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Udder type traits: A selection criterion in indigenous dairy cattle

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Abstract
Dairy cattle conformation is a very crucial trait as it serves being the basis for selection of cows in breeding herds. Cattle conformation is related with production and nonproduction traits, subsequently with production efficiency of the animal. It becomes essential to include type traits in the selection criteria of the dairy cattle to attain the wholesome benefit from the animal without facing adverse consequences on animal health. Udder and teat type traits are one of the type traits that have significant influence on the overall production, health and reproduction traits of the dairy cattle. The importance of udder and teat type traits have been discussed in the paper with main emphasis on the relation of these traits with milk production and longevity of the animal. To maximise the profitability and overall improvement of the dairy herd, it is recommended to include the udder type traits and other relevant traits in the selection indices of the indigenous dairy cattle.

Keywords: udder type traits, criterion, indigenous dairy cattle

Introduction
Confirmation traits are of much significance in dairy cows producing higher yields efficiently fulfilling the ultimate aim of a dairy farmer. That is why, confirmation traits are recorded in many of the modern dairy cattle breeds. Type traits are confirmation traits of dairy animals determining dairy characteristic features of any dairy animal [1]. The physical appearance of an animal in terms of all body characteristics, which are related with productivity and fertility of the animal, is termed as the type and the traits that collectively define the type of an animal are termed as type traits [2]. Type traits that are recorded relatively early in life are medium to high heritable which makes selection relatively more efficient. These traits are used for selection of animals through the creation of the prediction equation based on the independent variable and assuring selection of the superior animal [3]. Also, these can be recorded in a single assessment, making them reliable and relatively cheap traits that can be included in selection indices for several purposes [4].

Significance of confirmation traits
Much importance is given to the Confirmation traits and they are of interest to many animal breeders because of their influence on production, longevity and profitability[5]. Conventionally, most of the dairy farmers judge the merits of the cow based on body confirmation. Dairy industry also shows a special interest in the relationships among body confirmation measurements of dairy cows [6]. conducted a study on Sahiwal cows maintained at Govt. livestock farm, Hisar. They scored a total of 208 Sahiwal cows for 15 linear traits on the 50-point scale to study the importance of type traits for milk production potential. Dairy character and most of the udder traits had a high association with milk production. The index selection based on first lactation milk yield, dairy character and rear udder width resulted in a higher expected genetic gain in total milk production up to third lactation. He concluded that linear type traits could serve as indicators for the selection of superior cows. Several researchers have stressed to quantify the significance and the impact of type traits on production traits in cattle [7]. For instance, the genetic correlation between type traits (including udder depth and teat length) was found to be 0.08 to 0.69 in HF cows in a study conducted by [8]. In Holstein breeding program it was observed that positive genetic correlations among milk production traits and the body type traits may reflect past emphasis on milk production traits [9, 10, 11]. Higher yielding heifers have more angular and deeper udders [5, 12] also had the same view that

the type traits were related with productive traits which is highlighted by the fact that through selection indices these have been used as selection criteria in several countries [12, 13, 14] reported the highest phenotypic correlation between milk yield and dairy type.

For many dairy entrepreneurs, longevity is the most important trait associated with dairy production. This belief is quite understandable since the length of time that a cow remains in the herd reflects its ability to meet or surpass the herd owner's minimum expectations. Longer herd life reduces replacement costs and increases the proportion of lactations from higher yielding, mature animals. Therefore, it is paramount that we increase the cow's chance of surviving longer in the herd [3]. [15] reported that one of the genetic factors that affect longevity is cow confirmation traits, which varies within different breeds, farms and animals. Type traits have been used as indirect selection criteria for herd life [16]. Phenotypic and genetic correlations between the type traits and survival have been demonstrated by [17]. In the 1970s, when breed associations first developed linear type appraisal programs, initial attempts to increase dairy cow longevity through type trait selection began and for the next two decades, type and longevity were considered synonymous[3]. Selection for longevity is, however, rather difficult because, in real-time, it is not possible to obtain estimated breeding values of sires based on direct longevity of their daughters. These values have to be predicted indirectly. Selection can, therefore, be realized indirectly through type traits which are correlated to longevity [18].

Selection based on body measurements and milk production could result in a greater genetic gain in milk yield than single selection for milk yield. Therefore, longevity, reproduction and total milk production in cows become the important traits in the selection criteria, which have tight connections to economic effectiveness of milk production[4]. The functional confirmation traits that influence or facilitate the longevity and reproduction status of dairy cows are the appearance of udder confirmation, feet and leg confirmation, thoracic and abdominal body confirmation, rump and loin structure. It was found that the main linear traits associated with productive traits were body compound (index comprised by stature, chest width, angularity, and rump angle) and udder compound (index comprised by udder depth, fore udder attachment, rear udder height, rear udder width, central ligament, front teat position and rear teat position), fore udder attachment, teat length, rear teat position and udder depth.

Classification and scoring

Classification of animals based on their type traits is termed as Type Classification or Scoring. Classification is an important tool in decision making as it focuses on the selection of animals that should have a longer herd life, expressing their productive and reproductive potential based on their morphological traits. The measurement of type traits is linear scoring as recommended by the International Committee for Animal Recording (ICAR). Classification is done on linear scales in the form of scores for standard type traits. The standard traits to be considered during type classification are as follows: Dairy strength; including Stature, Heart girth, Body length, Body depth and Angularity; Rump; including Rump angle and Rump width; Feet and legs; including Rear legs set, Rear legs rear view and Foot angle; Udder; including Fore udder attachment, Rear udder height, Central ligament, Udder depth, Front teat placement, Teat length, Rear teat placement, Rear udder width and Teat thickness, and General; Body condition score. The principle of the WHFF type harmonisation programme has been acquired by The International Committee of Animal Recording (ICAR) and the use of the 16 traits are a prerequisite for the data to be included in international evaluations. The European Holstein-Friesian federation (EHFF) took the responsibility to examine harmonization of type classification systems in 1986 with the objectives of preparing recommendations for the harmonization of type classification, including the definition of traits, classification systems and publication of type proofs which was adopted by World Holstein Friesian Federation in 1988. The quality and robustness of the programme have been demonstrated in the Multiple Across Country Evaluation (MACE) for type evaluations producing inter-country correlations, which at one time, were considered impossible to achieve. This MACE programme can be considered as the catalyst to establish global uniformity.

Linear type traits were first recorded in dairy cattle in the early 1980s [19, 20, 5]. Cattle Breeders' Associations were established in Turkey in 1995 under the Federation of Cattle Breeders' Association (CBAT) and CBAT became a member of the International Committee for Animal Recording (ICAR) in 2000. In the CBAT breeding programs, the weighting values for type traits and milk yield were given as 0.30 and 0.70, respectively.

Udder type traits

The importance of type traits can be known from the fact that there are different types of records being utilized to evaluate and rank the cows. Some weight to the type traits has been given in many of the selection indices and the udder is considered the most important component amongst all the typical traits. Initially, the most commonly recorded traits were udder and teat type traits. Out of all confirmation traits, they mainly influenced milking ability, udder health, and longevity of animals. So, such information could be included in some selection index or even this could be utilized as a separate criterion for selection [21]. The udder of the cow is one of the most important criteria that can be used to predict production.

Various authors have demonstrated the influence of udder traits on milk production. A strongly attached and well-balanced udder with fine texture will support high and persistent production over the cow's lifetime [22]. concluded that large cow with good udder confirmation, udder depth, a strong central ligament, deep angular bodies and good quality bones tend to produce more milk. Usually, it is said that a cow having a large udder with appreciable glandular tissue and a symmetrical shape is an asset. Selection criteria relevant to milk production potential includes the bigger size of the udder and teat, pedigree history of the animal indicating inheritance from a known high producer as recalled by owner, well-attached udder and squarely placed teats [4]. [23] Stated that udder of the cow is one of the most important criteria that can be used to predict production performance [24]. Opened that since the confirmation of the udder is important to the functionality of the animal, thus, deeper udders could be reliable predictors of greater milk production [25]. also had a similar view that cows with deeper udders were high yielding. In another study [26], reported that prediction of test day milk yield was found to be negatively correlated with udder depth in Sahiwal cows and the mean values of the udder traits were

higher in Jersey X Sahiwal crossbreds than that in Sahiwal group [27]. Also suggested that udder measurement should be used in addition to visual appraisal in selecting the dairy cows [28]. Reported that udder height is a better predictor of lactation performance and the udder of the cow is one of the most important criteria used to predict production performance. Significant association of udder measurement with milk yield of dairy cows has been reported by [29, 30] in European breeds of cattle, while [31] reported a positive relationship between udder size and milk yield in Red Sindhi and Sahiwal cows in India [32]. estimated udder and teat measurements in Hariana cattle, as well as, their association with milk production traits and observed positive and highly significant association of milk production with udder length, udder width and udder depth as well as with the length of fore and rear teats [21]. Found udder length had the highest phenotypic correlation with test day yield at the first stage of lactation followed by udder width, udder circumference and udder depth. Udder traits (especially, the height of the udder above the hock) were found to positively influence the length of productive life.

Generally, the genetic correlations showed that higher-yielding cows have relatively deeper body, deeper udders, good udder depth and good fore-udder attachment. Some studies showed that genetic correlations among the udder type traits and milk production traits indicating genetic selection for increased milk production alone will be leading in cows with better fore udder attachment (FUA), rear udder height (RUH), rear udder width (RUW), central ligament (CL) and udder depth (UD). Although most of the studies reported positive genetic correlations among udder traits and milk production traits, negative genetic correlations were also observed by [5]. Genetic correlations between milk yield and the type traits ranged from–0.13 for udder depth to 1.00 for udder and feet and legs. Genetic correlations between yield and some type traits were negative, indicating that continuous selection for milk yield could cause deterioration in some confirmational traits. FUA had a negative correlation with milk yield and somatic cell score (-0.11) indicating that cows with stronger udder attachments have a lower milk production and better-quality milk [19]. concluded that udder depth and fore udder attachment had the largest negative correlations with the yield (–0.52 and –0.37, respectively). In British Friesians, genetic correlations ranged from –0.52 to 0.24 between linear type scores and milk yield for primiparous animals. It has also been reported that phenotypic correlations between type scores and milk yield was lower than 0.30 [33] and genetic correlations between milk yield and type traits ranged from –0.44 for udder depth in dairy cattle [34] found low to moderate positive genetic correlations between AN (angularity) and FUA (fore udder attachment) with milk production traits [35] reported genetic correlations between the first lactation milk yield and the type traits for dairy cows as –0.48 for udder depth to 0.54 for dairy form. They also calculated that the daughters of bulls siring the highest yielding cows had deeper udders with looser fore udder attachments and sloping rumps [36] reported that the correlations between confirmation traits and milk yield components tended to decrease in successive lactations [37]. and [38] stated the values of the genetic correlations of longevity with udder traits and milk production, which ranged from 0.56 to 0.42 and 0.49 to 0.65, respectively, indicating the existence of genetic gains for longevity and milk production based on selection for udder traits.

In a study conducted by [39], it was stated that udder traits had the greatest impact on functional longevity. Fore teat placement had the strongest influence on functional longevity followed by udder depth, fore udder attachment, median ligament and rear teat placement. Similarly, [40] also highlighted the fact that type traits with the strongest genetic correlations with productive life were fore udder attachment, mobility and final score (0.44, 0.50, and 0.57, respectively) [41], found that udder depth and teat rear view were the traits most related to survival [4] reported that fore udder, rear udder, central ligament and udder depth appear to be potential indicators of cow longevity and it is necessary to test these traits regularly so that they can be used as important selection criteria for the improvement of Czech Fleckvieh longevity. Of the linear traits, angularity and udder depth were among those with the highest genetic correlation with survival [5].

Several researchers have shown a consistent relationship between udder confirmation and udder health and longevity. In a study done by [42], the significant effect of central ligament and udder depth on cow lifespan and lifetime productivity was observed in different cow breeds [15]. found that udder traits, especially udder depth, have a profound effect on survival. The most important udder traits in relation to udder health and longevity were found to be fore udder attachment and udder depth, where strongly attached fore udders and high udders were found to be beneficial. They also reported that teat length negatively influenced milking characteristics and potentially udder health and, as a result, influenced the cow's longevity. The significantly longer productive life (1899.7 - 1908.4 days) occurred in a cow group with average teat length, but in those groups, there were significantly lower lifetime milk production and test day milk production. It was advocated by [9, 43] that productive life decreases because of udder, reproductive, structural and locomotive disorders. Bulls with higher breeding values for fore udder attachment (which inherit strongly attached fore udders to their daughters) have considerably higher breeding values for udder health than bulls which inherit loose fore udders. Thus, this confirmation trait has a strong positive effect on udder health [44]. Showed that cows with longer teats were genetically predisposed to a higher incidence of mastitis. In addition, cows may alter their gait if udders are deep and pendulous. Udder depth and milking ease accounted for 84% of the total contribution of type traits to functional longevity. Recent Canadian data reported that rear teat placement, udder depth and udder texture were udder traits that had a significant influence on functional survival [23]. found significant genetic correlations between longevity and the evaluation of the udder and the teats (r ranged from 0.38 to 0.66). Similar findings were presented by [45], especially, for Simmentalized breeds in Europe [46] have concluded that well attached fore udder, strong central ligament, high attached rear udder, close front teat placement and moderately long teats as the most significant traits for longer productive life. So, for most traits, it may be concluded that the relation between the linear confirmation traits and udder health or longevity is almost similar for all breeds.

Udder dimensions have been reported heritable by many workers. Heritability of udder traits was estimated to be between 0.14 and 0.42. Therefore, genetic selection has the ability to alter anatomical structure of the cow's udder. Selection for increased production has caused the udder to increase in size and mass. As a result, the udder's centre of gravity has shifted caudal or posterior and the suspensory

apparatus of the udder has been supplemented with additional support tissue that attaches to the pelvic floor by means of the symphysial tendon [4].

Teat type traits

Cows with longer teat lengths have lesser milk production than cows with relatively shorter teat length [47, 48, 49]. On the contrary [50], found Holsteins with larger dimensions of the udder and teats correspond with higher milk production [51, 52]. reported that in Karan Fries cows the teat length was significantly and positively correlated with milk yield. The correlation coefficient of teat length and diameter with milk production were not significant in Karan Fries cows [51]. Milk yield and composition were not much affected by shape of teats, as reported by [52], in Karan Fries cows. Teat length was, however, positively correlated with milk yield while rear teat diameter and milk yield were negatively correlated. There is always a need of correction of teat length and placement by breeders, because of new milking technologies that change every few years [15]. In most studies on milk production in dairy cattle, it has been reported that larger teat diameter influenced increased milk production [42, 53]. [54] observed that udder length was significantly correlated with milk yield on the day of measurement and phenotypic correlations between teat measurements and milk yield were significant.

There are different authorities involved in standards for measuring udder and teat type traits. For example, International Committee for Animal Recording and World Holstein-Friesian Federation, 2012 (1-9-point scale scoring system) are associated with the traits viz; Fore udder attachment, Rear udder height, Udder depth, Udder balance, Teat's length, Front teat placement, Rear teat placement, Central ligament, Teat thickness and Front teat position. Proceedings of 10th World Congress of Genetics Applied to Livestock Production (WCGALP), 2014 [55] is another authority marking the standards for udder and teat type traits *viz*; Fore udder length, Fore udder attachment, Rear udder width, Rear udder height, Udder support, Udder depth, Udder balance, Teats length, Teats diameter, Teats direction, Front teat placement, Rear teat placement and Overall udder score. H.A.U, 2016; Holstein Association USA, Inc. 2016, 2112224 1M 7/16 [56], (1 - 50-point scale scoring system) has set the standards typically for Fore udder attachment, Rear udder height, Udder depth, Udder balance, Teats length, Front teat placement, Rear teat placement and Central ligament.

Conclusion

It can be summarised that the conformation traits particularly udder type traits are advantageous enough to be included in the selection criterion of dairy animals. The inclusion will not only lead to better milk yields of the animals but also the overall improvement in other related traits will be taken care of. Considering the high heritability of udder traits and their relationships with economically important traits, regarding these characteristics in breeding programmes is desirable.

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