk between lactations.

At the descendants of the first generation between the live weight and the milk yield for 305 days of lactation, as well as the mass fraction of fat and the amount of milk fat, revealed a positive relationship, the tightness of the connection is weakly expressed.

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