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CORRELATION VARIABILITY OF SELECTION TRAITS OF HOLSTEIN ANIMALS

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A positive and statistically highly reliable correlation was found between the values of parents' pedigree values by the type of body of their own and the type of their offsprings (r = +0.364 ± 0.0503 – 0.611 ± 0.0396), as well as between the parents' evaluation by type and the sum of balls for their daughters’ exterior (r = +0.210 ± 0.049 – +0.586 ± 0.033). Also, a positive and statistically significant correlation was established between the evaluation of the udder of the

daughters of the bull's father and the bull's daughters (r = +0.408 ± 0.049) and the mother bull and daughters of the bull (r = +0.381 ± 0.049).

At the same time, a very low negative correlation was established between the body size of the bulls' daughters and their milk production for 305 days of the first lactation (milk yield r = -0.095 ± 0.0513, milk fat (r = +0.003 ± 0.0518; protein (r = +0.055 ± 0.0516).

Keywords: **body type, correlation, breeding traits, breeding value of traits, type production indices**

СПІВВІДНОСНА МІНЛИВІСТЬ СЕЛЕКЦІЙНИХ ОЗНАК ТВАРИН ГОЛШТИНСЬ-КОЇ ПОРОДИ

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Додатну і статистично вірогідну кореляцію встановлено між селекційним індексом за типом екстер'єру батьків і їх потомків (r = +0,364 ± 0,0503 – +0,611 ± 0,0396), а також між оцінкою за типом екстер'єру в балах батьків і їх дочок (r = +0,210 ± 0,049 – +0,586 ± 0,033). Додатна і статистично вірогідна кореляція встановлена між оцінкою вимені дочок батьків бугаїв і дочок бугаїв (r = +0,408 ± 0,049) і матерів бугаїв та дочок бугаїв (r = +0,381 ± 0,049).

Низький від'ємний коефіцієнт кореляції встановлено між розміром тіла дочок бугаїв і їхньою молочною продуктивністю за 305 днів першої лактації: -0,095 ± 0,0513; молочний жир – +0,003 ± 0,0518; білок – +0,055 ± 0,0516.

Ключові слова: **тип будови тіла, кореляція, селекційна ознака, племінна цінність, селекційний індекс**

СООТНОСИТЕЛЬНАЯ ИЗМЕНЧИВОСТЬ СЕЛЕКЦИОННЫХ ПРИЗНАКОВ ЖИВОТНЫХ ГОЛШТИНСКОЙ ПОРОДЫ

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Положительную и статистически достоверную корреляцию установлено между селекционным индексом по типу экстерьера родителей и их потомков (r = +0,364 ± 0,0503 – +0,611 ± 0,0396), а также между оценкой за типом экстерьера в балах родителей и их дочерей (r = +0,210 ± 0,049 – +0,586 ± 0,033). Положительная и статистически достоверная корреляция получена между оценкой вымени дочерей отцов быков и дочерей быков (r = +0,408 ± 0,049), а также матерей быков и дочерей быков (r = +0,381 ± 0,049).

Низкий, отрицательный коэффициент корреляции установлено между размером тела дочерей быков и их молочной продуктивностью за 305 дней первой лактации: -0,095 ± 0,0513; молочный жир – +0,003 ± 0,0518; белок – +0,055 ± 0,0516. *Ключевые слова:* **тип телосложения, корреляция, селекционный признак, племенная ценность, селекционный индекс**

Introduction. Over the past 20 years, almost all countries with a developed livestock sector have changed the direction of selection of dairy cattle from a limited number of characteristics (milk production and type) to their complex, taking into account animal health, fat content, protein in milk, reproductive capacity, duration of economic use, number of somatic cells in milk, ease calving, etc. The methods of evaluation, the algorithms of TPI indices, the characteristics taken into account in each country are determined by the selection program for each breed and changes in time. The genetic value of animals is assessed by breeding indices, which are used to rank animals according to the level of breeding value. The value of the breeding index of bulls is determined by the number and relative specific traits of the characteristics on which breeding is conducted. Breeding value, as a genotypic assessment of an animal, does not always correspond to the level of their breeding index. According to a number of researchers [1, 6, 7], the breeding value of bulls decreases against the background of the genetic trend of selection characteristics. Studies of the

correlative variability of complex and functional traits of dairy animals have been given special attention in recent years [1, 2, 4, 6, 7, 8, 10, 11, 13].

The results of research by a number of authors [1–9] indicate the presence of a multidirectional, with different levels, correlation between individual population-genetic parameters of linear evaluation and economic-useful traits of animals. Thus, a positive and statistically significant correlation between milk productivity (at the level of 5.255 kg of milk per cow) was in cows of first lactation of Ukrainian red dairy breed and the attachment density of udder shares, the breeding index of their fathers with the efficiency of their use, and very low with the rest of the linear descriptive traits established.

In the Ukrainian Black-and-White dairy breed have been reliable positive correlative variability of group traits of an estimation of an exterior of cows (productivity of 6200 kg) which characterize a dairy type, a body, feet and legs and an udder with descriptive traits – chest depth (r = 0.255 – 0.777), angularity (r = 0.321 – 0.397), the central ligament of udder (r = 0.135 – 0.351), the front attachment of the udder (r = 0.230 – 0.440) and the height of the posterior udder attachment (r = 0.154 – 0.404), [9] established.

The results of the researchers indicate that the integration of individual descriptive characteristics into group (complex) allows them to be used more efficient in cattle breeding.

In this regard, the study of changes in the direction and level of the relative variability of complex traits of the exterior, productivity and functional characteristics of animals with different levels of productivity is relevant.

The aim of the work is to establish the nature and degree of the phenotypic correlation between type productivity index (TPI), predicted transmitting ability (PTA), (breeding value) and the type of ancestral body with the pedigree value and milk productivity of their Holstein breed offspring at the milk yield level of 11.000–12.000 kg of milk per lactation.

Material and methods. The correlation relationship between indices of predicted transmitting ability (PTA) and type productivity indices (TPI) in generations was studied on the basis of data on the quality evaluation of the offspring of 372 Holstein sires [3], selected for use in breeding by 5 breeding characteristics of milk production (milk, fat and protein content, milk fat, milk protein), type of exteriors and functional traits of daughters. The PTA value of daughters and their mothers was estimated from point of view of the indicators of absolute milk productivity and the genotypic value of these characteristics. The digital data of scientific research was processed by methods of mathematical statistics, the software package "Statistica 6.1".

Results. A positive and statistically significant correlation was found between TPI index of the bulls and their PTA value by quantitative indicators of the productivity of their daughters (milk yield – r = +0.350 ± 0.045, milk fat – r = +0.458 ± 0.0412, protein – r = +0.507 ± 0.0386) and very low, but positive – between qualitative traits (fat content – r = +0.105 ± 0.0512, protein – r = +0.101 ± 0.0514). The correlation between the TPI of the fathers and the breeding value of their sons was significantly lower and not always positive. The coefficient of correlation between the TPI of the fathers and the PTA of the sons by the milk yield of their daughters was +0.190 ± 0.004; milk fat (r = -0.550 ± 0.051); protein (r = +0.156 ± 0.050); fat content (r = -0.127 ± 0.053) and protein (r = -0.076 ± 0.054).

According to the "mothers-sons" inheritance line, it was established, that the correlation between the TPI of mothers and the breeding value of sons was also positive, but much lower in milk yield (r = +0.028 ± 0.0517), milk fat (r = +0.224 ± 0.049), and significantly higher in fat content (r = +0.157 ± 0.0527) and protein (r = +0.101 ± 0.054) in milk as compared to these in the "fathers – sons" line.

The correlation between the TPI indices of the mothers of the bulls' fathers and all the indicators of the absolute productivity of the bulls' daughters was, although positive, but very low (r = from +0.010 ± 0.0518 to +0.160 ± 0.0504), and between TPI of father's fathers and the absolute productivity of daughters of bulls – negative (table 1).

1. Correlation between indicators of the parents' selection index (TPI), breeding value (PTA) and productivity of their offspring, r ± mr

TPI, milk productivity	Milk productivity of daughters for 305 days of the 1st lactation, kg				
	milk	% fat	milk fat	% protein	milk protein
TPI of bulls × PTA of bulls	+0.350 ± 0.0456[3]	+0.105 ± 0.0512[1]	+0.458 ± 0.0412[3]	+0.101 ± 0.0514	+0.507 ± 0.0386[3]
TPI of fathers × PTA of sons	+0.190 ± 0.0499[3]	-0.127 ± 0.0537[1]	+0.159 ± 0.0507[3]	-0.076 ± 0.0543	+0.156 ± 0.0505[2]
TPI mothers × PTA of sons	+0.028 ± 0.0517	+0.157 ± 0.0527[2]	+0.224 ± 0.0491[3]	+0.101 ± 0.0540	+0.157 ± 0.0391[3]
TPI of fathers × daughter's yield	+0.258 ± 0.0483[3]	+0.156 ± 0.0505[2]	+0.379 ± 0.0495[3]	+0.110 ± 0.0511[1]	+0.308 ± 0.0495[3]
TPI FM × daughter's milk yield of bulls	+0.010 ± 0.0518	+0.158 ± 0.0504[2]	+0.127 ± 0.0509[1]	+0.160 ± 0.0504[2]	+0.070 ± 0.0515
TPI FF × daughter's milk yield of bulls	-0.053± 0.0516	-0.175 ± 0.0515	-0.101 ± 0.0504	-0.127 ± 0.0506	-0.013 ± 0.0518

Remark: *[1)] $p < 0.1$; [2)] $p < 0.01$; [3)] $p < 0.001$.*

The highest and positive correlation was established between the values of the breeding value of both parents and their sons for the milk productivity of their daughters (milk yield r = +0.451 – 0.491, milk fat r = + 0.440 + 0.501, protein r = + 0.415 – 0.485, (table 2). A positive and highly reliable correlation was also established between PTA indices of the ancestors and the absolute milk productivity of their female offspring in generations.

2. Relationship between the indices of the breeding value of ancestors and their descendants, r ± mr

PTA value, milk productivity	Milk productivity of daughters for 305 days of lactation, kg		
	milk	milk fat	milk protein
PTA of fathers × PTA of sons	+0.451 ± 0.0412[3]	+0.501 ± 0.0388[3]	+0.485 ± 0.0396[3]
PTA mothers × PTA of sons	+0.491 ± 0.0397[3]	+0.440 ± 0.0418[3]	+0.415 ± 0.0429[3]
PTA of fathers × daughter's milk yield	+0.643 ± 0.0303[3]	+0.163 ± 0.0504[2]	+0.399 ± 0.0487[3]
PTA FM × daughter's milk yield of bulls	+0.264 ± 0.0476[3]	+0.260 ± 0.0485[3]	+0.178 ± 0.0504[3]
PTA FF × daughter's milk yield of bulls	+0.186 ± 0,0502[3]	+0.292 ± 0,0476[3]	+0.148 ± 0,0509[2]

The highest correlation was established between the PTA value by the milk yield of the fathers and the absolute milk yield for 305 days of the first lactation of their daughters (r = +0.643 ± 0.0303).

As the distance between generations increases, the correlation between the ancestral PTA and the absolute performance of their offspring decreases. Thus, in the second generation, the correlation coefficients between the PTA of the father's fathers (FF) and the fathers' mothers (FM) with the absolute productivity of their granddaughters amounted to r = +0.186 – 0.264; milk fat – r = +0.260 – 0.292; protein – r = +0.148 – 0.178.

The highest and positive correlation was established between the PTA of fathers of milk productivity and the absolute indicator of the milk productivity of their daughters (milk yield r = +0.643 ± 0.030, milk fat r = + 0.669 ± 0.028, protein (r = +0.552 ± 0.037), (table 3).

As a result of the research, a positive and statistically highly reliable correlation was established between PTA of the parents' type of body and the type of their offspring (BS) (r = +0.364 ± 0.0503 – 0.611 ± 0.0396), as well as between the parent's evaluation by type and the sum of the scores (SC) for the exterior of their daughters (r = +0.210 ± 0.049 – +0.586 ± 0.033). Also, a positive and statistically significant correlation was established between the evaluation of the udder of the daughters of the bull's father and the bull's daughters (SC) (r = +0.408 ± 0.049) and the bulls' mothers and daughters of the bulls (r = +0.381 ± 0.049).

At the same time, a very low, and negative correlation was between the body size of the bulls' daughters and their milk production for 305 days of the first lactation (milk yield r = -0.095 ± 0.0513), milk fat (r = +0.003 ± 0.0518); milk protein (+0.055 ± 0.0516). A very low

3. Relative variability of complex and functional traits of animals of Holstein breed

Evaluation, indications	$r \pm m_r$	h^2	Evaluation, indications	$r \pm m_r$
Body type:			Daughters BS	
Fathers × sons	+ 0.401 ±0.048	0.16	× milk yield	-0.095 ±0.0513
Mothers × sons	+ 0.513 0.083	0.26	× milk fat	+0.003 ±0.0518
Fathers × daughters BS	+ 0.611 ±0.039	0.37	× protein	-0.055 ±0.0516
Mothers × daughters BS	+0.364± 0.050	0.13	Dau. milk yield × fat content	-0.376 ±0.0490
Fathers × dau. (SC)	+0.586 ±0.031	0.034	Dau. milk yield × protein content	-0.224 ±0.0489
Mothers × dau. (SC)	+0.220 ±0.049	0.04	Environment factors	
Udder's composite:			Milk productivity:	
F Dau × sons dau.	+0.408 ±0.049	0.17	Daughters × contemporaries (GRP)	
M Dau × sons dau.	+0.381 0.049	0.14	× milk yield	+0.794 ±0.0192
Feet and legs:			× milk fat	+0.814 ±0.0175
Fathers × sons	+0.039 ±0.052	0.001	× protein	+0.743 ±0.024
Mothers × sons	+0.082 ±0.051	0.008		
Fertility:				
F type traits × difficulty birth (DB)	+0.086 ±0.0516	0.007		
M type traits × difficulty birth (DB)	+0.019 ±0.052	0.00		

and negative correlation was established between the ancestral breeding value of the type of their physique and the milk productivity of their female offspring for 305 days of the first lactation (r between milk yield = -0.052 – 0.171; fat – 0.034 – 0.110; protein – 0.029 – 0.162), (table 4).

4. Correlation between the indicators of breeding value by the type of bulls and the milk productivity of their daughters, (r ± mr)

Indicators	Milk productivity of daughters for 305 days 1st lactation, kg		
	milk	milk fat	milk protein
Father's type traits × daughters milk productivity	-0.171±0.0503	-0.082 ± 0.0514	-0.162 ± 0.0504
FF × dau. milk productivity	-0.052 ± 0.516	-0.110 ± 0.0513	-0.104 ± 0.0512
FM × dau. milk productivity	-0.082 ± 0.0514	+0.034 ± 0.0517	-0.029 ± 0.0516

Discussion. The highest correlation was established between the indices of PTA for milk production of bulls with similar indicators of their fathers and mothers. The lower, and not always positive, correlation between offspring's PTA and the breeding indices (TPI) of their ancestors can be explained by the fact, that each feature is included in the algorithm of the selection index in relative units of standard deviation with a specific density.

At the achievement of the milk yield of cows at the level of 11–12 thousand kg, such important trait as type of animal's constitution is leveled and receded into the background. In a number of countries (New Zealand, Holland), this indicator has not been introduced at all in the selection index algorithm, and in the United States, Germany, France its specific density has dropped from 30 in 2000 up to 8–12 % in 2015 year. Specialists of these countries believe, that behind this trait Holstein animals are already sufficiently consolidated and use a number of new traits to create "ideal", economically profitable cows [7]. Among them, there are udder health, daughters' reproductive ability, calving ease, calves' survival, number of somatic cells, duration of economic use of cows, which ensures economic efficiency of their use [14].

A low correlation was established between the evaluation of the composition of the feet and legs of parents and their sons (r = +0.039 – 0.082). Also low correlation was established between the ancestors' rating by type and the difficulty of calving the daughters of bulls (r = +0.019 – 0.086),

in our studies, once again confirms the increase in the number of daughters' births difficulty with an increasing in the assessment according to the type of their parents' physique.

It was found, that with the increase of milk yield of Holstein cows up to 11–12 thousand kg, the correlation coefficient with the fat content in it decreases up to -0.376 ± 0.0490 and protein to -0.224 ± 0.0489, which is statistically highly significant.

In our studies, a positive close statistically significant correlation was established between the milk production of bulls' daughters and their contemporaries, which have been used in 564 herds. The correlation coefficient between the milk yield was +0.794 ± 0.0192; milk fat +0.814 ± 0.0175 and milk protein +0.743 ± 0.024, which indicate the predominant influence of environment factors on the formation of milk productivity of cows.

Conclusion. The conduct of selection work on the basis of integrated accounting of TPI indices with PTA (breeding value) of sires on specific traits of milk productivity is more effective in selection of fathers and mothers of bulls for improving herds and breeds, in comparison with the selection of animals only by selection breeding indices.

The results of the research allow to state, that the relative variability of the complex traits of the exteriors and productivity of dairy animals is changed in the process of their improving and, to a certain extent, is as an indicator of direction and level of their productivity. At the milk yield level of 11–12 thousand kg of milk, a positive and statistically significant correlation of the indices of value of the types of ancestors and their offspring is still observed, but is leveled between the body size and milk productivity.

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ПРОДУКТИВНОЕ ДОЛГОЛЕТИЕ ГОЛШТИНСКИХ КОРОВ ЕВРОПЕЙСКОЙ СЕЛЕКЦИИ РАЗНЫХ ЛИНИЙ В УСЛОВИЯХ ПРОМЫШЛЕННОЙ ТЕХНОЛОГИИ

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Исследовано влияние линейной принадлежности на продуктивное долголетие и пожизненную молочную продуктивность голштинского скота европейской селекции в условиях промышленной технологии. Установлено достоверное влияние генетического происхождения коров на величину пожизненного удоя, содержания жира и белка в молоке, а также сроки их хозяйственного использования, что подтверждает целесообразность использовать в селекционно-племенной работе производителей выдающихся линий, которые объединяют в себе высокую племенную ценность по продуктивности дочерей с улучшающим эффектом по длительности их хозяйственного использования. Полученные данные указывают на возрастание силы влияния линейной принадлежности на пожизненные показатели продуктивности коров отечественной генерации, что свидетельствует об ослаблении действия паратипических факторов в условиях круглогодового беспривязно-боксового содержания и однотипного кормления.

Ключевые слова: **коровы, голштинская порода, линии, долголетие, пожизненная продуктивность, корреляция**

PRODUCTIVE LONGEVITY OF HOLSTEIN COWS OF EUROPEAN SELECTION OF DIFFERENT LINES UNDER INDUSTRIAL TECHNOLOGY CONDITIONS

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