

## FEATURES OF CONFORMATION TYPE OF COWS FIRSTBORN UKRAINIAN BLACK-AND-WHITE DAIRY CATTLE IN THEIR PHENOTYPIC RELATIONSHIP WITH MILK YIELD

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*Evaluation of animals for breeding Ukrainian Black-and-White dairy breed was carried out according to the method of linear classification of type in the breeding farms of LLC "Vladana" and the experimental farm of the Institute of Agriculture of the North-East of the NAAS (EF IANE). The estimation of cows in the herd of BF "Vladana" (83.8 score) on this set of milk-type traits in comparison with peers of the EF IANE (82.3 score) showed a significant advantage of the former with a highly reliable difference of 1.5 score ( $P < 0.001$ ). The average estimate at the level of 84.2 and 83.0 score in cows of the herd of SF "Vladana" and NAAS EF IANE indicated about fairly good development of their body. The best condition of limbs in animals of the herd BF "Vladana" with 83.5 score and slightly worse than in peers EF IANE (82.5 score) with a highly significant difference of 1.0 score ( $P < 0.001$ ) in favor of the former. Udder in animals of the breeding farm "Vladana" with an average grade of 84.7 score was on the 2.3 score higher ( $P < 0.001$ ) compared with peers in the EF IANE (82.4 score). In general, firstborn cows of controlled farms in the BF "Vladana" and EF IANE, which were classified according to the final type assessment, received an average score of 84.2 and 82.8 of 88 possible for animals of this age, which corresponded to the level on the international scale "Good Plus". The results of the estimation of first-born cows in the controlled farms show that the degree of the main descriptive traits development of conformation, provided by the method of linear classification, differed by significant intra-herd and inter-herd variability. A sufficient level of reliable positive relationship with milk yield was found both by group traits, except for limbs, and by the vast majority of descriptive traits of the conformation, with slightly higher correlation coefficients in cows of BF "Vladana". The determined phenotypic correlations between linear conformation traits and milk yield per lactation indicate about their reliability in the selection of cows by productivity.*

**Key words:** *Ukrainian Black-and-White dairy, linear classification, type, conformation, correlation.*

DOI: <https://doi.org/10.32845/bsnau.lvst.2021.2.2>

According to the requirements of modern progressive milk production technologies, the conformation of animals should be as close as possible to the desired type. Conformation typing of livestock was caused by the unification of methods of keeping, feeding and milking animals in the conditions of technological processes automation. Existing differences between animals, especially those with conformation flaws, can negatively affect the elements of technology.

For example, design of the stall related to the size and bigness of animals, the quality of limbs - limiting factor in loose housing and milking in the hall. The capacity and uniformity of the udder morphological traits development - teats position and length, udder depth and the intensity of milk flow, which determine factors of the level of automation of milking processes and

its multiplicity [2, 3, 9, 13, 25].

Taking into account the features of industrial technology, certain requirements for cow's conformation of the desired dairy type should be as follows: animals must be different by a strong, dense constitution, harmonious body structure, a straight back, and a wide loin, a wide and long rump, with a slight slope of the line from the hook bones to the ischium humps. The limbs of animals are strong, the pasterns are short, and hocks are dry, well developed, without pathological thickenings. The desired udder of a dairy-type cow in the set of morphological traits should be large in volume, proportionally formed, bath-shaped and cup-shaped, the size should be characterized by good development both in width and length, with the spread of parts far forward along the abdomen and back beyond the thigh line,

bottom placed at a sufficient distance above the hock joint, the front part is close to the stomach, and the rear part is high and firmly attached with a pronounced, deep furrow of the central ligament, the teats are located in the middle of the udder lobes at an optimal distance, cylindrical form, the desired length and thickness, directed vertically downward [7, 8, 12, 15].

The descriptive nature of the body parts provided for their quantitative characteristics, the level of which indicating the appropriate degree of approximation of the evaluated animals to the cow of the desired (model) type. Introduced a quantitative expression of a single score scale in the system of linear classification of dairy cattle, a technique that was first established by breeders of the USA and Canada in the 30s of the last century, and in the last 35-50 years its updated modern version is intensively used by other countries of the world with highly developed dairy cattle breeding [17, 20, 23, 26, 22, 27, 28]. The methodology was based on the conformation of the model animal as the aim of selection, and the primary task of linear classification - to estimate bull-sires by the type of their daughters. As a result of the assessment, we received a graphic image of the daughter's conformation profile of the assessed sires according to descriptive body parts that have important economic and functional significance.

To implement the new version of the Law of Ukraine "On Pedigree in Livestock Breeding" in the Sumy region, a linear classification of dairy cows has been introduced, including the Ukrainian Black-and-White dairy cow. In addition to the creation of a database for estimation sires by the type of their daughters, the purpose of our research was to use linear classification indicators to obtain objective information about the conformation of animals in particular herd, to establish the level of development, the nature of heritability, the degree of correlative and phenotypic variability body parts of constitution and udder of cows, with in order to timely identify undesirable deviations and shortcomings of conformation traits and operatively affect their correction by appropriate selection.

Countless scientific studies have proven [1, 6, 14, 16, 22] that the use of Holsteins, when creating the Ukrainian Black-and-White dairy breed and its further development, will reliably improve the body type and morphological qualities of the udder. At the same time, when using all kinds of selection methods, in the process of crossing livestock of different origins as an improving maternal, was observed the formation of various zonal types. Therefore, in order to determine the condition of animal's conformation of Sumy intrabreed type of Ukrainian Black-and-White dairy breed at this stage of selection, we have carried out research by the results of linear classification of two pedigree herds on its breeding.

**Material and methods.** The estimation of animals was carried out according to the method of type linear classification [5, 11, 22] in the selection herds for breeding of Ukrainian Black-and-White dairy breed - the LLC "Vladana" pedigree farm and experimental farm in the Institute of Agriculture of the North-East of the NAAS (EF IANE). Firstborn cows were assessed at the age of 2-4 months after calving according to two systems: A – 9-score with a linear description of individual conformation body parts; B – 100-score classification system, taking into account four complexes of selection traits, characterizing: the severity of dairy type, body development, limbs condition and udder morphological qualities. Each conformation complex was assessed independently and has its own weight coefficient in the overall

assessment of animals: dairy type - 15%, body - 20%; legs - 25% and udder - 40%. Biometric processing of experimental data was carried out according to the formulas given by E.K. Merkureva [4] on a PC using software.

**Research results.** The conformation type of dairy cow differs by a set of traits of the body structure and udder, which in a holistic combination can provide high productivity of animals while maintaining good health and their long-term use in modern conditions of high-tech production processes [3, 9, 10, 12, 19, 21].

In the system of 100-score classification according to groups of body parts of the conformation characterizing the dairy type, the physiological ability of the animal to high milk yield was assessed. Cows of a pronounced dairy type should be distinguished by angular shapes, good body development, which is harmoniously combined with proportionally developed individual parts. Assessment of cows in the LLC "Vladana" herd (83.8 score) by this complex of traits in comparison with the peers in the NAAS EF IANE (82.3 score) showed a significant advantage of the former with a highly reliable difference in 1.5 score ( $P < 0.001$ ), Table 1.

When estimating a group of body parts characterizing the body, following are evaluated - the animal strength, the height, depth and body length. A wide chest is an indicator of the animal health as a whole, it indicates about good development of lungs and heart, which provide the functional efficiency of cows during prolonged productive use. By the body depth, you can determine the ability of animal to consume a large amount of roughage as opposed to concentrated. The average estimate at the level of 84.2 and 83.0 score in cows of the LLC "Vladana" herd and NAAS EF IANE indicated about fairly good body development.

The assessment of limbs was considered in the aspect of animal's ability to loads and free movement. The state of the rear and front legs and hooves was assessed. The best condition of limbs was in animals of the LLC "Vladana" herd with an assessment of 83.5 score and somewhat worse in the contemporaries of the NAAS EF IANE (82.5 score) with a highly reliable difference of 1.0 score ( $P < 0.001$ ) in favor of the former.

When evaluating the dairy system, the udder structure was considered, preference was given to the traits by which will depend high milk yield and adaptability to machine milking. In addition, high quality udder is less vulnerable to injury and disease. It should be noted that the total number of animal score by 40% will depend on the value of assessment for udder. According to the linear classification, animals udder in the LLC "Vladana" breeding farm was the best with an estimate of 84.7 score, which on 2.3 score higher compared to peers at the same age in the NAAS EF IANE ( $P < 0.001$ ).

In general, the firstborn cows of the controlled farms "Vladana" and NAAS EF IANE, which were classified according to the final type assessment, received an average score of 84.2 and 82.8, respectively, out of 88 possible for animals of this age, which corresponded to the level of "Good Plus".

A descriptive system of linear assessment gives a clear idea of the most important body parts development of the cow's conformation separately from the group ones, which have economic (functional, breeding value).

According to this system, definite ICAR [22] traits of the cow's conformation are necessarily described, included to the characteristics of group traits of the dairy type, body, limbs and

udder, taking into account a certain list of shortcomings that are most often found in animals. When evaluating animals on a single 9-score scale, the average severity of trait was estimated at 5 score, and biological deviations towards deterioration in development with a decrease in score to 1 and, conversely, if

development of the trait increasing, the estimate raised to 9 score. Although the maximum estimate of 9 score did not always characterize the desired type development of the conformation body part. This included traits such as rump position, hock angle, udder depth, teat placement and length.

Table 1

**The results of linear classification of firstborn cows  
Ukrainian Black-and-White dairy breed**

Linear conformation traits	BF "Vladana" (n=195)		NAAS EF IANE (n=116)	
	x ± S.E.	Cv, %	x ± S.E.	Cv, %
Set of traits that characterize:				
dairy type	83,8±0,15	2,65	82,3±0,19	2,88
body	84,2±0,13	2,52	83,0±0,21	3,12
limbs	83,5±0,18	2,19	82,5±0,17	2,82
udder	84,7±0,17	2,54	82,4±0,18	2,91
Final score	84,2±0,14	2,31	82,8±0,17	2,74
Descriptive traits:				
height	7,6±0,11	19,4	5,7±0,13	31,6
chest width	6,5±0,08	15,7	6,2±0,14	16,4
body depth	7,5±0,09	14,9	6,5±0,11	18,6
angularity	7,2±0,07	11,4	6,1±0,14	19,7
rump angle	4,9±0,05	14,8	5,2±0,12	17,1
rear width	6,8±0,09	21,9	5,8±0,12	28,3
Pelvic limbs angle	4,6±0,06	16,4	4,1±0,11	27,9
pelvic limbs posture	6,8±0,11	18,9	5,7±0,12	21,2
hoof angle	5,4±0,07	19,9	4,7±0,09	25,7
Fore udder attachment	7,1±0,09	18,1	5,8±0,13	23,9
Rear udder attachment	6,7±0,11	21,1	5,4±0,12	26,5
central ligament	6,8±0,12	22,0	6,1±0,15	27,9
udder depth	6,6±0,10	24,6	5,5±0,16	31,2
Front teats position	4,4±0,17	31,1	4,9±0,11	27,8
Rear teats position	4,9±0,15	24,3	5,6±0,13	22,4
teats length	5,4±0,10	21,8	5,3±0,08	17,9
Locomotion	7,5±0,12	19,6	6,8±0,14	22,8
Body condition	5,8±0,14	16,4	6,9±0,15	26,7

The results of assessing firstborn cows of controlled farms indicate that the degree of development the main descriptive traits of conformation, provided for by the method of linear classification, was distinguished by significant intra-herd and inter-herd variability.

The evaluated animals of the "Vladana" breeding farm are characterized by well-defined height (7.6 score), body (7.5 score), angularity (7.2 score), position (4.9 score) and rear width (6.8 score), fore (7.1 points) and rear (6.7 points) udder parts attachment, central ligament (6.8 score), udder depth (6.6 score), locomotion (7.5 score) with the best characteristic of traits, determining the dairy production of cows.

The problematic issue of animals herd in the "Vladana" breeding farm was the condition of limbs and hooves, which required a solution by selecting of sires evaluated by type.

The firstborn of the NAAS EF IANE herd were characterized by significantly smaller stature, well-developed body, desired at the optimal level, rump position, tight attachment of the fore and slightly above the middle rear udder parts, a sufficient strength level of the body structure and dairy type severity.

Sufficiently high coefficients of variability of individual descriptive body parts of the conformation indicate the need to improve them in the part of animals of the studied Ukrainian Black-and-White dairy breed at the present stage of selection.

One of the main factors of successful breeding in the

dairy cattle population was the level of correlative variability, including linear traits of the conformation associated with milk productivity, which was constantly confirmed by scientific research both by domestic scientists and throughout the world [2, 3, 9, 10, 17, 19, 21, 26, 28].

Considering the importance of correlation in the selection of dairy cattle for conformation type, the relationships we identified between linear traits and milk yield of firstborn cows within the controlled herds showed the existence of a reliable correlation between the assessment both for individual complexes of conformation traits and for the overall assessment of the 100-score system of linear classification, Table 2.

A sufficient level of reliable positive relationship with milk yield was found for group traits, excluding limbs, with slightly higher correlation coefficients in the BF "Vladana" cows. Highly reliable correlations with milk yield demonstrate the severity of dairy type of firstborn cows of the BF "Vladana" and NAAS EF IANE, respectively ( $r = 0.411$  and  $0.375$ ;  $P < 0.001$ ), similarly the body development ( $r = 0.399$  and  $0.259$ ;  $p < 0.001$ ), the quality of udder morphological traits ( $r = 0.384$  and  $0.312$ ;  $p < 0.001$ ) and final score ( $r = 0.404$  and  $0.361$ ;  $p < 0.001$ ). This made it possible to assure the breeders of these farms in the effectiveness of the linear assessment use in the process of selection animals according to indicators of the conformation type.

**Relationship of the firstborn cows assessment of Ukrainian Black-and-White dairy breed  
with milk yield in 305 days of lactation**

Linear conformation traits	BF "Vladana" (n=195)		NAAS EF IANE (n=116)	
	r ± m <sub>r</sub>	t <sub>r</sub>	r ± m <sub>r</sub>	t <sub>r</sub>
Set of traits that characterize: dairy type	0,411±0,051	8,05	0,375±0,067	5,60
body	0,339±0,053	6,39	0,259±0,073	3,55
limbs	0,186±0,063	2,95	0,241±0,073	3,30
udder	0,384±0,061	6,29	0,312±0,070	4,46
Final score	0,404±0,062	6,52	0,361±0,068	5,29
Descriptive traits: height	0,255±0,061	4,18	0,355±0,068	5,16
chest width	0,085±0,067	1,26	0,055±0,071	0,77
body depth	0,329±0,065	5,06	0,282±0,065	4,34
angularity	0,419±0,060	6,98	0,383±0,064	5,98
rump angle	0,121±0,071	1,70	0,092±0,077	1,19
rear width	0,329±0,064	5,14	0,248±0,062	4,00
Pelvic limbs angle	-0,088±0,073	1,21	0,132±0,076	1,73
pelvic limbs posture	0,285±0,065	4,38	0,232±0,062	3,74
hoof angle	0,166±0,074	2,24	0,187±0,076	2,46
Fore udder attachment	0,315±0,072	4,38	0,275±0,073	3,77
Rear udder attachment	0,246±0,075	3,28	0,204±0,077	2,65
central ligament	0,328±0,072	4,56	0,288±0,072	4,00
udder depth	-0,087±0,072	1,21	-0,092±0,077	1,19
Front teats position	-0,127±0,075	1,69	-0,113±0,074	1,53
Rear teats position	-0,114±0,071	1,61	-0,093±0,074	1,26
teats length	-0,047±0,073	0,64	-0,055±0,076	0,72
Locomotion	0,345±0,076	4,54	0,239±0,067	3,57
Body condition	-0,278±0,069	4,03	-0,243±0,073	3,32

A positive relationship with milk yield was observed for the vast majority of descriptive traits of the conformation similarly within the controlled farms, since they are a kind of group reflection: stature ( $r = 0.255$  and  $0.355$ ), body depth ( $r = 0.329$  and  $0.282$ ), angularity ( $r = 0.419$  and  $0.383$ ), rump width ( $r = 0.329$  and  $0.248$ ), pelvic limbs posture ( $r = 0.285$  and  $0.232$ ), fore udder attachment ( $r = 0.315$  and  $0.275$ ), central ligament ( $r = 0.328$  and  $0.288$ ), locomotion ( $r = 0.345$  and  $0.239$ ).

As for such traits as udder depth, teats position and length, they correlated negatively with milk yield, however, the level was not confirmed by statistical reliability. A negative and highly significant correlation was found in both experimental herds between body condition and milk yield ( $r = -0.278$  and  $-0.243$ ). Our data are consistent with similar studies by foreign scientists. Thus, in studies by Alphonsus et al. [18] the genetic and phenotypic correlations between body condition and milk yield were  $-0.465$  and  $-0.370$ , respectively. According to Tapki and Ziya Guzey [27], the genetic and phenotypic correlations between body condition and traits of milk productivity (milk yield, milk fat and protein) turned out to be negative with variability

from  $-0.29$  to  $-0.34$  and from  $-0.19$  to  $-0.21$ . Similar negative genetic correlations between body condition and milk yield ( $-0.34$ ), milk fat ( $-0.45$ ) and milk protein ( $-0.39$ ) were obtained by Zink et al. [28].

Thus, the determined phenotypic correlations between linear traits of conformation and milk yield per lactation indicate their reliability in the selection of cows by productivity.

**Conclusions.** The use of linear classification technique in the breeding process of improving Ukrainian Black-and-White dairy cattle was a reliable and effective means of objectively determining the breed features of the cow's conformation type. Installed low scores and significant values of variability of individual descriptive traits indicate the need to introduce monitoring of their development and effective selection of sires in order to correct them.

A positive relationship has been established between the main linear traits characterizing the conformation type and the level of milk productivity will contribute to effective breeding in the selection of animals for these traits.

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**Особливості екстер'єрного типу корів-первісток української чорно-рябої молочної породи у їхньому фенотиповому зв'язку з величиною надою**

Оцінка тварин з розведення української чорно-рябої молочної породи проводилась за методикою лінійної класифікації типу в племінних заводах ТОВ „Владана” та дослідному господарстві Інституту сільського господарства північного сходу НААН (ДГ ІСГПС). Оцінка корів стада ПЗ „Владана” (83,8 балу) за цим комплексом ознак молочної породи у порівнянні з ровесницями ДГ ІСГПС (82,3 балу) засвідчила істотну перевагу перших з високодостовірною різницею 1,5 балу ( $P < 0,001$ ). Середня оцінка на рівні 84,2 та 83,0 бали у корів стада ПЗ „Владана” та ДГ ІСГПС свідчить про достатньо добрий розвиток їхнього тулуба. Кращий стан кінцівок у тварин стада ПЗ „Владана” з оцінкою 83,5 балу і децю гірший у ровесниць ДГ ІСГПС (82,5 балу) з високодостовірною різницею у 1,0 бал ( $P < 0,001$ ) на користь перших. Вим'я у тварин племінного заводу „Владана” з середньою оцінкою 84,7 балу на 2,3 балу вище ( $P < 0,001$ ) у порівнянні з ровесницями ДГ ІСГПС (82,4 балу). Загалом корови-первістки підконтрольних господарств ПЗ „Владана” і ДГ ІСГПС, які класифіковані за фінальною оцінкою типу, отримали середній бал відповідно 84,2 і 82,8 із 88 можливих для тварин цього віку, що відповідає за міжнародною шкалою рівню „добре з плюсом”. Результати оцінки корів-первісток підконтрольних господарств свідчать, що ступінь розвитку основних описових ознак екстер'єру, передбачених методикою лінійної класифікації, відрізняються значною внутрістадною та міжстадною мінливістю із вищими показниками оцінки у корів-первісток ПЗ „Владана”. Достатній рівень достовірного додатного зв'язку з надоєм виявлено як за груповими ознаками, за виключенням кінцівок, так і за переважною більшістю описових ознак екстер'єру, з децю вищими коефіцієнтами кореляції у корів ПЗ „Владана”. Встановлені фенотипові кореляції між лінійними ознаками екстер'єру та надоєм за лактацію свідчать про їхню надійність при селекції корів за продуктивністю.

**Ключові слова:** українська чорно-ряба молочна, лінійна класифікація, тип, екстер'єр, кореляція.

Дата надходження до редакції: 12.04.2021 р.