LIFESPAN OF COWS OF DAIRY CATTLE DEPENDING ON THE UDDER LINEAR TRAITS EVALUATION

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Abstract

The aim of the paper was to study the lifespan dependence of Ukrainian Red-and-White dairy (URWD) and Ukrainian Black-and-White dairy (UBWD) breeds on the level of linear traits evaluation that characterize the udder morphological qualities in the overall system of linear classification of the conformation type. The experiments were conducted in the herds of Cherkasy and Sumy regions for breeding URWD (n = 465) and UBWD (n = 598) breeds. By the trait fore udder parts attachment, reliable difference between cows, estimated at 1 and 9 scores, was 636 (URWD; P <0.001) and 721 (UBWD; P <0.001) days. The difference between the lowest and highest scores of the height of attachment of the udder rear parts in cows of experimental breeds was 663 (URWD; P <0.001) and 715 (UBWD; P <0.001) days. Animals with an assessment of the development of central udder ligament above 5-8 scores lived longer, according to assessed breeds, from 2,402 to 2,723 (URWD) and from 2,572 to 2,869 (UBWD) days. Cows of the UBWD breed estimated at 5-9 scores lived on 141-170 (P <0.01) days longer compared to the URWD cows. Relative variability between the udder depth and lifespan was curvilinear, as higher lifespan observed in cows with 6-7 scores. Cows of both breeds with an average grade of 7 for the fore teats position were used the longest in the herd. Evaluation of the relative variability of the fore teats length and cow's lifespan of controlled breeds showed that cows had a longer functional life with an average score of 5 and 6. The relative variability established between the evaluation of linear traits that characterize the udder morphological structure and the lifespan of cows testified about the effectiveness of animal selection by type in the direction of longevity. Linear traits that positively correlate with the lifespan of cows can be used in the future as indirect predictors of longevity.

Key words: Ukrainian Red-and-White dairy breed, Ukrainian Black-and-White breed, linear type traits, lifespan

INTRODUCTION

The use of the Holstein gene pool in the process of improving Ukrainian dairy breeds undoubtedly led to an increase in their milk productivity. However, cows with a high share inheritance of Holstein became more demanding on the conditions of feeding and keeping [24]. High mechanization of technological processes and growth of Holstein inheritance, by testimony of studies [23, 32], led to decrease in the indicators of the productive longevity of cows. Therefore, the lifelong productivity of cows, as the most important productive trait, was included in the selection indices developed in the individual countries [22, 30]. This was one of the main factors influencing the profitability of dairy cattle breeding. Due to its high economic value, the national dairy associations have registered longevity as a selection trait [21].

Since cattle breeders were interested in the traits that were inherited and the solution to the problem of longevity due to inheritance factors became more complicated precisely because of the low heritability of the traits that characterize it, especially those related to lifespan. Worldwide studies have confirmed this property [12, 14, 32, 34].

This population-genetic regularity was confirmed by summarizing a number of studies of brown Swiss, Guernsey, Holstein, Jersey, Red dairy and Simmental breeds from 19 countries of the world, by which the heritability of lifespan was quite low and ranged from 0.016-0.116 [8].

Problem of dairy cattle productive longevity in the world has existed for a long time, so

breeders are actively searching for methods to decide it. One of the means to solve the problem of lifespan was animals' selection by the traits of conformation type. The motivation for this event was based on the existence of positive correlation between parts of the body structure of the conformation and indicators of cows' duration use [4, 13, 14, 33, 34].

According to the linear assessment of Jersey cows, were established significant moderate and strong positive genetic correlations between most of the udder traits and the functional life of cows in the herd (from 0.23 to 0.63) [7]. Authors [9] on studies of Mexican Holsteins proposed to include five linear traits (chest width, teats length, central ligament, texture and udder depth) that positively correlated with productive lifespan as indirect predictors of longevity.

Authors [15] were sure that indirect genetic selection for traits: udder depth, rear teats position and udder texture, bone quality, fore udder attachment, body depth, and chest width can lead to a correlated increase in Holstein cows' longevity.

The use of linear classification method in the selection process of improving Ukrainian dairy breeds made it possible to identify the desired development of those linear traits on which the animals' lifespan will depend, in order to consider them in the process of selection.

Therefore, the purpose of our research was to study the lifespan dependence of cows of the Ukrainian Red-and-White dairy (URWD) and Ukrainian Black-and-White dairy (UBWD) breeds on the level of linear traits assessment that characterize morphological qualities of the udder in the overall system of linear classification of the conformation type.

MATERIALS AND METHODS

The research base was the leading selection herds of the Cherkasy and Sumy regions for breeding Ukrainian Red-and-White (n=465) and Black-and-White (n=598) dairy breeds. The conformation type of first-born cows was assessed using the linear classification method according to the latest ICAR recommendations [11] at the age of 2-4 months after calving. The lifespan of cows was determined by the number of days between the dates of birth and date of withdrawal from the herd. Experimental indicators using methods of biometric statistics, calculated according to the formulas of E. K. Merkurieva [20].

RESULTS AND DISCUSSIONS

Milk yield is closely linked to conformation traits among which udder traits occupy a special place from a genetic point of view, a a reason to be used in cows' selection and breeding [18, 19].
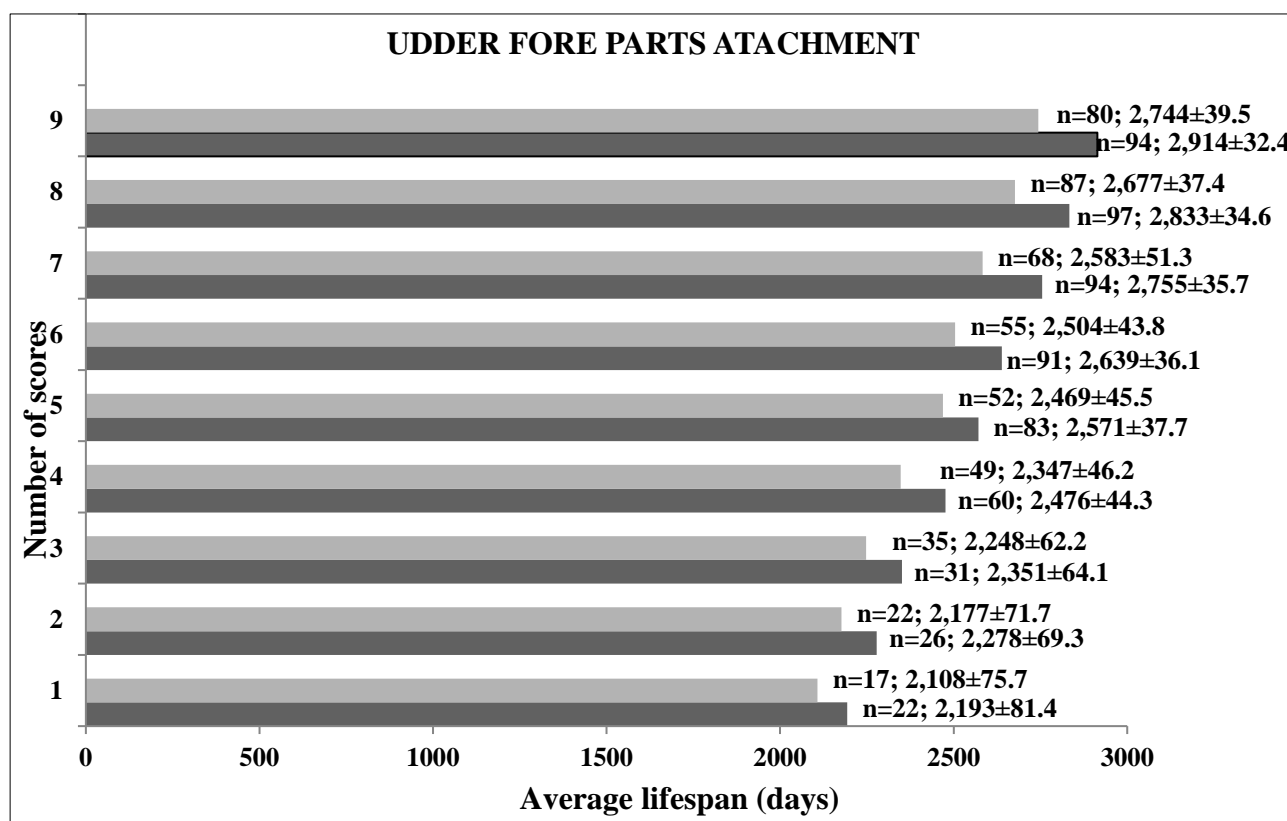
The evaluation of udder morphological traits of dairy cows in the linear classification system occupied a certain place, because in the final score of type its share in the most countries was 40% [1]. Scientific and practical experience in the selection of dairy cattle has repeatedly confirmed that the udder morphological traits are the most important and reliable external indicators of high milking capacity [3] and manufacturability of cows [8]. Linear classification of the body type descriptive traits was carried out, characterizing such morphological udder qualities of first-born cows as: fore udder parts attachment, height of the udder rear parts attachment, central ligament, udder depth, fore teats position and length. A certain relative variability was established between the assessment level of these type traits and the production and lifespan of animals [28, 29].

The udder fore parts attachment to the cow's belly, as one of the most important descriptive traits, assessed by strength, characterizing by an angle formed at this junction. The highest grade (9 score) for this body part development was received by an animal in which the udder differed by gradual transition glandular tissue of the fore part into the belly with help of connective lateral ligaments with formation of an obtuse angle above 161° [22]. The strength of udder attachment characterized by excellent fore parts development and the bath-like form. The functional feature of the attachment strength of the udder fore parts

was prevention it from sagging with age, which ensured the effectiveness of longevity traits [2, 31].

Results of the trait assessment of the fore udder parts attachment (Fig. 1) showed the relative relationship presence between this trait development and cow's lifespan of evaluated breeds. Reliable difference between cows estimated at 1 and 9 scores was quite significant and amounted to 636 (URWD; P<0.001) and 721 (UBWD; P<0.001) days. An interbreed comparison the lifespan of cows depending on the evaluation was in favor of UBWD cows with variability ranging from 85-172 days with reliable difference when comparing estimates of 9 score

(P<0.001). About significant influence this trait on the lifespan of cows was reported in the studies of foreign authors. Thus, when assessing cows of Jersey breed the highest relationship established between the fore udder parts attachment and functional life with genetic correlations for the first three lactations of 0.23; 0.63 and 0.33 [7], respectively. According to the genetic parameters evaluation of the Italian brown Swiss dairy cattle [25], the strong positive genetic correlation was determined between the fore udder parts attachment and milk yield (0.45), but insignificant - with the functional longevity (0.10).

UDDER FORE PARTS ATACHMENT

Score	
9	n=80; 2,744±39.5 / n=94; 2,914±32.4
8	n=87; 2,677±37.4 / n=97; 2,833±34.6
7	n=68; 2,583±51.3 / n=94; 2,755±35.7
6	n=55; 2,504±43.8 / n=91; 2,639±36.1
5	n=52; 2,469±45.5 / n=83; 2,571±37.7
4	n=49; 2,347±46.2 / n=60; 2,476±44.3
3	n=35; 2,248±62.2 / n=31; 2,351±64.1
2	n=22; 2,177±71.7 / n=26; 2,278±69.3
1	n=17; 2,108±75.7 / n=22; 2,193±81.4

Note: hereinafter - ■ - Ukrainian Red-and-White dairy breed;   ■ - Ukrainian Black-and-White dairy breed.
Fig. 1. Relative variability in the evaluation of descriptive type trait "udder fore parts attachment" and cow's lifespan of controlled breeds
Source: Own results.

The next linear trait - height of the udder rear parts attachment, similarly to the previous one, performs a supporting function, not allowing the udder to sag with age. Desirable development of this body part was rated with the highest score. The difference between the lowest and highest scores for this trait, obtained from the results of studies in cows of

tested breeds, was 663 (URWD; P<0.001) and 715 (UBWD; P<0.001) days (Fig. 2). Reliable advantage cows of the UBWD on this trait at 174–192 (P<0.001) days was established only by grades of 7–9 scores. Other studies had also reported about positive influence of this trait on the lifespan [2, 7, 29].
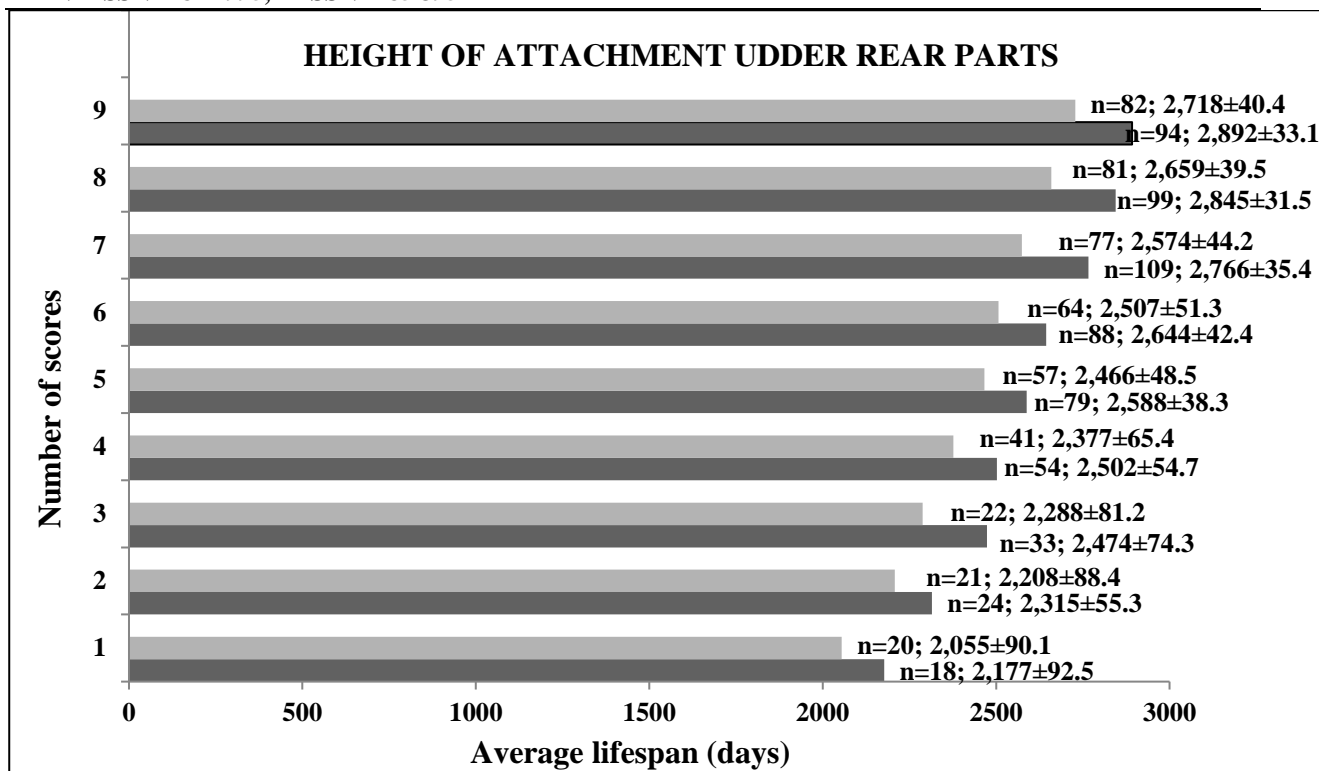
Fig. 2. Relative variability in the evaluation of descriptive type trait "height of attachment udder rear parts" and cow's lifespan of controlled breeds
Source: Own results.

The next linear udder trait in dairy cattle was the central ligament, related to its support at the appropriate height. The results of the experiment are shown in Fig. 3.
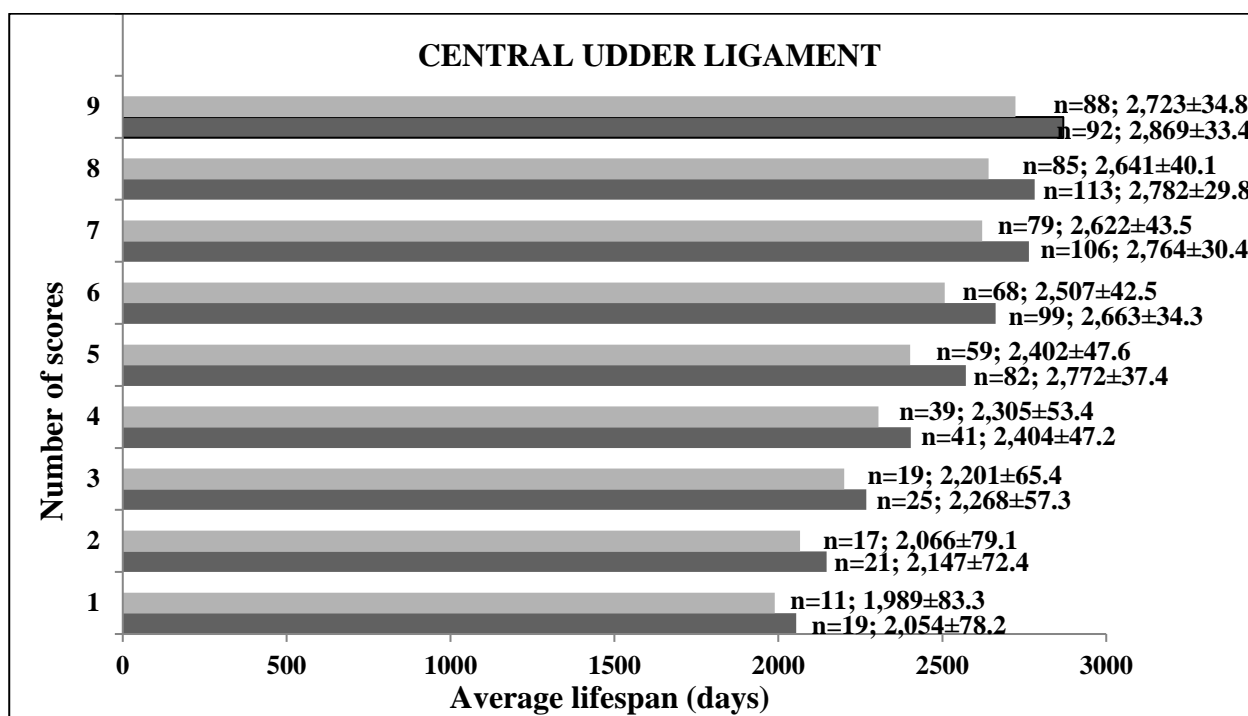

Fig. 3. Relative variability in the evaluation of descriptive type trait "central udder ligament" and cow's lifespan of controlled breeds
Source: Own results.

Highly located udder above the floor facilitated the operator to prepare it for milking process and during lying prevented cooling and injury. The high udder position with a deep, strength, well-defined and high raised central ligament was the desired trait development with the highest of 9 score.

Histogram's sleepers (Fig. 3) showed that the average cows' lifespan of tested breeds significantly depended on the score level for type trait central ligament. Animals with an assessment for the udder central ligament development above 5–8 scores lived longer, according to assessed breeds, from 2,402 to 2,723 (URWD) and from 2,572 to 2,869 (UBWD) days. Cows of the UBWD breed graded at of 5–9 scores lived longer by 141–170 (P<0.01) days compared to URWD cows.

Accordingly, in agreement with our results, Schneider et al. [26] and Sewalem et al. [27] found that the supporting ligament of Holstein cows was one of the most important udder traits, as animals with lower scores (with extremely weak ligaments) were nearly twice as likely to be culled than animals with higher scores. The udder bottom location relative to the floor is a very important functional technological linear type trait of dairy cattle. The udder bottom distance to the floor significantly dependent on the previous three traits responsible for the strength of its attachment. Histogram indicators (Fig. 4) testified that cows with high udder position were significantly less susceptible to these risks and used in the herd over a much longer period of time.
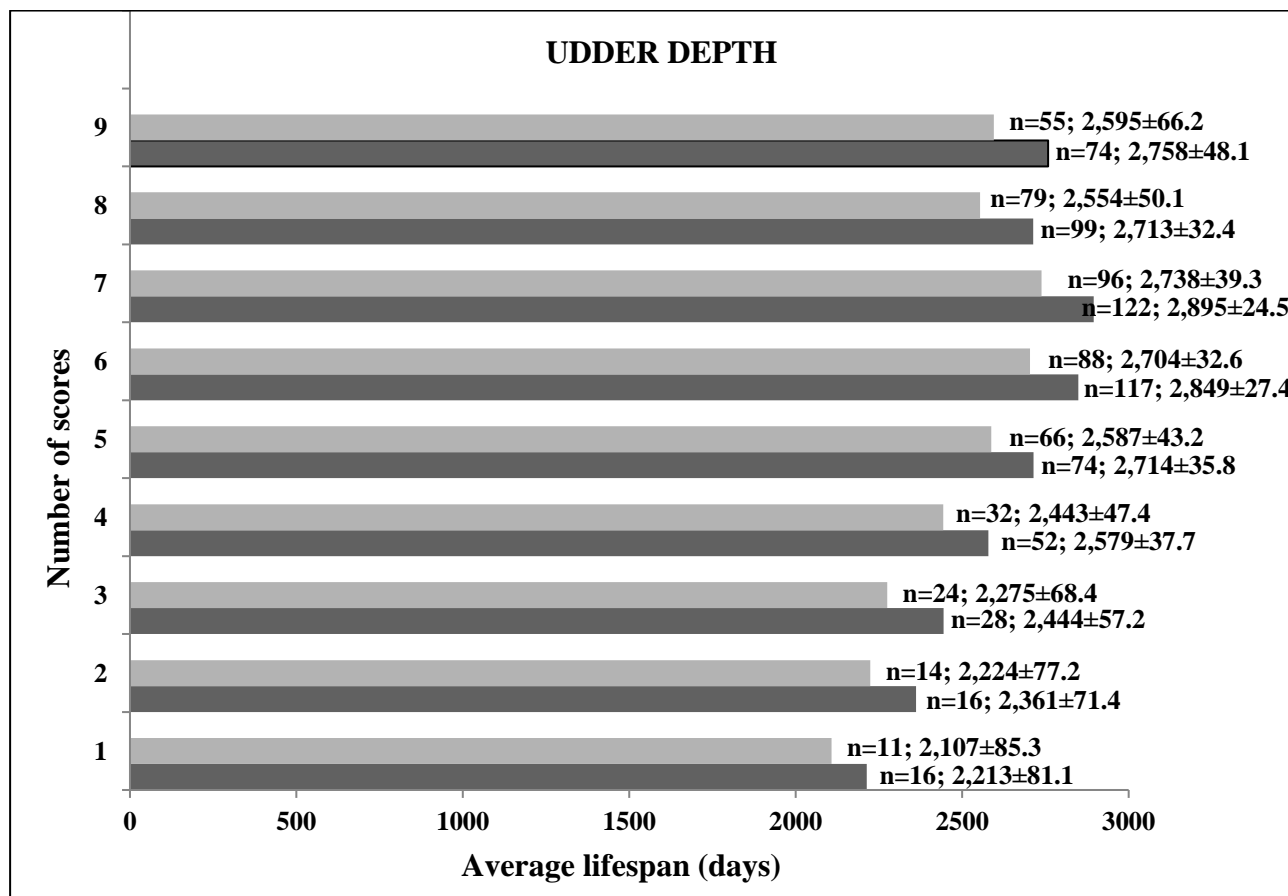

Fig. 4. Relative variability in the evaluation of descriptive type trait "udder depth" and cow's lifespan of controlled breeds
Source: Own results.

The relative variability between the udder depth and lifespan was curvilinear, as higher longevity observed in cows with 6–7 scores. A reliable decrease in the lifespan of cows will start from 4 to 1 scores. The significant decrease in the lifespan of cows began from assessment of 4 to 1 scores. The difference between the highest lifespan of cows with an

assessment of 7 score and of 5–1 scores for udder depth was 151 – 631 days for cows of the URWD breed with reliable difference (P<0.01–0.001), and for UBWD cows was 181–682 days (P<0.001). An interbreed comparison showed the advantage cows of the UBWD breed over URWD by lifespan within all values of scores and for some the difference in their favor was reliable. Relative close relation of the udder depth and functional longevity was found in Italian brown Swiss cattle with genetic correlations of 0.42 ± 0.10 [25], South African Jerseys with correlations of 0.10–0.49 depending on lactation [7], that confirmed results of our research.

Another linear trait of the udder - the fore teats position, that is very important both from the selection and from technological point of view (Fig. 5). In general, the teats placement on the udder can be wide, almost square; wide fore and close rear teats; close lateral at normal distance between teats of the left and right sides; close placement of all teats. Both very close (up to 6 cm) and very long (more than 20 cm) distance between the teats tops was undesirable. Teats spaced at an optimal distance (12-16 cm), centrally located on the udder parts, vertically directed downwards, cylindrical or conical in shape, best met of machine milking requirements [17].
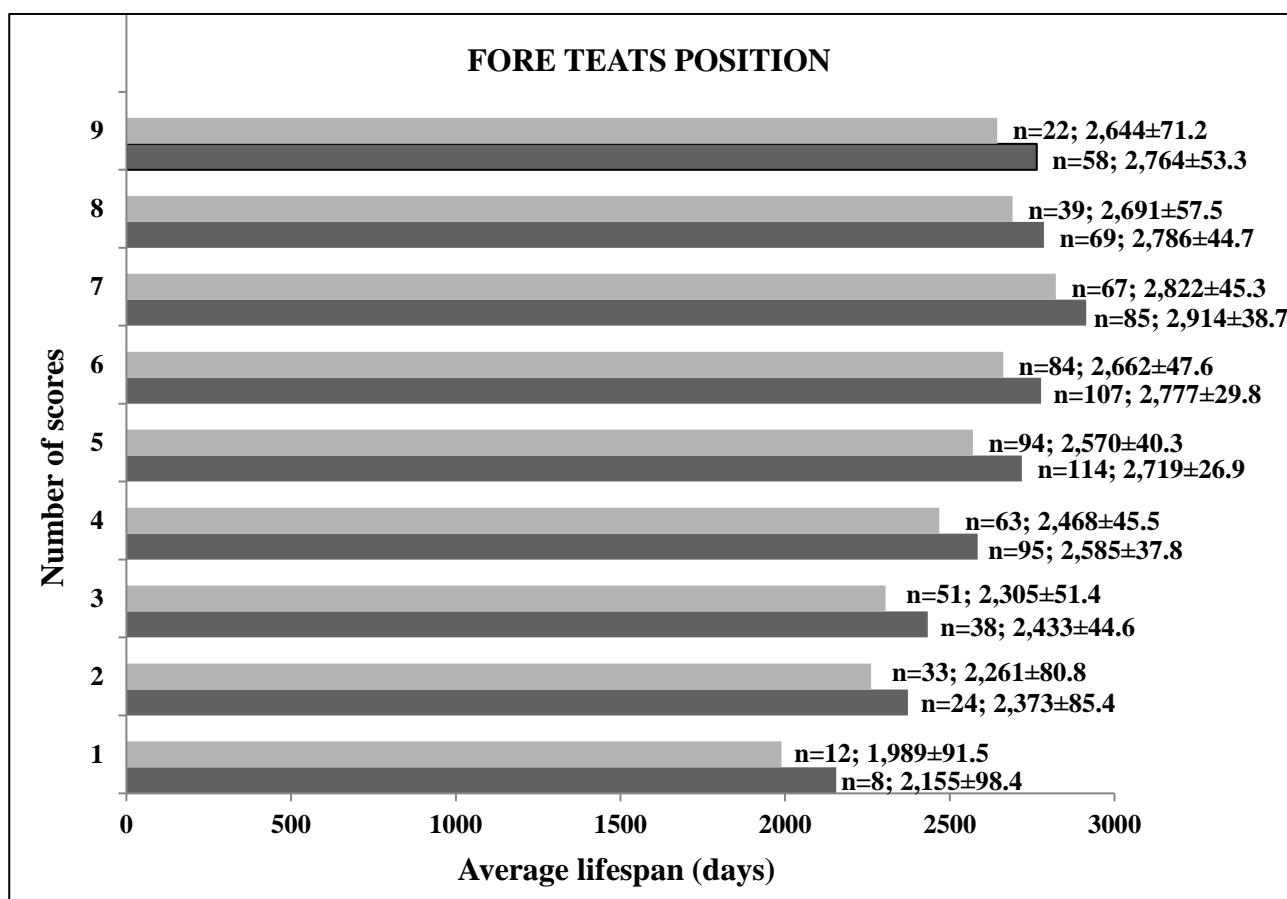

Fig. 5. Relative variability in the evaluation of descriptive type trait "fore teats position" and cow's lifespan of controlled breeds
Source: Own research.

Very close or very wide the fore and rear teats position is not the best trait development in the linear classification system. However, if you choose from extreme variants – the best was wider position than a narrow one. Histogram results showed that the cows

lifespan of both breeds, depending on the assessment of fore teats position characterized by slight curvilinear variability. Cows of both breeds with an average score of 7 were used for the longest time in a herd. Further deviations towards decrease in the lifespan

were observed in cows graded at 8-9 and 6-1 scores with advantage of the UBWD breed. The significant decrease in the lifespan indicator began in cows assessed for this trait from 4 to 1 scores, with an increase in the distance between the teats position. About positive influence of the fore teats placement on the functional longevity of cows of dairy breeds reported by other studies [5, 6, 7, 26, and 31].

The last of the udder linear traits – the teats length, refers more to the technological traits. Modern dairy cattle of different breeds are characterized by various indicators of the fore and rear teats length. According to studies [27], the teats length in first-born cows of Ukrainian Black-and-White dairy breed was 5.6 cm, and the Holstein breed – 5.8 cm. By researches data [3] of udder measurements of Holstein cows, it was found that the fore teats

length was 5.37 cm, and the rear ones - 4.83 cm. According to recent studies of cows first-born Holstein cattle [10], the fore and rear teats length was 5.11 and 4.79 cm, respectively. Based on the experimental data of linear evaluation and correlation relationships between them and milk yield, the desired manifestation of the conformation type of first-born cows created of Ukrainian RWD and BWD breeds was established in the overall unity of the main descriptive type traits that are part of the linear classification system, by which the fore teats length should be 5 cm with 5 score [16, 17]. Analyzing the indicators of studies of cows of Ukrainian dairy breeds, it can be concluded that the fore and rear teats length corresponded to the desired type, varying within 5–6 cm, respectively to 5 and 6 scores of linear evaluation (Fig. 6).
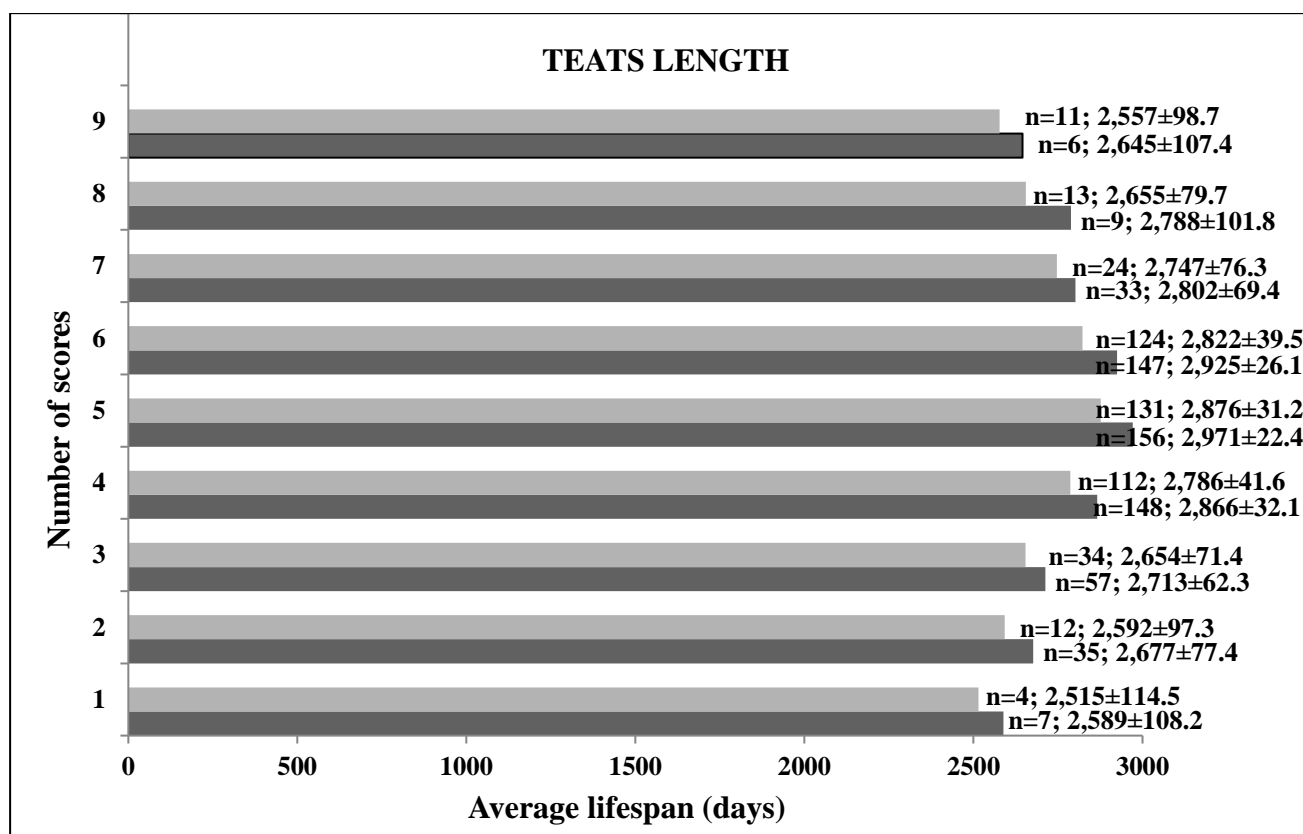

Fig. 6. Relative variability in the evaluation of descriptive type trait "teats length" and cow's lifespan of controlled breeds
Source: Own results.

Evaluation of the relative variability of the fore teats length with cow's lifespan of controlled breeds indicated that the functional life was longer in cows with average grade of

5 and 6. An increase in the assessment of this trait to 7–9 scores in cows of the URWD breed affected lifespan downward from 129 to 299 days, and decrease in the assessment to

3–1 scores from 222 to 361 (P<0.01). A similar comparison cows of the UBWD breed estimated at 5 and 6 scores with groups of animals graded at 7–9 showed a reduction in their lifespan by 123–326 days (P<0.01), and in cows with scores of 4-1, the life was reduced by 59-382 days.

Summarizing the results of the research, it was important to note that each of the evaluated descriptive traits in cows of both breeds had an influence on the lifespan with different variability within each specific type trait.

CONCLUSIONS

The relative variability established between the evaluation of linear traits characterizing the udder morphological structure and the lifespan of cows testified about the effectiveness of animal selection by type in the direction of longevity. Linear traits positively correlated with cow lifespan can be used as indirect predictors of longevity.

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