

E-ISSN: 2709-9369  
P-ISSN: 2709-9350  
[www.multisubjectjournal.com](http://www.multisubjectjournal.com)  
IJMT 2021; 3(2): 211-215  
Received: 20-10-2021  
Accepted: 04-12-2021

**Sangame AD**

Department of Livestock  
Production Management,  
College of Veterinary and  
Animal Sciences, Udgir.  
Maharashtra Animal and  
Fishery Sciences University  
(MAFSU), Nagpur,  
Maharashtra, India

**Pawar PH**

Department of Livestock  
Production Management,  
College of Veterinary and  
Animal Sciences, Udgir.  
Maharashtra Animal and  
Fishery Sciences University  
(MAFSU), Nagpur,  
Maharashtra, India

**Pawankar KN**

Department of Livestock  
Production Management,  
College of Veterinary and  
Animal Sciences, Udgir.  
Maharashtra Animal and  
Fishery Sciences University  
(MAFSU), Nagpur,  
Maharashtra, India

**Ramteke SS**

Department of Veterinary  
Clinical Complex, College of  
Veterinary and Animal  
Sciences, Udgir. MAFSU,  
Nagpur, Maharashtra, India

**Corresponding Author:**

**Sangame AD**

Department of Livestock  
Production Management,  
College of Veterinary and  
Animal Sciences, Udgir.  
Maharashtra Animal and  
Fishery Sciences University  
(MAFSU), Nagpur,  
Maharashtra, India

## **Study on morphometric and phenotypic characteristics of udder in Marathwadi buffalo in different stages of lactation**

**Sangame AD, Pawar PH, Pawankar KN and Ramteke SS**

**Abstract**

Five hundred Marathwadi female buffaloes from 1<sup>st</sup> to 5<sup>th</sup> parity was studied for their morphometric characters of udder and teat such as udder length, udder width, udder depth, teat length and teat diameter etc. The buffaloes were selected from five tehsils of Latur district and four groups were made based upon the stage of lactation i.e. up to 7<sup>th</sup> week, 7<sup>th</sup> to 14<sup>th</sup> week, 14<sup>th</sup> to 21<sup>st</sup> week and above 21<sup>st</sup> week. The phenotypic and morphometric characters were studied to know the correlation between selected characters and stage of lactation in different tahsils of Latur District. Maximum length of udder was recorded during 14-21 weeks of lactation, while minimum length was recorded during initial phase within 0-7 weeks of lactation.

**Keywords:** Marathwadi buffalo, stage of lactation, phenotypic, morphometric characters

**Introduction**

The home tract of Marathwadi buffaloes comprises Marathwada region of Maharashtra state. This breed derived its name from its home tract. These buffaloes are mainly found in Parbhani, Nanded, Beed, Osmanabad, Jalna, Aurangabad and Latur districts of Marathwada region. The Marathwada region of Maharashtra is enriched with Marathwadi breed of buffalo. This breed is entirely different from western i.e., Jaffrabadi, Mehsana, Surti and northern types i.e. Murrah, Nili Ravi and clearly represents a very ancient indigenous type characterized with lighter built and long flat horns (Joshi and Phillips, 1953)<sup>[10]</sup>.

Indiscriminate breeding of the buffaloes results in loss of the purebred character of the animal. Therefore, selection of the animals based on phenotypic and morphometric characters is one of the important criteria to reduce the loss of purebred character of the animals. Selection of the animals based upon the phenotypic and morphometric characters of teat and udder play a role in propagation of the character in subsequent generations which has significant effect on the production of the milk. (Abdullah *et al.*, 2013)<sup>[11]</sup>. In female animals Udder and teat morphology gives sure ideas regarding her supremacy for breeding purpose, its attachment and prominence of milk mirror and milk veins for lactation. Udder and teat measurements may vary in different lactations. Hence, an attempt has been designed to study the morphological variations in udder and teat morphology and their relation with different phases of lactations in Marathwadi buffaloes.

**Materials and Method**

The present experiment was conducted in Latur District of Marathwada region, Maharashtra, India twenty-five villages were selected and from each village 20 Marathwadi buffaloes with different stage of lactation (up to 7<sup>th</sup> weeks, 7-14 weeks, 14-21 weeks and above 21 weeks) were selected randomly for present study. Udder and teat measurement of total 500 Marathwadi individual female buffaloes was collected. Arrangement made to stand the animal on even surface and in normal position at the time of measurement. Measuring tape, vernier calliper and measuring metal scales were used for taking required measurements. Parameters like Udder length, Udder width, Udder Depth, udder shape, Teat length, Teat Diameter were studied during the experiment. The data collected during the study were statistically analyzed by using standard methods described by Snedecor and Cochran (1994).

**Result and Discussion**

Average udder length of udder of Marathwadi buffalo in Latur district at 0-7, 7-14, 14-21 and above 21 weeks of lactation were 50.34±0.84, 54.94±0.51, 58.47±0.41 and 55.62±0.46 cm respectively.

**Table 1:** Udder Length in Marathwadi Buffaloes (cm) as per stage of lactation

Stage of Lactation (Week)	Tehsils in Latur District					Overall Average n=500
	Ahmedpur n=100	Deoni n=100	Jalkot n=100	Nilanga n=100	Udgir n=100	
Up to 7 <sup>th</sup> n=125	49.50±1.68	48.98±2.40	50.04±2.29	51.38±1.58	51.80±1.29	50.34±0.84
7 <sup>th</sup> -14 <sup>th</sup> n=125	54.68±1.44	54.88±1.05	53.78±1.20	55.28±1.08	56.10±0.96	54.94±0.51
14 <sup>th</sup> -21 <sup>st</sup> n=125	58.68±1.09	57.60±1.24	59.01±0.64	57.79±0.68	59.30±0.83	58.47±0.41
Above 21 <sup>st</sup> n=125	55.12±0.92	55.14±0.99	56.03±1.13	55.82±1.17	55.98±0.96	55.62±0.46

Length of udder varies as per the advancement of the lactation order characteristically. During the entire phase of any parity order, udder length increased by 8.13 ± 0.62 cm. while average decrease in udder length after 21<sup>st</sup> weeks of lactation was 2.85±0.43 cm. In Marathwadi buffalo peak length of udder may be recorded during 14 to 21 weeks of lactation at any order of parity. Maximum length of udder was recorded during 14-21 weeks of lactation, while minimum length was recorded during initial phase within 0-7 weeks of lactation. This denoted that, peak length of udder can be measured at second order of lactation in case of Marathwadi buffalo.

Similar observation was also noted by Tayade *et al* (2010)<sup>[22]</sup>, he observed phenotypic characteristics of Gaolao strain of Nagpuri buffalo and reported that, with the advancement of age, udder width increased progressively up to 11 year of age. In Murrah buffalo, Prasad *et al.* (2010)<sup>[15]</sup> reported an increase in udder morphology with increase in parity. Abdullah *et al.* (2013)<sup>[1]</sup> also studied Nili- Ravi buffalo, and stated that, the Udder length showed the pattern of increasing size as lactation number increases. These findings are parallel to the findings of Bhuiyan *et al.* (2004)<sup>[6]</sup>.

**Table 2:** Udder Width in Marathwadi Buffaloes (cm) as per stage of lactation

Stage of Lactation (Week)	Tehsils in Latur District					Overall Average n=500
	Ahmedpur n=100	Deoni n=100	Jalkot n=100	Nilanga n=100	Udgir n=100	
Up to 7 <sup>th</sup> n=125	31.50±1.12	32.90±0.91	30.66±0.77	31.62±1.0	30.92±0.95	31.52±0.43
7 <sup>th</sup> -14 <sup>th</sup> n=125	36.24±1.43	35.84±0.94	33.24±0.95	32.46±0.87	32.78±0.76	34.11±0.47
14 <sup>th</sup> -21 <sup>st</sup> n=125	39.04±0.82	37.76±0.90	38.29±0.82	37.78±0.69	39.00±0.51	38.38±0.33
Above 21 <sup>st</sup> n=125	32.85±0.76	32.39±0.73	33.52±0.83	35.30±0.82	36.87±0.94	34.19±0.39

Average udder width of udder of Marathwadi buffalo in Latur district at 0-7, 7-14, 14-21 and above 21 weeks of lactation were 31.52±0.43, 34.11±0.47, 38.38±0.33 and 34.19±0.39 cm respectively. The width of udder found minimized after 14 weeks of lactation which denoted that, peak width of udder can be measured at second order of lactation. During the entire phase of any parity order, udder width increased by 6.86 ± 0.38 cm. while average decrease in udder width after 21<sup>st</sup> weeks of lactation was 4.19±0.36 cm. In Marathwadi buffalo peak width of udder may be recorded during 14 to 21 weeks of lactation at any order of parity.

of Nagpuri buffalo and reported that, with the advancement of age, udder width increased progressively up to 11 year of age. In Murrah buffalo, Prasad *et al.* (2010)<sup>[16]</sup> reported an increase in udder morphology with increase in parity. Abdullah *et al.* (2013)<sup>[1]</sup> also studied Nili- Ravi buffalo, and stated that, the Udder width showed the pattern of increasing size as lactation number increases. These findings are parallel to the findings of Bhuiyan *et al.* (2004)<sup>[6]</sup>. From the results obtained in concurrence to present investigation, it may be summarized that In Marathwadi buffalo average udder width ranged from 30.24±0.41 to 38.36±0.39 cm. with an average of 34.35±0.40 cm. The findings are in close agreement to the reports revealed by Prasad *et al.* (2010)<sup>[15]</sup>, Gubbawar *et al.* (2012)<sup>[9]</sup>.

Similar observation was also noted by Tayade *et al.* (2010)<sup>[22]</sup>, he observed phenotypic characteristics of gaolao strain

**Table 3:** Udder Depth in Marathwadi Buffaloes (cm) as per stage of lactation

Stage of Lactation (Week)	Tehsils in Latur District					Overall Average n=500
	Ahmedpur n=100	Deoni n=100	Jalkot n=100	Nilanga n=100	Udgir n=100	
Up to 7 <sup>th</sup> n=125	11.22±0.14	10.86±0.16	11.37±0.25	11.16±0.20	10.94±0.18	11.11±0.08
7 <sup>th</sup> -14 <sup>th</sup> n=125	12.00±0.19	12.35±0.18	11.87±0.26	11.67±0.25	11.95±0.22	11.97±0.10
14 <sup>th</sup> -21 <sup>st</sup> n=125	10.99±0.34	9.62±0.19	10.78±0.30	11.14±0.33	10.38±0.32	10.58±0.14
Above 21 <sup>st</sup> n=125	8.68±0.28	8.84±0.30	9.51±0.31	8.71±0.28	9.08±0.25	8.96±0.13

Average udder depth of Marathwadi buffalo in Latur district at 0-7, 7-14, 14-21 and above 21 weeks of lactation were 11.11±0.08, 11.97±0.10, 10.58±0.14 and 8.96±0.13 cm respectively. The variation in the depth of udder was characteristically related with parity and lactation order of Marathwadi buffalo. During the entire phase of any parity the average change in depth of udder in relation to the different lactation order varied in the range of 0.53 to 1.62

cm. Peak depth of udder can be measured at second order of lactation in case of Marathwadi buffalo.

Considering the overall results and discussions in regards of present investigation, it may be concluded that Marathwadi buffalo was found with medium sized udder in respect to the Udder depth. The findings are in close association with the studies reported by Prasad *et al.* (2012)<sup>[16]</sup>, Yosbanis (2013)<sup>[23]</sup> and Abdullah *et al.* (2013)<sup>[1]</sup>.

**Table 4:** Teat Length in Marathwadi Buffaloes (cm) as per stage of lactation

Stage of Lactation (Week)	Tehsils in Latur District					Overall Average n=500
	Ahmedpur n=100	Deoni n=100	Jalkot n=100	Nilanga n=100	Udgir n=100	
Up to 7 <sup>th</sup> n=125	6.00±0.24	5.76±0.25	5.66±0.29	5.47±0.31	5.9±0.27	5.70±0.12
7 <sup>th</sup> -14 <sup>th</sup> n=125	6.48±0.24	6.67±0.23	6.73±0.22	6.61±0.28	6.74±0.19	6.64±0.10
14 <sup>th</sup> -21 <sup>st</sup> n=125	5.87±0.14	6.07±0.27	5.98±0.23	5.89±0.17	5.77±0.18	5.92±0.09
Above 21 <sup>st</sup> n=125	5.26±0.15	5.40±0.15	5.14±0.13	5.35±0.14	4.80±0.16	5.19±0.06

The average change in teat length in concurrence to the different lactation order within any parity was found directly proportioned to the lactation order up to 14<sup>th</sup> weeks, while thereafter, found inversely proportioned with stage of lactation. During the entire phase of lactation, teat length varied from 0.22 to 1.73 cm. Average teat length of Marathwadi buffalo in Latur district at First, Second, Third, and Fourth stages of lactation were 5.70±0.12, 6.64±0.10, 5.92±0.09, and 5.19±0.06 cm respectively. During the entire phase of any parity, length of teat varies as the stage of lactation changes.

The numerical values for different levels of improvement of any phenotypic character might be species and breed specific. In the present study, it may be revealed that, the

average teat length in Marathwadi buffalo ranges from 4.63 ±0.08 to 7.07±0.08 cm. The highest values recorded for this parameter in buffaloes by Radekar *et al.* (2003) [17] and Lavania *et al.* (2011) [11] are found in close agreement with the results of present investigation. It was categorically observed and reported that, in Marathwadi buffalo, average teat length increased from first to fourth parity of lactation. Similar observations are recorded by Prasad *et al.* (2010) [15]. After fourth parity size of teat found contract up to 6.10±0.11 cm which might be due to advancement of age in animal. The studied teat parameter in the present investigation and its analysed findings are in close agreement with the reports revealed by Batra (1984) [4], Akhtar *et al.* (1999) [2] and Marai *et al.* (2001) [12].

**Table 5:** Teat Diameter in Marathwadi Buffaloes (cm) as per stage of lactation

Stage of Lactation (Week)	Tehsils in Latur District					Overall Average n=500
	Ahmedpur n=100	Deoni n=100	Jalkot n=100	Nilanga n=100	Udgir n=100	
Up to 7 <sup>th</sup> n=125	5.16±0.30	5.35±0.34	5.30±0.36	4.96±0.33	4.75±0.32	5.10±0.14
7 <sup>th</sup> -14 <sup>th</sup> n=125	5.76±0.41	5.88±0.46	5.56±0.45	5.56±0.41	5.73±0.43	5.70±0.19
14 <sup>th</sup> -21 <sup>st</sup> n=125	4.35±0.28	4.50±0.27	4.96±0.31	4.44±0.27	4.30±0.23	4.51±0.12
Above 21 <sup>st</sup> n=125	3.69±0.19	3.94±0.17	3.59±0.19	3.36±0.17	3.74±0.16	3.66±0.08

Average Teat diameter of Marathwadi buffalo in Latur district at First, Second, Third, and Fourth stages of lactation were 2.55±0.07, 2.85±0.09, 2.25±0.06, and 1.83±0.04 cm respectively. The average increase observed in teat diameter from onset of lactation up to 14<sup>th</sup> week was recorded 0.30 cm. However, from 14<sup>th</sup> week onward, there was gradual decrease in teat diameter. In present study average decrease in teat diameter after second stage of lactation was 1.83 cm. Thus, the recorded average variation in teat diameter in respect to lactation order was ranged from 0.30 to 1.83 cm. During the entire phase of any parity, stage of lactation categorically affects teat diameter in Marathwadi buffalo.

From the results obtained in present study, it may be revealed that, the average diameter of teat in Marathwadi buffalo ranged from 1.50±0.04 to 3.20±0.08 cm. however

the order of parity showed linear correlation with diameter. Results for the average teat diameter recorded are in close agreement of Akhtar *et al.* (1999) [2]. Marai *et al.* (2001) [12] reported that, parity affected udder traits in-significantly. He also reported that, teat size (length and diameter) tended to decrease after fourth month of lactation, thus the findings reported by Marai *et al.* (2001) [12] strongly supports the results obtained in present investigation, however the findings reported by Lavania *et al.* (2011) [11] are not in agreement.

Hence from the results obtained and discussed with the support of available similar studies related to present investigation, it may be concluded that, Marathwadi buffalo found with teats of medium diameter, further it is reported that, parity affects teat diameter characteristically.

**Table 6:** Udder Shape in Marathwadi Buffaloes as per Stage of Lactation

Udder shape	Stage of Lactation				Overall n=500
	Up to 7 <sup>th</sup> week n=125	7 <sup>th</sup> -14 <sup>th</sup> week n=125	14 <sup>th</sup> -21 <sup>st</sup> week n=125	Above 21 <sup>th</sup> week n=125	
Trough	16.8% (n=21)	19.2% (n=24)	21.6% (n=27)	20% (n=25)	19.4% (n=97)
Bowl	55.2% (n=69)	44.8% (n=56)	35.2% (n=44)	44% (n=55)	44.8% (n=224)
Round	26.4% (n=33)	31.2% (n=39)	31.2% (n=49)	33.6% (n=42)	32.6% (n=163)
Pendulous	1.6% (n=2)	4.8% (n=6)	4% (n=5)	2.4% (n=3)	3.2% (n=16)

Irrespective of parity, the shape of udder in Marathwadi buffalo in its different lactation orders showed percentile average as 19.4% Trough, 44.8% Bowl shaped, 32.6% Round and 3.2% Pendulous shaped udder. Bowl shape of udder is prominently observed in Marathwadi buffalo followed by round shape and trough type. Very scanty population of Marathwadi buffalo bears pendulous shaped udder. Overall observations regarding the shape of udder in

Marathwadi buffalo in its different parities showed percentile average as 19.4% Trough, 44.8% Bowl shaped, 32.6% Round and 3.2% pendulous shaped udder. From the results it may be revealed that, bowl shape of udder was prominently observed in Marathwadi buffalo followed by Round shape and trough type. Very scanty population of Marathwadi buffalo bears pendulous shaped udder. The findings recorded and the results obtained are in close

agreement with Chaki (1999) [7], Sonwane *et al.* (2002) [21], Bainwad *et al.* (2007) [3] and Sonwane (2015) [20]. From the results it may be revealed that, bowl shape of udder is prominently observed in Marathwadi buffalo followed by round shape and Trough type. Very scanty population of Marathwadi buffalo bears pendulous shaped udder. The similar observations are reported by Rao *et al.* (1991) [18] in buffalo. Bharadwaj (2007) [5] reported that shape of udder were associated with milk production. Significantly higher milk yield was obtained in buffaloes having long and deep udders with higher rear attachment than those having short

and shallow udders with low rear attachment. From the above results, it may be summarized that considering the low production potential of Marathwadi buffalo reported by Maske (2014) [13], the results obtained in present investigation were in association with the fact. From the results it may be concluded that, bowl shape of udder was prominently observed in Marathwadi buffalo followed by round shape and trough type. Very scanty population of Marathwadi buffalo bears pendulous shaped udder. The similar observations are reported by Rao *et al.* (1991) [18] in buffalo.

**Table 7:** Teat Shape in Marathwadi Buffaloes as per Stage of Lactation

Teat shape	Stage of Lactation				Overall n=500
	Up to 7 <sup>th</sup> week n=125	7 <sup>th</sup> -14 <sup>th</sup> week n=125	Up to 7 <sup>th</sup> week n=125	7 <sup>th</sup> -14 <sup>th</sup> week n=125	
Cylindrical	43.2% (n=54)	50.4% (n=63)	52% (n=65)	51.2% (n=64)	49.2% (n=246)
Funnel	27.2% (n=34)	25.6% (n=32)	24% (n=30)	21.6% (n=27)	24.6% (n=123)
Pear/Bottle	21.6% (n=27)	19.2% (n=24)	17.6% (n=22)	19.2% (n=24)	19.4% (n=97)
Conical	8% (n=10)	4.8% (n=6)	6.4% (n=8)	8% (n=10)	6.8% (n=34)

Irrespective of parity order, the shape of teats in Marathwadi buffalo in its different lactation orders showed percentile average as 49.20% Cylindrical, 24.60% Funnel shaped, 19.40% Bottle shaped and 06.20% Conical shaped teats. Maximum Marathwadi buffalo found with cylindrical teats followed by Funnel Shaped, Bottle shaped and Conical shaped teats. Cylindrical shape of teat was prominently observed in Marathwadi buffalo followed by Bottle shaped and Conical shaped. Very scanty population of Marathwadi buffalo bears Conical shaped teats.

Maximum Marathwadi buffalo found with cylindrical teats followed by Funnel Shaped, Bottle shaped and Conical shaped teats. Similar observations are also reported by Sonwane *et al.* (2002) [21] and Bainwad *et al.* (2007) [3] in respect to Marathwadi buffalo. However, the similar findings from Chaki *et al.* (1999) [7], Dutta *et al.* (2003) [8], Prasad and Chauhan (2003) [14], Prasad *et al.* (2010) [15] and Sanjaykumar *et al.* (1992) [19] in concurrence to their studied in different buffalo breeds.

**Table 8:** Teat Tip in Marathwadi Buffaloes as per Stage of Lactation

Teat tip	Stage of Lactation				Overall n=500
	Up to 7 <sup>th</sup> week n=125	7 <sup>th</sup> -14 <sup>th</sup> week n=125	Up to 7 <sup>th</sup> week n=125	7 <sup>th</sup> -14 <sup>th</sup> week n=125	
Rounded	81.6% (n=102)	75.2% (n=94)	71.2% (n=89)	64.8% (n=81)	73.2% (n=366)
Pointed	18.4% (n=23)	24.8% (n=31)	24.8% (n=36)	35.2% (n=36)	26.8% (n=134)

The percentile distribution of different shapes of teat tip in Marathwadi buffalo at different lactation stages recorded as 81.60, 18.40; 75.20, 24.80; 71.20, 28.80; 64.80, and 35.20% at First (0-7 week), Second (7-14 week), Third(14-21 week), Fourth (above 21 weeks) stage of lactation respectively in Marathwadi buffalo.

From the results obtained, it was observed that, the percentile contribution of Rounded and pointed type of teat tip at different lactation stages of Marathwadi buffalo were recorded as 81.60, 18.40; 75.20, 24.80; 71.20, 28.80; 64.80, and 35.20% at First (0-7 week), Second (7-14 week), Third(14-21 week), Fourth (above 21 weeks) stage of lactation respectively in Marathwadi buffalo. Maximum frequency distribution for rounded type teats were observed in Marathwadi buffalo, the findings are close association of Bainwad *et al.* (2007) [3]. Overall, irrespective of lactation order, average percentile contribution of Rounded and pointed type of teat tip observed in relation to the different lactation stages in Marathwadi buffalo from Latur district of Maharashtra were 73.2 and 26.8% respectively. The reports of Sonwane *et al.* (2002) [21], Prasad and Chauhan (2003) [14], Bainwad *et al.* (2007) [3] scientifically support the findings of present investigations.

**Conclusion**

Based on the results obtained from the present experiment Peak values for different traits of Udder and Teat can be

recorded between 14<sup>th</sup> to 21<sup>st</sup> weeks of lactation in Fourth parity. Marathwadi buffalo possess medium sized bowl-shaped udder having cylindrical shaped teats with rounded tip.

**Acknowledgement**

Authors expresses special thanks to Associate Dean, College of veterinary and animal sciences, Udgir, MAFSU, Nagpur. For extending supports to carry out the present research work.

**References**

1. Abdullah M, Khalid J, Muhammad SK, Nisar A, Jalees AB, Umair Y. Relationship Of Udder And Teat Morphology With Milk Production In Nili-Ravi Buffaloes Of Pakistan, Buffalo Bulletin. 2013;32(2):1335-1338.
2. Akhtar N, Thakuria K, Dos D. Teat measurement and their relation with milk yield in swamp buffalo. The Indian Veterinary Journal. 1999;76(5):412-416.
3. Bainwad DV, Deshmukh BR, Chauhan DS, Thombre BM. Study on Udder Characteristics of Buffaloes with Socio-Economic Status of Owners in Marathwada, Indian J Anim. Res. 2007;41(1):39-42.
4. Batra TR, Mc Allister AJ. Relationships among udder measurements, milking speed, milk yield and CMT scores in young dairy cows. Can. J Anim. Sci.

- 1984;64:2438-2440.
5. Bharadwaj A, Dixit VB, Sethi RK, Khanna S. Association of breed characteristics with milk production in Murrah buffaloes, the Indian journal of animal sciences. 2007;77(10):1011-1016.
  6. Bhuiyan MM, Islam MR, Ali ML, Hossain MK, Kadir MA, Lucky NS, *et al.* Importance of mammary system conformation traits in selecting dairy cows on milk yield in Bangladesh. *J. Biolog. Sci.* 2004;4(2):100-102.
  7. Chaki EK, Ghosh N, Mujumdar SC. Relationship of udder and teat types to part lactation yield and peak yield in primiparous crossbred cows., *The Indian Veterinary Journal.* 1999;76(1):58-60.
  8. Dutta KS, Tajne KR, Gadariya MR, Murthy KS. Biometry of adult Jaffrabadi Buffalo in the field. 4th Asian buffalo congress-2003, New Delhi. 2003, 114.
  9. Gubbawar SG, Shelke RR, Chavan SD, Pohare SR. Phenotypic characteristics of Gaolao strain of Nagpuri buffalo breed. *Asian J Animal Sci.* 2012;7(1):6-14.
  10. Joshi NR, Phillips RW. F.A.O. Publication, Rome; c1953.
  11. Lavania P, Khadda BS, Pathodiya OP. Studies on Udder Measurement Traits in Surti Buffaloes, *Journal of Progressive Agriculture.* 2011;2(1):70-72.
  12. Marai IFM, Farghaly HM, Nasr AA, Abou-Fandoud AA. Buffalo Cow Productive, Reproductive and Udder Traits and Stay ability under Sub-tropical Environmental Conditions of Egypt. *Journal of Agriculture in the Tropics and Subtropics.* 2001;102:1-14.
  13. Maske SS. Buffalo Breeds in Maharashtra (India), *Weekly Science Research Journal.* 2014;1(45):1-5.
  14. Prasad RB, Chauhan AK. Phenotypic characterization of Tarai buffalo. 4th Asian Buffalo congress-2003, New Delhi. 2003 113.
  15. Prasad RMV, Raghava Rao E, Sudhakar K, Ramesh Gupta B, Mahender M. Studies on udder and teat measurements as affected by parity and their relationship with milk yield in Murrah buffaloes, *Buffalo Bulletin.* 2010;29(3):194-198.
  16. Prasad RMV, Sudhakar K, Raghava Rao E, Gupta RB, Mahende M. Studies on the udder and teat morphology and their relationship with milk yield in Murrah buffaloes. *Livestock Research for Rural Development.* 2010;22 (1):1-8.
  17. Radekar BA, Ulmek BR, Deekar DK, Farande MB. Studies on Udder Measurement Traits of Pandharpuri Buffaloes. 4th Asian buffalo congress-2003, New Delhi. 2003, 109.
  18. Rao AV, Narsinha, Suryanarayana Murthy T. Studies on Morphological Udder and Teat Characteristics of Riverine Buffaloes in Andhra Pradesh., *Buffalo Bulletin.* 1991;10(1):18-22.
  19. Sanjaykumar VV, Rao VP, Reddy CE, Satyanarayana A. Studies on performance of Godawari buffaloes under field conditions. *Proceedings of National Seminar on Animal Genetics and Breeding Research and Education.* 1992;25:56.
  20. Sonwane RB. Morphometric characterization of Marathwadi buffalo I its breeding tract. Thesis submitted to M.V.Sc. (LPM) Degree to M.A.F.S.U., Nagpur (M.S.); c2015.
  21. Sonwane JS, Karanjkar PL, Karanjkar LM. Udder characterization of milk animals in Ambajogai tehsil. *Indian Journal of Animal Research.* 2002;36(1):55-57.
  22. Tayade UD, Zinjarde RM, Rokde SN, Ingole AS. Phenotypic characteristics of gaolao strain of Nagpuri buffaloes in Wardha district of Maharashtra. *Indian J. Animal sci.* 2010;80(1):67-68.
  23. Yosbanis E, Jose C, Pastor P, Luis N. Relationship Between Udder Morphology, Production and Composition of Buffalo Milk., *Revista científica de veterinaria.* 2013;23(3):220-225.