

# Study on Association of Skin Thickness Measurements and Milk Production in Murrah Buffaloes

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## Abstract

*The present study was planned to find out the skin thickness and its relationship with milk yield in Murrah buffaloes. The experiment was conducted at ABIS Buffalo Dairy Farm, Rajnandgaon on 300 milking Murrah buffaloes. The data was statistically analyzed using R statistical software. The average skin thickness of neck, chest, abdomen, rump, hind quarter, udder and flank regions were  $6.27 \pm 0.11$ ,  $6.13 \pm 0.13$ ,  $7.28 \pm 0.14$ ,  $9.78 \pm 0.15$ ,  $8.00 \pm 0.12$ ,  $4.14 \pm 0.09$  and  $8.53 \pm 0.12$  mm respectively. In this study the skin fold thickness of neck and chest region had highly significant effect, whereas skin thickness of other regions under study had no significant effect on total lactation milk yield. The study indicated that except udder region the correlation of all skin thickness with TMY was found to be negative and significant. The regression coefficient indicated that an increase in skin thickness by 1 mm at different places would cause a decrease in average total lactation milk yield up to 135 liters. These results could facilitate the use of skin fold thickness in selection of better animals under field conditions.*

**Keywords:** Correlation, Milk Yield, Murrah Buffaloes, Skin Thickness

## Introduction

Buffaloes play very important role in Indian agriculture. It is reported that about 73.77 % of world buffalo population are found in South Asia including India. In India, the total buffalo population is recorded 109.85 million and about 51% of total milk production is shared by these animals, 20<sup>th</sup> Livestock Census, Govt. of India (2019). As there has been an immense increase in the human population, buffaloes therefore hold the greatest promise and potential for milk production. Out of 16 registered breeds of buffaloes of India, Murrah buffalo is the most important breed that is known for its high milk yield potential. The home tract of this breed stretches around Southern parts of Haryana state in India. Murrah breed has been used extensively in foreign countries to improve the milk production of dairy buffalo in other countries like Brazil, Italy, Bulgaria and Egypt. Milk yield is an important selection criterion in buffalo breeding programme. Some morphological features like body length, chest girth, abdominal girth, body depth, hip bone distance, pin bone distance, height at wither, muzzle width, tail length, udder dimension and skin thickness are considered important for selection of dairy buffaloes. The extensive study on physical appearance of most of exotic cattle breeds has been carried out in various parts of the world. However, such type of information is insufficient especially the concepts of body parts measurements and milk yield relationship in dairy buffaloes is very recent Dhillod *et al.* (2017). Although conflicting reports have been published regarding the relationship of skin thickness with milk production in buffaloes, it is however, essential to study further about the skin thickness of dairy breeds of buffalo. As scanty literature is available for the relationship of skin thickness with milk production, the present study was, therefore, conducted to find out the variability of skin thickness of Murrah buffaloes in relation to their milk production.

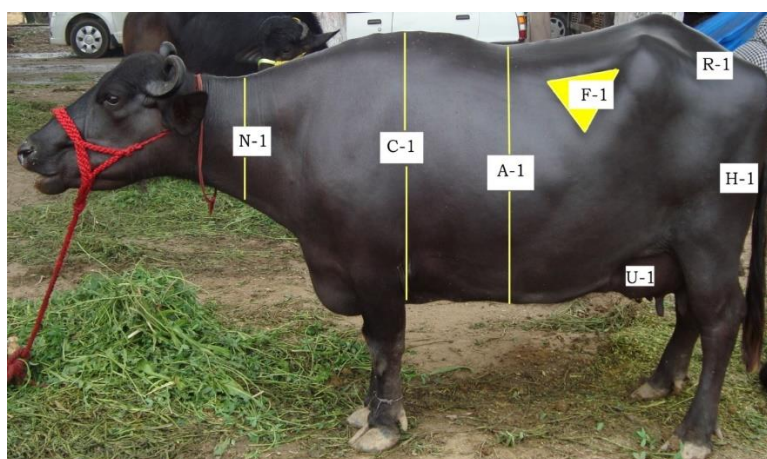
## Material and Methods

### Ethical Approval

All the procedures have been conducted in accordance with the guidelines laid down by the Institutional Ethics Committee.

### Source of Data

The data on skin fold thickness of Murrah buffaloes were obtained from ABIS Buffalo Dairy Farm, Gormara, Rajnandgaon (Chhattisgarh) to investigate the variability of skin thickness and its relation with milk production. A total of 300 milking Murrah buffaloes in a range of first to sixth parity (lactation period) were selected for the present experiment. The total lactation milk yield was recorded over an average period of 238- 271 days lactation length.



**Figure 1:** Seven sites of skin fold thickness

In the study the skin fold thickness of all the 300 selected Murrah buffaloes were recorded three times, in an interval of one month. The data on skin fold thickness of the selected animals were measured using Digital Vernier Callipers. The procedure for measuring skin fold thickness in seven regions of animal body Neck, Chest, Abdomen, Hind quarter, Rump, Udder and Flank was as per the standard procedure given by Dhillod *et al.* (2017). As skin thickness

was double the actual thickness, therefore, it was divided by two from skin fold thickness measurements so as to get actual skin thickness. The data on total lactation milk yield was classified and coded on the basis of skin fold thickness of eight regions (3 levels; thin, moderate and thick) and parity (5 levels; 1-6). The data collected for skin thickness were classified into thin, moderate and thick categories based on Struge's formula given by Sturges (1926).

### Statistical Analysis

The summary statistics of skin thickness and other parameters was estimated using *basic statistical package R* statistical software R 3.6.3 version R environment (2020). The relationship (correlation and regression) between total lactation milk yield and skin thickness of different regions was done by using *basic statistical package* of R statistical software R 3.6.3 version R environment (2020). The linear model function (*lm*) of R statistical software (R 3.6.3 version) was used to test the significance of different skin fold thickness and parity on milk yield of Murrah buffaloes. The linear model used was as follows:

$$Y_{ijklmnopq} = \mu + P_i + SN_j + SC_k + SA_l + SF_m + SH_n + SU_o + SR_p + e_{ijklmnopq}$$

Where,

$Y_{ijklmnopq}$  =  $q^{\text{th}}$  milk yield observation of Murrah buffalo under the effect of at  $i$ -th parity,  $j$ -th neck thickness,  $k$ -th chest thickness,  $l$ -th abdomen thickness,  $m$ -th flank thickness,  $n$ -th hind quarter thickness,  $o$ -th udder thickness,  $p$ -th rump thickness;  $\mu$  overall least square mean;  $P_i$  the  $i^{\text{th}}$  fixed effect of Parity ;  $SN_j$  the  $j^{\text{th}}$  fixed effect of neck thickness;  $SC_k$  the  $k^{\text{th}}$  fixed effect of chest thickness;  $SA_l$  the  $l^{\text{th}}$  fixed effect of abdomen thickness;  $SF_m$  the  $m^{\text{th}}$  fixed effect of flank thickness;  $SH_n$  the  $n^{\text{th}}$  fixed effect of hind quarter thickness;  $SU_o$  the  $o^{\text{th}}$  fixed effect of udder thickness;  $SR_p$  the  $p^{\text{th}}$  fixed effect of rump thickness and  $e_{ijklmnopq}$  the random error or residual of  $Y_{ijklmnopq}$

The significance of the fixed effects was analyzed by using the Duncan's multiple range test using the *agricolae* package of R statistical software (R 3.6.3 version).

## Results and Discussion

### Descriptive Statistics

The skin thickness was measured from seven sites or regions namely neck, chest, abdomen, rump, hind quarter, udder and flank in different lactation/parity of Murrah buffaloes are presented in Table 1. The skin thickness of udder found to be minimum followed by that in ascending order of chest, neck, abdomen, hind quarter, flank and rump of Murrah buffalo. The plane of nutrition might be the important factor in determining the extent of which the skin thickness of an individual differs from the breed average. The plan of nutrition influences the thickness of adipose tissue layer and the expansion and consistency of corium.

**Table 1:** Mean skin thickness (mm) of various region in Murrah buffaloes

Regions	Mean $\pm$ S.E.
Neck	6.27 $\pm$ 0.11
Chest	6.13 $\pm$ 0.13
Abdomen	7.28 $\pm$ 0.14
Rump	9.78 $\pm$ 0.15
Hind quarter	8.00 $\pm$ 0.12
Udder	4.14 $\pm$ 0.09
Flank	8.53 $\pm$ 0.12
Overall average skin thickness	7.16 $\pm$ 0.12

### Estimates of Fixed Effects

The analysis of variance revealed that the effect of observed that effect of parity had significant effect on total lactation milk yield. In this study the skin fold thickness of neck and chest region had highly significant effect

( $P < 0.01$ ) on total lactation milk yield of Murrah buffaloes whereas skin fold thickness of other regions under study had no significant effect on total lactation milk yield. The estimates of parity effects and skin fold thickness on total lactation milk yield are presented in Table 2. It was also observed that highest total milk yield was recorded in cows under low skin thickness of neck, chest, rump and hind quarter, moderate skin thickness of abdomen and udder and thick skin of flank regions. More milk yield from thick skin of flank region may be due to under- skin fat deposits in the animals. All the lactating animals under thick skin at different region were found to be lowest milk producing animals. This might be the fact that animals under thin and moderate skin thickness did not deposit extra fat in their body and utilized most of their energy for milk production. On the other hand, thick skin thickness Murrah buffalo cows probably might have deposited fat in their body and did not convert all their intake energy for milk production. Bharadwaj *et al.* (2007) found higher milk yield in buffaloes having thin skin than medium and thick-skinned animals. Animals with thin skin could dissipate more heat and thus be more efficient for the production of milk in warm regions.

**Table 2:** Least Square mean  $\pm$  S.E. of Total Milk Yield (TMY) affected by different skin fold thickness in Murrah buffaloes

Effect		Mean $\pm$ S.E.
Overall Mean $\pm$ S.E.		1541.25 (300) $\pm$ 25.96
Stage of lactation	1 <sup>st</sup>	1530.29 (115) <sup>NS</sup> $\pm$ 54.65
	2 <sup>nd</sup>	1525.66 (85) <sup>NS</sup> $\pm$ 20.89
	3 <sup>rd</sup>	1567.80 (100) <sup>NS</sup> $\pm$ 44.07
Parity	1 <sup>st</sup>	1305.73 (120) <sup>b</sup> $\pm$ 51.96
	2 <sup>nd</sup>	1674.90 (70) <sup>c</sup> $\pm$ 47.11
	3 <sup>rd</sup>	1853.09 (55) <sup>d</sup> $\pm$ 60.60
	4 <sup>th</sup>	2064.16 (20) <sup>e</sup> $\pm$ 47.28
	5 <sup>th</sup>	1316.01 (20) <sup>b</sup> $\pm$ 42.96
	6 <sup>th</sup>	1033.62 (15) <sup>a</sup> $\pm$ 50.76
Neck	Thin	1684.04 (100) <sup>c</sup> $\pm$ 34.14
	Moderate	1540.80 (100) <sup>b</sup> $\pm$ 36.01
	Thick	1398.91 (100) <sup>a</sup> $\pm$ 44.69
Chest	Thin	1629.83 (100) <sup>c</sup> $\pm$ 40.72
	Moderate	1474.90 (120) <sup>b</sup> $\pm$ 37.35
	Thick	1519.03 (80) <sup>a</sup> $\pm$ 42.54
Abdomen	Thin	1545.81 (125) <sup>NS</sup> $\pm$ 42.24
	Moderate	1558.05 (90) <sup>NS</sup> $\pm$ 44.05
	Thick	1519.89 (85) <sup>NS</sup> $\pm$ 35.30
Rump	Thin	1601.64 (100) <sup>NS</sup> $\pm$ 32.09
	Moderate	1539.00 (100) <sup>NS</sup> $\pm$ 34.78
	Thick	1483.12 (100) <sup>NS</sup> $\pm$ 42.89
Hind quarter	Thin	1571.62 (88) <sup>NS</sup> $\pm$ 39.15
	Moderate	1540.60 (115) <sup>NS</sup> $\pm$ 36.97
	Thick	1511.53 (97) <sup>NS</sup> $\pm$ 35.04
Udder	Thin	1528.48 (146) <sup>NS</sup> $\pm$ 31.61
	Moderate	1562.00 (100) <sup>NS</sup> $\pm$ 34.42
	Thick	1533.27 (54) <sup>NS</sup> $\pm$ 43.86
Flank	Thin	1507.30 (107) <sup>NS</sup> $\pm$ 35.84
	Moderate	1555.82 (132) <sup>NS</sup> $\pm$ 36.70
	Thick	1560.63 (61) <sup>NS</sup> $\pm$ 38.70

Superscripts are depicted significant at  $P < 0.01$ ) NS = Non-Significant

The present study is corroborated with the earlier workers Barati *et al.* (2017) where they found that the flank and udder region having thin skin fold yielded significantly ( $P < 0.01$ ) greater milk than thick skinned animals and the neck region with moderate thickness of skin produced significantly ( $P < 0.01$ ) more milk. The significant effect of skin fold thickness of on milk yield was also reported by Jian *et al.* (2014), Dhillod *et al.* (2017) in Murrah buffaloes, Gavan and Constantin (2019) in HF cows, Prabhakar *et al.* (2018) in Tharparkar cattle and Zhang *et al.* (2019) in Chinese HF cows respectively.

## Relationship between Skin Thickness and Milk Yield

The correlation co-efficient between skin thickness of different regions and milk yield is depicted in Table 3. The results showed that correlation coefficient between the skin thickness of neck, chest, abdomen, rump, hind quarter, udder and flank and TMY in Murrah buffalo cows were - 0.377, - 0.498, -0.355, -0.282, -0.207, 0.073 and -0.072 respectively. The study indicated that except udder region the correlation of all skin thickness with TMY was found to be negative and significant. The maximum correlation was found between skin thickness of chest and TMY ( $r = -0.49$ ). Similar negative correlations with different skin fold thickness and total milk yield was also reported by Hamid *et al.* (2000), Dhillod *et al.* (2017) in Murrah buffaloes, Gavan and Constantin (2019) in HF cows and Zhang *et al.* (2019) in Chinese HF cows; respectively. The regression coefficient for total milk yield with skin thickness of various sites is given in Table 3. The results indicated that an increase in skin thickness of neck, chest, rump and hind quarter would decrease in average TMY, whereas increase in skin thickness of udder will cause increase in average TMY. Regression co-efficient (Table 3) indicated that an increase in skin thickness by 1 mm at different places would cause a decrease in average total lactation milk yield up to 135 liters in total lactation. Hamid *et al.* (2000) reported that an increase in thickness by 1 mm at different places would cause a decrease in average lactation milk yield by 127 litre in crossbred cows of Bangladesh. Dhillod *et al.* (2017) reported that an increase in thickness by 1 mm at different places would cause a decrease in average milk yield by 102 litre in Murrah buffaloes. Prabhakar *et al.* (2018) reported that an increase in thickness by 1 mm at different places would cause a decrease in average milk yield by 114 litre in Tharparkar cattle.

**Table 3:** Correlation co-efficient (r) and Regression of different skin thickness with total milk yield in Murrah buffaloes

Skin Thickness Measurement Sites	Total Milk Yield	Intercept $2294.24 \pm 260.17$
Neck	-0.377**	-27.22± 44.51
Chest	-0.498**	-135.24± 39.84
Abdomen	-0.355*	-0.95 ± 39.84
Rump	-0.282**	-16.22 ± 26.81
Hind quarter	-0.207*	-29.58 ± 37.64
Udder	0.0730 <sup>NS</sup>	88.89 ± 35.64
Flank	-0.072 <sup>NS</sup>	-32.00 ± 36.87

\*\* Significant at  $P < 0.05$  level \* Significant at  $P < 0.01$  level NS = Non-significant

## Conclusion

It can be inferred from the study that differences in milk yield exist due to variation in skin thickness of different body region in Murrah buffaloes. The animals with thin and moderately thick skin were found to produce higher amount of milk with a greater flow rate compared to thick skinned animal. The use of skin fold thickness is beneficial to monitor changes in body fat deposition with increasing days in milk of the animals. These results could facilitate further exploration in the use of skin fold thickness for management precision and can be useful in selection of better animals under field conditions.

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## Conflict of Interests

There is no conflict of interest.

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