

## Importance of mammary system conformation traits in selection of Jaffarabadi buffaloes for milk production

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### ABSTRACT

A study was carried out to know the relationship between variation in mammary system conformation traits and milk yield in Jaffarabadi buffaloes. 150 buffaloes selected from dairy farms located in and around Hyderabad were utilized for the study. Among udder shapes, bowl shaped udder was most common followed by globular, pendulous and goaty udder with 53.3%, 26.66%, 16% and 4%, respectively and cylindrical shaped teats was most common followed by conical, funnel, pear and bottle shapes with 48.0%, 22.66%, 13.33%, 10% and 6%, respectively. The average udder length, width and depth in buffaloes ranged from 62.64 ± 0.74 (globular udder) to 67.81 ± 1.03 cm (pendulous udder), 50.51 ± 0.35 (bowl udder) to 54.07 ± 1.35 cm (goaty udder) and 17.26 ± 0.27 cm (bowl udder) to 20.25 ± 0.74 cm (goaty udder), respectively. Positive and highly significant (P<0.01) phenotypic correlation observed among three udder biometrics, indicating their close inter-relation. The mean teat lengths recorded for left fore, right fore, left hind and right hind teats were 7.69 ± 0.10 cm, 7.79 ± 0.11cm, 8.63 ± 0.16 cm and 8.67 ± 0.16 cm, respectively. The mean teat diameter ranged from 3.09 ± 0.06 cm (globular udder) to 3.57 ± 0.31 cm (goaty udder). Teat diameter was highest in goaty udder followed by pendulous, bowl and globular shaped udders. The mean milk yield/day in Jaffarabadi buffaloes with different udder shapes recorded was 8.48 ± 0.11, 8.12 ± 0.16, 7.97 ± 0.14 and 7.82 ± 0.13 Kg in bowl, globular, pendulous and goaty udders, respectively. The mean milk yield/day in various teat shapes recorded were 8.61 ± 0.12, 8.33 ± 0.27, 8.23 ± 0.15, 8.08 ± 0.18 and 7.67 ± 0.13 Kg in cylindrical, bottle, funnel, pear and conical shaped teats, respectively. Positive and highly significant (P<0.01) correlation observed between mammary system conformation traits and milk yield. The study concludes that, Jaffarabadi buffaloes with bowl shaped udder and cylindrical shaped teats were found to give more milk, Hence, these udder conformation traits may be helpful in their selection for higher milk yields.

**KEY WORDS:** Jaffarabadi buffalo, Milk Yield, Teat biometrics, Teat shape, Udder biometrics, Udder shape.

### INTRODUCTION

Livestock sector is an important component of India's economy in terms of income, employment and foreign exchange earnings. Buffalo occupies an important place in livestock economy of Asian region including India because of their adaptability

to harsh climatic conditions, tolerance to tropical diseases and poor management practices. They are valued for triple purpose i.e. milk, meat and draft power and well adapted to hot and humid climate, as they are known for their hardiness, cud chewing habit and higher milk fat content. Farmers with poor quality fodders, buffalo is advantageous over cattle due to their efficiency in digesting the dry matter and cellulose. Buffaloes are a vital source of income and employment especially to the weaker sections comprising landless labourers, marginal farmers and small farmers who form the majority in rural India.

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Buffaloes play a distinct role in improving the rural economy, which is primarily based on agricultural production systems. In fact, these animals can be considered as a financial asset since they serve as an insurance against the risk of crop failure due to natural calamities<sup>11</sup>. Buffaloes contribute for major volume of the total milk produced in India, even though their population is less compared to that of the cattle. India has emerged as the world's largest milk producer and milk production continues to grow at a fairly high rate. India ranks first in milk production, accounting for 18.5% of world production. Milk production in India during the period 1950-51 to 2015-16, has increased from 17 million tons to 155.5 million tons as compared to 146.3 million tons during 2014-15 recording around 6.27% growth<sup>4</sup>. Mammary gland (Udder) is one of the most important physiological and conformational characteristics of all dairy animals. It is the first site of judgment of local brokers or dairy farmers in our country for judging and selecting for their milking ability. Mammary system traits like udder shape, size of teats and placement of teats are the points to be considered in selection programme. It was reported<sup>31</sup> that both morphological and physiological mammary properties affect the milk yield in cattle and also reported<sup>21</sup> that udder and teat characteristics/measurements could be used as a reliable source for selection of buffaloes for milk production, but not much research was done on the udder and teat morphology and their relationship with milk yield in Jaffarabadi buffaloes. Therefore, the present study is aimed to study the udder and teat biometrics in relation to the milk production in Jaffarabadi buffaloes.

## **MATERIALS AND METHODS**

The influence of udder and teat morphology on milk yield in Jaffarabadi buffaloes was carried out at various private dairy farms located in and around Hyderabad. Animals were kept in similar enclosures by all the farm owners including infrastructure of farms so that there was no farm effect observed as such. A total of 150 Jaffarabadi milch buffaloes were selected and were kept in a closed housing system (tail to tail type), provided with sufficient space. They were fed roughages ad-lib consisting of mixture of

green fodders available in surrounding areas of dairy farms and concentrates were offered during milking, both at morning and evening as per the requirement. They were milked twice in a day and strict sanitary measures were taken before and after milking.

The udder shapes were classified basing on the visual appraisal as Bowl, Globular, Goaty and Pendulous shaped. Similarly, teat shapes were classified as Conical, Bottle, Pear, Cylindrical and Funnel shaped. The physical measurements taken on the udder were udder length, udder width and udder depth, while measurements taken on teats were teat length and teat diameter as followed<sup>21</sup>. The study was conducted during the period from May 2017 to August 2017. All the buffaloes were hand milked two times a day i.e. in morning (5.00 to 6.00 am) and evening (5.00 to 6.00 pm).

## **Statistical analysis**

The data obtained on various udder and teat parameters and milk yields were analyzed using SPSS statistical package (version 12.0.1). Analysis of variance was utilized to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan's Multiple Range and F Test<sup>12</sup>.

## **RESULTS AND DISCUSSION**

### **Shape of Udder**

The results of the present study showed that the occurrence of bowl shaped udder was more among Jaffarabadi buffaloes (Table 1 & Fig.1). The findings were similar to the reports in Murrah<sup>21</sup>, in Nagpuri<sup>30</sup> and in Nili ravi<sup>1</sup> buffaloes. The incidence of bowl, globular, pendulous and goaty shaped udders in the present study was 53.3%, 26.66%, 16% and 4%, respectively. The percentage of bowl-shaped udder found in the present study was less than those reported<sup>1&21</sup>, but greater than those reported<sup>5,28&30</sup>. The results revealed that more number of buffaloes with bowl shaped udders were present with the farmers, indicating that the farmers preferred this type of udder for milking as Jaffarabadi buffaloes with bowl shaped udder yielding more milk. These results were in accordance to the findings of<sup>8,10,13&</sup> and other researcher<sup>6</sup> also reported that udder of

this shape was more desirable than other shapes of udders for their high milk yielding ability.

In the present study, the goat shaped udders were less, and less than the reports of<sup>9,21&30</sup> and

more than those reported<sup>1&29</sup>. The less frequency with regard to the goat shaped udders in Jaffarabadi buffaloes may be due to the low milk yield and more time consuming for milking.



*a. Bowl Shaped Udder*



*b. Globular Shaped Udder*



*c. Pendulous Udder*



*d. Goaty Udder*

*Fig.1: Different Udder Shapes recorded in Jaffarabadi Buffaloes*

### **Shape of Teats**

The occurrence of cylindrical shaped teats was maximum among the Jaffarabadi buffaloes

studied (Table 1 & Fig. 2). The results of the present study were consistent with the findings of several researchers<sup>1,5,20,21,23,27,28&33</sup>, who recorded majority of buffaloes had cylindrical shaped teats.

*Importance of mammary system*



*a. Cylindrical Shaped Teats*



*b. Pear Shaped Teats*



*c. Conical Teats*



*d. Bottle Shaped Teats*



*e. Funnel Shaped Teats*

*Fig. 2: Different Teat Shapes recorded in Jaffarabadi Buffaloes*

However, a researcher<sup>14</sup> reported that conical shaped teats were predominant over other shapes in buffaloes and another researcher<sup>24</sup> reported, funnel shaped teats were predominant over other shapes in cows. In the present study, the percentage of bottle

shaped teats were found to be less but in contrary to our findings, a higher percentage was reported few workers<sup>2&21</sup>. Also, the percentage of funnel shaped teats observed in the present study was more than the reports of few researchers<sup>1&21</sup>.

**Table 1. Frequencies and percentages of Udder and Teat shapes in Jaffarabadi buffaloes**

Parameter	Frequency	Per cent
<b>Udder shape:</b>		
Bowl	80	53.33
Globular	40	26.66
Pendulous	24	16.00
Goaty	6	4.00
<b>Teat shape:</b>		
Cylindrical	72	48.00
Conical	34	22.66
Funnel	20	13.33
Pear	15	10.00
Bottle	9	6.00

#### Udder Biometrics

The mean and SE values of udder length (UL), udder width (UW) and udder depth (UD) for different udder shapes in Jaffarabadi buffaloes (Table 2 &

Fig. 3), ranged from  $62.64 \pm 0.74$  (globular udder) to  $67.81 \pm 1.03$  cm (pendulous udder),  $50.51 \pm 0.35$  (bowl shaped udder) to  $54.07 \pm 1.35$  cm (goaty udder) and  $17.26 \pm 0.27$  cm (bowl shaped udder) to  $20.25 \pm 0.74$  cm (goaty udder), respectively.

**Table 2. Udder biometrics (cm) in Jaffarabadi buffaloes according to udder shapes**

Udder shape	No. of Buffaloes	Udder length	Udder width	Udder depth
		(Mean $\pm$ SE)		
Bowl	80	$66.63^{ab} \pm 0.79$	$50.51^a \pm 0.35$	$17.26^a \pm 0.27$
Globular	40	$62.64^a \pm 0.74$	$50.66^a \pm 0.50$	$18.54^{ab} \pm 0.42$
Pendulous	24	$67.81^b \pm 1.03$	$53.63^b \pm 0.38$	$20.03^b \pm 0.55$
Goaty	6	$66.60^{ab} \pm 1.34$	$54.07^b \pm 1.35$	$20.25^b \pm 0.74$
<b>Overall Mean <math>\pm</math> SEM</b>	<b>150</b>	$65.75 \pm 0.52$	$51.19 \pm 0.26$	$18.16 \pm 0.22$

Means with similar superscripts within column do not differ significantly ( $P < 0.05$ )



a. Measurement of UL



b. Measurement of UW



c. Measurement of UD

Fig. 3: Udder Measurements recorded in Jaffarabadi Buffaloes

The perusal of Table 2 showing that, maximum UL was found in pendulous udder and maximum udder width UW in goaty shaped udder. These observations were in agreement with the findings of<sup>6</sup>, who reported higher UL observed in pendulous udders and maximum UW and udder depth (UD) were observed in goaty shaped udders. The overall mean udder measurements recorded in the present study are greater than the findings of<sup>6&21</sup> and udder width and depth were lesser than the findings of<sup>16&18</sup> in different breeds of buffaloes.

### Teat Biometrics

The mean values of teat measurements according to different udder shapes are presented

in Table 3 and Fig. 4. The overall mean values of teat lengths of left fore, right fore, left hind and right hind teats were  $7.69 \pm 0.10$  cm,  $7.79 \pm 0.11$ cm,  $8.63 \pm 0.16$  cm and  $8.67 \pm 0.16$  cm, respectively.

It was found that, goaty shaped udders having highest teat length followed by pendulous, globular and bowl shaped udders. Contrary to these findings, a researcher<sup>21</sup> observed longer teat length with pendulous udder, compared to other type of udders in Murrah buffaloes. It was reported by a worker<sup>3</sup> that the increase in length of teat might be due to increase in size of udder as per synthesis of mammary tissues with advancement of age.

Table 3. Teat measurements (cm) in Jaffarabadi buffaloes according to udder shapes

Udder shape	N	Teat length (Mean $\pm$ SE)				Avg. teat length	Teat diameter (Mean $\pm$ SE)				Avg. teat dia-meter
		Left fore	Right fore	Left hind	Right hind		Left fore	Right fore	Left hind	Right hind	
Bowl	80	7.64 <sup>a</sup> $\pm$ 0.15	7.71 <sup>a</sup> $\pm$ 0.15	8.38 <sup>a</sup> $\pm$ 0.20	8.55 <sup>a</sup> $\pm$ 0.20	8.07 <sup>a</sup> $\pm$ 0.16	3.06 <sup>a</sup> $\pm$ 0.04	3.06 <sup>a</sup> $\pm$ 0.04	3.23 <sup>a</sup> $\pm$ 0.04	3.27 <sup>a</sup> $\pm$ 0.04	3.16 <sup>a</sup> $\pm$ 0.04
Globular	40	7.56 <sup>a</sup> $\pm$ 0.18	7.73 <sup>a</sup> $\pm$ 0.21	8.69 <sup>a</sup> $\pm$ 0.30	8.46 <sup>a</sup> $\pm$ 0.35	8.11 <sup>a</sup> $\pm$ 0.24	3.01 <sup>a</sup> $\pm$ 0.07	2.96 <sup>a</sup> $\pm$ 0.07	3.18 <sup>a</sup> $\pm$ 0.07	3.23 <sup>a</sup> $\pm$ 0.08	3.09 <sup>a</sup> $\pm$ 0.06
Pendulous	24	8.00 <sup>a</sup> $\pm$ 0.26	8.06 <sup>a</sup> $\pm$ 0.27	9.29 <sup>a</sup> $\pm$ 0.48	9.28 <sup>a</sup> $\pm$ 0.42	8.65 <sup>a</sup> $\pm$ 0.33	3.01 <sup>a</sup> $\pm$ 0.06	3.03 <sup>a</sup> $\pm$ 0.06	3.38 <sup>ab</sup> $\pm$ 0.10	3.46 <sup>ab</sup> $\pm$ 0.10	3.22 <sup>a</sup> $\pm$ 0.07

Goaty	6	8.18 <sup>a</sup> ± 0.77	8.30 <sup>a</sup> ± 0.82	9.05 <sup>a</sup> ± 0.82	9.17 <sup>a</sup> ± 0.81	<b>8.68<sup>a</sup> ± 0.80</b>	3.44 <sup>b</sup> ± 0.32	3.44 <sup>b</sup> ± 0.32	3.65 <sup>b</sup> ± 0.30	3.75 <sup>b</sup> ± 0.29	<b>3.57<sup>b</sup> ± 0.31</b>
<b>Overall Mean ± SEM</b>	<b>150</b>	<b>7.69 ± 0.10</b>	<b>7.79 ± 0.11</b>	<b>8.63 ± 0.16</b>	<b>8.67 ± 0.16</b>	<b>8.20 ± 0.12</b>	3.05 ± 0.03	3.04 ± 0.03	3.26 ± 0.03	3.31 ± 0.04	3.17 ± 0.03

Means with similar superscripts within column do not differ significantly ( $P < 0.05$ )

The average teat diameter in different udder shapes (Table 3) ranged from  $3.09 \pm 0.06$  cm (globular shaped udder) to  $3.57 \pm 0.31$  cm (goaty shaped udder) in Jaffarabadi buffaloes. Contrary to these findings, a researcher<sup>21</sup> reported pendulous

udder teat diameter was more compared to other type of udders in Murrah buffaloes. The teat diameter was highest in goaty shaped udder followed by pendulous, bowl and globular shaped udders.



a. Measurement of Teat Length (cm)

b. Measurement of Teat Distance (cm)

c. Measurement of Teat Circumference (cm)

Fig. 4: Teat Measurements recorded in Jaffarabadi Buffaloes:

#### Udder and Teat Conformation Traits in relation to Milk Production

The average daily milk production in Jaffarabadi buffaloes with various udder shapes is depicted in Table 4. In the present study, bowl shaped udders yielded higher average daily milk yield compared to the other types of udders and the yields were  $8.48 \pm 0.11$ ,  $8.12 \pm 0.16$ ,  $7.97 \pm 0.14$  and  $7.82 \pm 0.13$

Kg in bowl, globular, pendulous and goaty shaped udders, respectively. These observations were corroborating the findings in cows<sup>8,10&13</sup>, in Friesian cows<sup>29</sup> and in Murrah buffaloes<sup>6&21</sup>. The results of the present study, suggesting that buffaloes with bowl shaped udder are to be recommended in selection and upgrading programmes due to their high milk yielding capacity compared to others.

Table 4. Daily milk production in Jaffarabadi buffaloes with various udder and teat shapes

Parameter	No. of Buffaloes	Total daily milk production (Mean ± SE; Kg)	Minimum (Kg)	Maximum (Kg)
<b>Udder shape (n=150):</b>				
Bowl	80	8.48 <sup>a</sup> ± 0.11	6.30	10.49
Globular	40	8.12 <sup>a</sup> ± 0.16	5.98	11.22
Pendulous	24	7.97 <sup>a</sup> ± 0.14	6.56	9.93
Goaty	6	7.82 <sup>a</sup> ± 0.13	7.17	8.01

<b>Teat shape (n=150):</b>				
Cylindrical	72	8.61 <sup>b</sup> ± 0.12	6.31	11.22
Conical	34	7.67 <sup>a</sup> ± 0.13	5.98	9.05
Funnel	20	8.23 <sup>ab</sup> ± 0.15	6.91	9.96
Pear	15	8.08 <sup>ab</sup> ± 0.18	7.17	9.93
Bottle	9	8.33 <sup>b</sup> ± 0.27	7.23	9.75
Total (Mean ± SEM)		8.28 ± 0.08	5.98	11.22

Means with similar superscripts within column do not differ significantly ( $P < 0.05$ )

The average daily milk production in Jaffarabadi buffaloes with various teat shapes are presented in Table 4. Udder with cylindrical shaped teats yielded more average milk compared to other type of teats and same findings were reported by several workers<sup>6,7,21&22</sup> in Murrah buffaloes, whereas, in contrary to this, other researchers<sup>10&25</sup> reported funnel shaped teats were associated with higher milk yields in cows.

The relationship between udder biometrics and milk production are presented in Table 5. There was positive correlation between udder measurements and milk yield. The correlation between udder measurements and average daily milk yield were highly significant ( $P < 0.01$ ) and similar results were reported<sup>32</sup>, with a conclusion that the milk yield was

significantly correlated ( $P < 0.01$ ) with each of the 3 udder measurements in Harijana cattle. It was also reported<sup>17</sup> that the correlation coefficients of milk yield with udder biometrics were positive and highly significant ( $P < 0.01$ ) in Kankrej and CB cows, while, other workers<sup>26</sup> reported that a positive and significant correlation ( $P < 0.05$ ) was found between total milk yield with UL and UW. Few researchers<sup>21</sup> also reported a positive correlation between the udder biometrics and the daily milk production in Murrah buffaloes. The average daily milk yield showed positive correlation with UW and UL as reported by<sup>6</sup> and the reports of<sup>16&18</sup> revealed that the correlations between milk yield and various udder measurements viz., UL (0.499), UW (0.413) and UD (0.178) were found positive and significant ( $P < 0.01$ ) in crossbred cows and buffaloes, respectively.

**Table 5. Correlation among udder biometrics and daily milk production**

	Mean Udder measurements			Mean Teat measurements		Average daily milk production (ADMP)
	Udder length (UL)	Udder width (UW)	Udder depth (UD)	Teat length (TL)	Teat diameter (TD)	
<b>UL</b>	1	0.410**	0.522**	0.135	0.156	0.441**
<b>UW</b>		1	0.588**	0.145	0.290**	0.325**
<b>UD</b>			1	0.349**	0.351**	0.338**
<b>TL</b>				1	0.581**	0.150
<b>TD</b>					1	0.161*
<b>ADMP</b>						1

\*Correlation is significant at 0.05 level (2-tailed)

\*\*Correlation is significant at 0.01 level (2-tailed)



Positive and significant correlation was observed among all udder measurements and the milk production in Jaffarabadi buffaloes (Table 5). The phenotypic correlation between udder length, udder width and udder depth were highly significant ( $P < 0.01$ ) is an indication of close inter relation between all the three udder traits. The results now recorded are corroborating with the findings in CB cows<sup>18</sup> and in buffaloes<sup>16</sup>.

The relationship between teat biometrics and milk production is also presented in Table 5. The correlation of average daily milk production with the average teat length, average teat diameter was found to be positive. However, significant correlation was observed between milk production and average teat diameter ( $P < 0.05$ ). Similar to the present study, some workers<sup>21</sup> reported positive correlation between average daily milk production and teat measurements such as teat length and teat diameter but found significance ( $P < 0.01$ ) only between the average teat diameter and milk yield in Murrah buffaloes and few other workers<sup>1</sup> also reported, average teat length and teat diameter had highly significant ( $P < 0.01$ ) and positive relationship with milk yield (0.315 and 0.494, respectively) in Nili-Ravi buffaloes.

## CONCLUSION

The findings of the present study justify that, the mammary system conformation traits can be effectively used for selection of buffaloes for milk production. The studies of<sup>f15&21</sup> in cows and Murrah buffaloes, respectively revealed that udder measurements are reliable criteria in selecting them for milk production. The other researcher<sup>17</sup> also revealed that the biometry of udder was related to milk yield and therefore could be considered as one of the criteria for selection of dairy animals. From the results of the present study, it may be concluded that Jaffarabadi buffaloes with bowl shaped udder and cylindrical shaped teats are to be recommended in selection for higher milk production capacity.

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