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Udder and teat morphology during '*Doka*' in cyclic and acyclic Murrah buffaloes (*Bubalus bubalis*)

Pratibha Singh, SK Phulia, AK Balhara, RK Sharma and Ankaj Thakur

Abstract
'Doka' is temporary teat engorgement one such expression in female buffaloes, which is being observed by the farmers for fore-telling the initiation of cyclic reproductive activity/estrus in buffaloes. The current study was conducted to observe morphological changes of teat and udder during and after *'Doka'* in Murrah buffaloes. Udder morphology was studied on thirty five animals Group I- cyclic *'Doka'* (n = 14) and Group II -cyclic without *'Doka'* (n = 21) while udder and teat measurements forty sex animals Group I (n = 19) cyclic *'Doka'*, Group II (n = 14) cyclic without *'Doka'*, Group III (n = 6) acyclic *'Doka'* and Group IV (n = 7) acyclic without *'Doka'*. Cyclic *'Doka'* animals were having bowl shape udder, cylindrical teats and fused quarter. During *'Doka'*, cyclic *'Doka'* (7.41±0.23 inches) and acyclic *'Doka'* (7.30±0.79 inches) showed significantly higher udder depth as compared to acyclic without *'Doka'* (7.41±0.23 inches). Teat length of fore and rear teats in cyclic *'Doka'* were non-significantly (p<0.05) higher during the *'Doka'* as compared to after *'Doka'* stage. Rear teat diameter in acyclic *'Doka'* (37.73±3.93 mm) is significantly (p<0.05) larger than the acyclic without *'Doka'* animals (24.74±2.16 mm). Therefore, it can be concluded that udder and teat morphology changes during *'Doka'* can be used as a tool for estrus detection tool in Buffaloes.

Keywords: Murrah, *'Doka'*, temporary engorgement of teat, teat measurement, udder morphology

Introduction
India is the leading producer of milk in the world with the nearly half of contribution from the buffaloes (Annual Report 2018-19, DAHD). Among all the seventeen registered breeds of buffaloes, Murrah is the one of the largest milk producer among all the buffalo breeds with the lactation milk yield of lactation milk yield of 1360 to 2270 kg per lactation (Sastry *et al*., 2005) [10]. However the productivity of the buffaloes is affected by poor reproductive efficiency, poor estrus expression, prolonged intercalving intervals, lack of vocalization, homosexual behavior, peak sexual activity during night hours and negative effects of hot environment on estrus expression (Suthar and Dhami, 2010; Singh *et al*., 2000, Perera 2011, Warriach *et al*., 2015) [6, 10, 11, 15]. Proper heat detection can help in increasing the productive and reproductive performance of buffaloes.
'Doka' (Temporary Engorgement of Teat - TET) is stage of temporary teat engorgement after milking, in buffaloes, which is being observed by farmers for fore-telling the initiation of cyclic reproductive activity/estrus. *'Doka'* phenomenon precedes estrus; and estrus occurs 5 days and 4.96 days following disappearance of symptoms *'Doka'* in young and old animals, respectively (Joshi *et al*., 2020) [5]. Therefore, present study is focused to study the morphometric changes in udder and teat morphology changes during *'Doka'* period in cyclic and acyclic buffaloes.

Material and Method
The present study was conducted at the Animal Farm of the ICAR-Central Institute for Research on Buffaloes, Hisar. It is situated in the dry tropical northern region of Haryana State in India. Buffaloes selected for the experiment were housed in half walled pukka sheds, with asbestos sheet roof and kutcha open paddock. Buffaloes were allowed daily for pasture grazing for 4-5 hr after morning milking. Additionally, these were stall-fed with adequate quantity of green fodder and wheat-bhoosa. Concentrate feed, supplemented with mineral mixture, was also provided. The concentrate was adjusted keeping in view milk yield of individual buffaloes. Fresh and cold drinking water was available all the times.

Visual examination of Doka
Daily visual examination of sign of '*Doka*' that is pre-estrus behaviour was observed after

milking 7.00 AM to 9.00 PM in the morning and before and during milking 2.00 PM to 5.00 PM in the evening. All the non-pregnant lactating animals were observed and noted the engorgement of teats after milking for '*Doka*' expression.

Udder morphology

To observe the incidence of various shape of teat and udder morphology Murrah buffaloes were categorized into two group that was group I- cyclic *'Doka'* n = 14 and group II - cyclic without *'Doka'* n = 21 and Teat and udder shapes has been classified as

- Teat shapes: Conical, bowel, cylindrical and funnel
- Udder shape: Pendulous, globular, bowl and goaty
- Quarter: Fused and separated

Udder measurement

Buffaloes were categorized into four groups, group I (n = 19) cyclic *'Doka'* group II (n = 14) cyclic without Doka, group III (n = 6) acyclic *'Doka'* and group IV (n = 7) acyclic without *'Doka'* Udder length, width, depth were measured according to Saini and Gill (1989) with the help of usual meter tape.

Udder length

Measured from the rear attachment of the udder, near the escutcheon, to the front of the udder where it blends smoothly with the body.

Udder width

It is the distance between two lateral lines of attachment of the udder to abdominal wall, beneath the flank. The measuring tape was kept in position on one side of the cow, under flank, near the stifle joint and it was passed over in between fore and rear teats to the other side.

Udder depth

The udder depth was measured by subtracting distance from the barn floor to the udder floor from distance from the barn floor to the base of the udder.

Teat measurement

Teat length

The distance from base of the teat to the tip of the teat, measured by the tape

Teat diameter

Diameter of the teat at the mid of the teat barrel, measured by the Vernier calipers

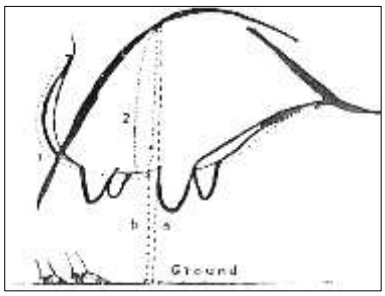

Fig 1: Measurement of Udder and Teat; 1 = Udder Length, 2 = Udder Width, 3 = Udder Depth (a-b)

Statistical analysis

All numerical data are represented as Mean ± SE. The relationship between udder measurements and teat measurements were using correlation coefficient. Differences in the parameters of milk composition, udder measurement between the groups were analyzed by using one way ANOVA with Duncan's post hoc test; however, within groups before and after *'Doka'* was analysed by Paired Samples Correlations. Differences at a p-value less than 5% ($p<0.05$) was considered to be statistically significant. All statistical analysis was performed using the SPSS (16.0) system for windows.

Results and Discussion

Udder morphology

Cyclic without *'Doka'* and Cyclic *'Doka'* both groups showed maximum bowl shape of udder and least was goaty type udder. Most of animals in both groups have cylindrical type of teats and then followed conical, funnel and pears shape. Fused type of quarter was found higher percentage in comparison to separated quarter. Rahman *et al.*, (1992) [8] found that after visual inspection of udder shape and udder measurement just before morning milking udder shape classified as bowl, round, flat and goat shaped. Likewise cylindrical teats were high percentage of 52.5 than pear, bottle, conical and funnel shape of teats with 18.0, 11.0, 10.5 and 8.0%, respectively. Prasad *et al.*, (2014) [7] studied variation in udder shape and teat on Murrah buffalo and their relation to milk yield, among udder shapes and found that Bowl shape (61%) was very common in occurrence followed by Globular (17%), Pendulous (13%) and Goaty (9.0%). It was also suggested that the average daily milk yield in buffaloes was highest in cylindrical shaped teats than bottle, funnel, pear and conical shaped teats.

Table 1: Incidence of shape of teat and udder in *'Doka'* exhibiting buffaloes (%)

Shapes/Stage	Udder				Teats				Quarter	
	Pendulous	Globular	Bowl	Goaty	Cylindrical	Conical	Funnel	Pear	Fused	Separated
Cyclic without *'Doka'* (n = 21)	14	21	64	0	36	29	14	14	57	43
Cyclic'Doka' (n = 14)	5	29	62	5	57	24	14	5	62	38
Overall	9	26	63	3	49	26	14	9	60	40

Measurement of udder

Various udder traits *viz.* udder length, udder width and udder depth in different groups were differ significantly ($p<0.05$) during and after *'Doka'* expression in buffaloes. Value of udder depth was differing significantly between categories as shown in data presented in Table 2. Cyclic *'Doka'* animals (Both cyclic and acyclic) were having significantly higher udder depth than the acyclic without *'Doka'*. Akhtar *et al.*, (1998) [1] recorded 433 observations on swamp type lactating buffaloes and reported the mean values of udder length, width, depth and circumference were 40.56 ± 0.15, 35.11 ± 0.16, 6.55 ± 0.07 and 56.07 ± 0.14 cm, respectively. The length, width, depth and circumference of the udder increase up to fourth lactation and show a decreasing trend from early to late stages of lactation.

Table 2: Measurement of udder (length, width and depth) in different categories of buffaloes during and after a week of '*Doka*'

S. No.	Parameters	N	Categories	During '*Doka*'	After '*Doka*'	Correlation
1	Udder length (cm)*	19	Cyclic *'Doka'*	24.03±0.56	21.58±0.96	r = 0.890
		14	Cyclic without *'Doka'*	21.67±0.55	21.56±0.57	
		6	Acyclic *'Doka'*	21.50±1.41	19.08±1.53	
		7	Acyclic without *'Doka'*	21.79±0.98	20.57±1.06	
2	Udder width (cm)*	19	Cyclic *'Doka'*	21.47±0.49	20.33±0.54	r = 0.945
		14	Cyclic without *'Doka'*	21.07±0.63	20.75±0.67	
		6	Acyclic *'Doka'*	21.25±2.07	20.0±2.13	
		7	Acyclic without *'Doka'*	20.00±0.70	19.57±0.71	
3	Udder Depth (inch)*	19	Cyclic *'Doka'*	7.41±0.23^{b}	6.86±0.22	r = 0.890
		14	Cyclic without *'Doka'*	6.80±0.32^{ab}	6.94±0.33	
		6	Acyclic *'Doka'*	7.30±0.79^{b}	6.50±0.77	
		7	Acyclic without *'Doka'*	6.00±0.33^{a}	5.90±0.40	

∗ $^{a, b, ab}$ (p<0.05) differ significantly

Measurement of teats

Teat length of fore and rear teats in cyclic *'Doka'* were non-significantly (p<0.05) higher during the *'Doka'* as compared to after *'Doka'* stage. Diameters of rear teat differ significantly (p<0.05) between the categories. Acyclic *'Doka'* animals had significantly higher (p<0.05) rear teat diameter when compared to Acyclic without *'Doka'* animals. Cyclic *'Doka'* animals were having non-significantly larger rear teat diameter than cyclic without *'Doka'* animals. Joshi *et al*., 2020 [5] also reported that the teat diameter during *'Doka'* was significantly higher (p<0.05) as compared to pre-*'Doka'* period both before and after milking. The increased teat diameter may be due to let down of milk in teat without any stimuli due to release of luteal oxytocin in response to secretion of PGF2α from the corpus luteum (Grizelj *et al*., 2010) [4]. Fore and rear teat length showed non-significant difference in all the groups during *'Doka'* and after *'Doka'* period. Joshi *et al*., 2020 [5] has also reported the difference in teat length between different stages of *'Doka'* to be non-significant.

Table 3: Teat measurement during '*Doka*' and after a week of '*Doka*' in different selected category of animals (n = 38)

S. No.	Parameters	N	Categories	During *'Doka'*	After *'Doka'*	Correlation
1	Fore Teat Length (inch)	16	Cyclic *'Doka'*	6.84±2.62	3.04±0.16	r = 0.360
		10	Cyclic without *'Doka'*	4.76±1.84	4.75±1.77	
		5	Acyclic *'Doka'*	3.48±0.02	2.42±0.13	
		7	Acyclic without *'Doka'*	2.94±0.29	2.67±0.23	
2	Fore Teat Diameter (mm)	16	Cyclic *'Doka'*	30.83±1.97	28.9±81.86	r = 0.983
		10	Cyclic without *'Doka'*	29.10±2.55	28.9±62.47	
		4	Acyclic *'Doka'*	31.20±2.52	28.4±21.63	
		7	Acyclic without *'Doka'*	24.71±1.44	22.55±1.28	
3	Rear Teat Length (inch)	16	Cyclic *'Doka'*	5.40±0.17	4.33±0.14	r = 0.972
		10	Cyclic without *'Doka'*	5.41±1.66	5.40±1.64	
		4	Acyclic *'Doka'*	4.33±0.28	3.33±0.16	
		7	Acyclic without *'Doka'*	3.20±0.20	3.21±0.22	
4	Rear Teat Diameter (mm)	16	Cyclic *'Doka'*	35.61±1.84 ^{ab}	32.94±2.01	r = 0.989
		9	Cyclic without *'Doka'*	26.95±6.79 ^{ab}	26.92±6.75	
		6	Acyclic *'Doka'*	37.73±3.93^{b}	35.17±3.81	
		7	Acyclic without *'Doka'*	24.74±2.16 ^{a}	24.13±1.78	

$^{a, ab}$ (p<0.05) differ significantly between categories

Conclusion

The teat and udder morphological examinations of *'Doka' vs* non *'Doka'* animals suggest that it might be more or less a normal physiological process, which is unique to buffaloes. In absence of behavioral symptoms in buffaloes, identifying the *'Doka'* during the milking can be considered as a sign of estrus. Increase in Udder depth and the rear teat diameter can further be used as a tool to affirm the *'Doka'* period in both cyclic and acyclic animals.

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