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Correlation of Morphological Traits with Milk Production in Murrah Buffaloes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The current investigation aimed to assess the correlation between morphometric characteristics and production performance in Murrah buffaloes, recognized as the premier milch breed globally. A cohort of 100 lactating Murrah buffaloes in their first to third lactation cycles was selected from the Buffalo Farm at Lala Lajpat Rai University of Veterinary and Animal Science, Hisar. The study focused on five traits: 305 days of lactation yield, muzzle width, brisket width, hip width, and skin thinness. Statistical analysis was conducted using Pearson's correlation method. The findings revealed negative correlations between lactation yield and the morphometric traits of muzzle width, brisket width, and hip width. Conversely, a positive correlation was observed between lactation yield

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and skin thinness. This study provides valuable insights for selecting dairy Murrah buffaloes that exhibit optimal production under field conditions, as these identified traits can be considered pivotal factors in the decision-making process for buffalo selection in dairy production systems.

Keywords: Morphometric characteristic; Murrah buffalo; skin thinness; production; correlation.

1. INTRODUCTION

In numerous Asian nations, including India, buffaloes (*Bubalus bubalis*) play a crucial role in ensuring food security by serving as a significant source of meat and milk for human consumption. The 20th Livestock Census of 2019 reported a buffalo population of 109.85 million in India, reflecting a 1.0% increase from the previous census. The global demand for the Murrah breed of buffalo is substantial due to its high milk fat content and potential for a substantial milk yield. Despite being a well-defined genetic resource, Murrah buffaloes exhibit considerable variation in external morphometric characteristics and other economically relevant traits under field conditions [1]. The external body parts of the buffalo contribute directly or indirectly to its milk production ability, displaying significant diversity. Field observations in Sri Lanka revealed notable variations in the external conformation and economic traits among Murrah, Surti, and Nili-Ravi buffaloes [1]. Scheinder et al*.* [2] emphasized the importance of linear type traits in both selection and reproduction decisions for Holstein dairy cattle.

Zavadilova and Stipkova [3] conducted a study on Czech Holstein cattle, revealing that linear-type traits exert a direct or indirect influence on the decisions related to selection and culling. In the context of dairy cattle, these linear type traits have been linked to both longevity and milk production [4,5], serving as indirect predictors for these important traits [6]. Additionally, linear-type traits can serve as indirect predictors of milk production and longevity, as suggested by Esteves et al*.* [6]. The linear traits encompass various anatomical features such as top wedge angle, rump slope, rump width, hip bone distance, navel flap length, brisket distance, wither height, body length, and skin thickness.

Throughout the history of breeding practices, there has been a persistent effort among breeders to establish a correlation between specific external characteristics and milk production, aiming to facilitate the early selection of dairy animals. Numerous studies, such as those by Bhatnagar and Kumar [7], Bharadwaj et al*.* [8], and Kshatriya et al*.* [9], have attempted to delineate the relationship between certain breed characteristics and milk production. Despite these efforts, limited research has been undertaken to investigate the association of linear-type traits with reproduction and production in Murrah buffaloes. This gap in knowledge highlights the need for further scientific inquiry into the specific linear type traits that may influence the reproductive and productive aspects of Murrah buffaloes. However, research regarding the relationship between linear type traits and production and reproduction performance in Murrah buffaloes is limited, with scant literature available. Thus far, minimal work has been conducted in this area. Investigating the external body structure of dairy buffaloes is crucial not only to adhere to breed standards but also to enhance milk productivity and ensure optimal reproductive health.

Ugur [10] identified a noteworthy correlation between specific linear type traits and milk production in dairy animals. However, the existing literature on the association between skin thickness and milk production has yielded conflicting reports. While research has been conducted on cattle and their crossbred counterparts, there is a paucity of literature addressing the relationship between external body structure and milk production in buffaloes. Consequently, the present study was initiated to examine the phenotypic trait variability of Murrah buffaloes in conjunction with their milking traits.

2. METHODOLOGY

Murrah buffaloes (100) in first to third parity that were in the early stage of lactation (30–60 days in milk) were selected and kept under uniform management conditions at Buffalo Farm, Lala Lajpat Rai University of Veterinary and Animal Science, Hisar. 49 buffaloes were in the first lactation, 30 buffaloes were in the second lactation and 21 buffaloes were in the third lactation and were recorded for 4 body morphometric traits. The lactation period considered for the study was 305 days. Anatomical measurements, including muzzle width over the nasal septum, brisket width, skin thinness (assessed with a Vernier caliper), and hip width, were conducted using appropriate

measuring instruments. Skin thinness was recorded using a Vernier caliper on the lateral skin of the buffalo's neck region, with the reading subsequently halved to determine the precise skin thinness value of a single fold. Muzzle width (MW) was determined using a large horn caliper, and the full width was documented. The hip bone distance was quantified as the distance between the two hip bones, measured using a measuring tape. Brisket width was assessed as the distance between the forelegs, facilitated by a measuring tape. These buffaloes were milked twice a day, i.e. morning and evening by hand milking and the calves were allowed to suckle their mother for a let-down of milk. The milking was performed by a full-hand method using both hands from the beginning of milking till the end of stripping.

2.2 Statistical analysis

The average of the treatment group was subjected to statistical procedures as outlined by Snedecor and Cochran, [2]. The data underwent analysis utilizing Pearson's correlation coefficient, as assessed through the standard method recommended by Snedecor and Cochran. The coefficient 'r', known as the linear correlation coefficient, quantifies the magnitude and direction of a linear association between two variables. Occasionally termed the Pearson product-moment correlation coefficient, it is named after its originator, Karl Pearson. The mathematical expression for calculating 'r' is as follows:

$$r=\frac{n(\sum xy)-(\sum x)(\sum y)}{\sqrt{[n\sum x2-(\sum x)^2][n\sum y2-(\sum y)^2]}}$$

Where n is the number of pairs of data.

3. RESULTS AND DISCUSSION

In the investigation, various morphometric traits were systematically measured, including muzzle width over the nasal septum, brisket width, skin thinness assessed using a Vernier caliper, and hip width. The detailed results of these measurements are provided in Table 1.

The analysis of correlations between first, second, and third lactation milk yield in a sample comprising 49 buffaloes, 30 buffaloes, and 21 buffaloes, respectively, and multiple body measurements has yielded significant findings. Notably, a positive correlation was identified between the skin thickness of the buffaloes and their milk production across the first, second, and third lactation cycles. Conversely, negative correlations were observed between brisket size, muzzle width, and hip girth, and milk yield during these respective lactation periods.

Moreover, it is notable that the correlation between skin thinness and milk production exhibited a more pronounced effect in the second lactation compared to the first, and this positive correlation persisted into the third lactation. These findings underscore the potential significance of skin thinness in influencing milk production across multiple lactation cycles in buffaloes.

Correlations between first lactation milk yield (49 buffaloes) and various body measurements revealed a positive association with skin thinness, while negative associations were observed with brisket size, muzzle width, and hip girth. Similarly, correlations with second lactation milk yield (30 buffaloes) indicated positive associations with skin thinness and hip width, alongside negative correlations with brisket size and muzzle width. Notably, the correlation coefficient for skin thinness was higher in the second lactation compared to the first. Correspondingly, correlations between third lactation yield (21 buffaloes) and body measurements demonstrated a positive association with skin thinness and negative associations with brisket size, muzzle width, and hip width. In conclusion, the consistent positive correlation observed between skin thinness and milk production across the first, second, and third lactation cycles suggests a potential role of skin thinness as a contributing factor to milk production in buffaloes.

The 305-day lactation yield demonstrated a positive and statistically significant correlation with live weight, as well as with various physical traits, as reported by Agasti et al. [11]. In the current study, a positive correlation was observed between lactation yield and skin thinness. Buffaloes with thin skin exhibited higher milk production compared to those with medium skin thickness, potentially attributed to enhanced heat dissipation in animals with thinner skin, rendering them more efficient in milk production, especially in warmer climates [12].

Table 1. Correlation between lactation yield and body measurements in Murrah buffaloes

Lactation order	Body Measurements			
	MUZZLE	BRISKET	SKIN THIC.	HIP WIDT.
Lactation-I	-0.149	-0.162	0.291	-0.135
Lactation-II	-0.079	-0.109	0.364	0.173
Lactation-III	-0.198	-0.355	0.190	-0.046

thinness. Buffaloes with thin skin exhibited higher milk production compared to those with medium skin thickness, potentially attributed to enhanced heat dissipation in animals with thinner skin, rendering them more efficient in milk production, especially in warmer climates [12].

These findings align with the observations of Dhillod et al. [13], who reported a significant negative correlation ($p < 0.01$) between milk yield and skin thickness (-0.79). Barati et al. (2017) noted negative correlations between daily milk yield and skin thickness in various regions, including the flank and udder, with significant associations. Kshatriya et al. [9] similarly identified significant negative correlations between skin thickness at the neck, chest, and flank regions with milk yield in both indigenous and crossbred cattle. A negative and statistically significant correlation ($P < 0.01$) between milk yield and skin thickness was observed. Buffaloes with thin skin exhibited higher milk yields compared to those with medium and thick skin, as reported by Dhillod et al. [14]. This finding aligns with the results of Bhardwaj [8] study, which similarly noted significantly higher milk yields in buffaloes with thin skin. These findings are consistent with the outcomes of the present study. Additionally, Bhatnagar and Kumar [12] proposed that animals with thin skin possess greater heat dissipation capabilities, potentially leading to enhanced milk production efficiency, particularly in warmer climates.

Notably, Desai and Sharma [15] reported positive and significant correlations between skin thickness with milk yield in Hariana cattle, contrasting with the present study. The current findings diverge from those reported by Dahiya et al. [16], wherein first lactation milk yield demonstrated the strongest correlation with hip bone distance (0.52), followed by top wedge angle (0.42). These results imply the potential utility of these morphometric measurements for early prediction of first lactation milk yield in Murrah buffaloes [17,18].

In our investigation, second lactation milk yield displayed positive associations with hip width and skin thickness, while exhibiting negative correlations with brisket size and muzzle width. These observations underscore the noteworthy interrelation between morphometric characteristics, particularly skin thickness, and lactation yield in Murrah buffaloes.

4. CONCLUSION

In summary, a notable discovery from the current investigation is the identification of negative correlations between brisket width, muzzle width, and hip width with both first and third lactation milk yield in Murrah buffaloes. Conversely, certain parameters, specifically skin thinness at the neck region, exhibited positive correlations with all three lactation yields. Additionally, a positive correlation was observed between hip girth and second lactation yield. Consequently, these two traits, namely skin thinness at the neck region and hip girth, hold potential as selection indicators for identifying high-producing Murrah buffaloes under field conditions, particularly in the absence of specific milk production records. However, further research is warranted to delve into these relationships comprehensively, facilitating informed selection practices based on these identified morphometric traits.

ETHICAL APPROVAL

The procedures were carried out in adherence to the protocols outlined by the Institutional Ethics Committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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