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Sonographic study of teat characters in Mesopotamian Buffalo in Central of IRAQ

Taif N. H. Mustafa [1,*], Garabed A. Baghdasar [2], Saif M. M. Al aameri [1] and Jabbar Kh. Al Saedy [3]

[1] *Ministry of Agriculture, Vet.Directerate, Baghdad/Iraq.*
[2] *ALnukhba College University, Baghdad, Iraq.*
[3] *International Buffalo Delegate, Baghdad, Iraq.*

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Abstract

This study represents the first investigation of buffalo teat sonography in Iraq, which was conducted in Abu Ghraib district. The study included 10 buffaloes (5 primiparous and 5 multiparous) obtained from three buffalo breeding herds at Abu Gharib district and subjected to ultrasound. The SAS program was used for statistical analysis. The research assessed four key traits: teat canal length (TCL), teat diameter (TD), teat cistern diameter (TCD), and teat wall thickness (TWT). These traits were measured both before and after morning and evening milking using an ultrasound device (CHISON ECO3 EXPERT VET) equipped with a macro convex transducer (5-7.5 MHz), with measurements recorded in millimeters (mm).

The findings revealed significant differences in TCL among primiparous buffaloes in both morning and evening. TCL increased from 7.78 mm to 10.04 mm in morning milking and from 8.22 mm to 10.22 mm in evening milking. The TD showed a significant decrease from 36.86 mm to 26.58 mm in the morning and from 35.10 mm to 25.68 mm in the evening, although the time of milking (morning or evening) did not yield statistically significant differences. A noticeable reduction in TCD was observed, with values dropping from 23.40 mm to 17.28 mm before and after morning milking, and from 20.90 mm to 17.36 mm in evening milking. Among multiparous buffaloes, significant differences were noted for TCL, TD, and TCD, though TWT remained unchanged between morning and evening milking. These findings underscore the feasibility of implementing milking machines for buffaloes in the future.

Keywords: Mesopotamian Buffaloes; Multiparous; Primiparous; Teat Sonography

1. Introduction

This study is conducted for the first time in Iraq and is a part of the requirements of the International Buffalo Federation project in 2021 [1]. According to national karyotyping survey, data considered the river species with fifty (50) chromosomes [2]. It is the highest milk production in the Iraq. Secondarily, it may be taken as meat producer and animals were not used for work at all [3].

The Mesopotamian buffalo is distributed in 16 Iraqi governorates in the northern, central, and southern parts of Iraq. The biggest gathering is concentrated in the largest marshes region in southern parts of Iraq. It is characterized by its great ability to benefit from marsh plants and aquatic herbs to a better degree than the other of ruminants [4]. While meat production comes in the second place, this is agreed with a previous study [5] showed that the percentage of milk production of Mesopotamian buffalo ranges from 5 - 8% compared to total milk production in country, while meat production represents a very small percentage of 1.3%.

* Corresponding author: Taif N. H. Mustafa.

The first domestication of buffaloes appeared on seals in two regions, first in the Indus Valley (Mohenjo Daro) and second in the Mesopotamian civilization (Ur/Sumerians civilization) in south of Iraq about the middle of third millennium B.C [6; 7]. Iraqi buffaloes are different in colors, shape (phenotypic variations), and the ability of milk production with bigger body measurements comparing to Indian, Pakistani and Egyptian buffaloes [8]. Studies confirm the great scientific importance of teat dimensions in automatic milking, as well as the importance of milking speed as a better basis for selection for European dairy cattle [9]

while another study [10] for native Iraqi buffalo in Badosh in Mosul moral superiority and significant increase in distance between front to rear teat was 4.41cm. Baghdasar et al.,[8] found that the buffalo body measurements of the Al-Fadhiliya region in Iraq were as follows (the length of the front and rear seats and the diameter of the front and rear seats were (6.2±0.1, 7.4± 0.2; 3.3± 0.2 and 3.6± 0.2 cm) and distance between front teats and rear teats (16.9±0.3 and10.9±0.3cm) respectively. In recent years, ultrasonography has been extensively applied to animals as a safe and non-invasive diagnostic tool in veterinary practice [11], and this valuable technique was very accurate to find observed visualizing any changes of the mammary gland cistern clearly [12].

Due to its importance teats charactersi and the lack of researches in this subject, the present study has been conducted. Also, through this study, we aspire to prove the relationship of genetic inheritance to the morphological characters of the teats and udders of buffalo.

2. Material and methods

2.1. This study was conducted on three buffalo herds

Only traditional management of buffalo; as there is no machine milking at all. The study was conducted during the period from June to August 2024, where the temperature ranged between (44º - 48ºC) and humidity ranged between (22%-26%).

2.1.1. First herd: in White Gold Village

A mixed herd of 35 buffaloes, herd age is 11 years. The feed consists of approximately 30% green fodder and 70% dry fodder, which depends primarily on the harvest remains of wheat or barley plants (hay), wheat seed h cotton seeds.

2.1.2. Second herd: Agricultural research station/in Abu Ghraib.

The animals of this farm were selected from several other herds. This herd is 25 years old and consists of 100 buffaloes. Animal nutrition depends mainly on green fodder and grazing if necessary Concentrated feed is used from time to time depending on its availability and consists of bran and the remains of wheat and barley grains.

2.1.3. Third herd:/in Aqarquf area

A young mixed herd no more than five years' old, herd's number is 60 buffaloes; it was purchased from several areas of Baghdad Governorate. The herd's nutrition is fairly ideal, as it relies on green, dry, and concentrated fodder in almost ideal proportions, the main component of green fodder is turmeric and for concentrated feed, it consists of bran as the main ingredient, wheat flour, crushed barley, cotton seeds, and crushed date pits in certain proportions. It is ideal and rich feed, and the management in this farm is very good, and this is more information about these three herds:

2.2. Ultra-sonographic examination of buffalo teat

Ultrasound device used for teat ultrasonography examination in this study was the CHISON ECO3 EXPERT VET (CHISON Medical Technologies Co., Ltd.)

using a macro convex transducer model: MC5V-A. And B-mode real-time Ultrasonography with a 5-7.5 MHz using (mm) for measurements by immersing the teat into a polyethylene bag or cup fulfilled with warm water (30-37 ˚C), and the probe was applied to the ultrasound gel covered wall of the cup, or build into the cup. The scanner is applied on the outer wall of the polyethylene bag or cup [13]. Rambadu et al., [14] observed gel application and water bath methods produced clearer ultrasound images than direct contact and stand-off methods.

Teat ultrasonography measurements were taken in the milking buffaloes during the routine milking hours before and after milking for two groups (primiparous & multiparous). Each 5 buffaloes are primiparous and 5 multiparous from (3 – 7) calving. Each buffalo has been measured within the first month of lactation and at the middle of lactation between

4-5 months. For each buffalo the measurements have been taken without changing the operator before milking in the morning and in the evening manually for all the 4 teats. In case of pre-milking, the measurements have been taken before and after milking process (3-5 minutes) so that we have 40 views. ultrasonographic videos were recorded with the same ultrasound device (CHISON ECO3 EXPERT VET) for each teat (4 teats) measurement was taking for teat canal length (TCL), teat wall thickness (TWT), teat cisternal diameter (TCD), teat diameter (TD), (measurement was performed at 4 cm above the ostium papillary) [15]. The recorded ultrasonography videos were saved individually and the clearest videos were selected for studying purposes. The clearest three ultrasound images were selected for each character. Averages of these three images were calculated and used in the measurement conducted with the (CHISON ECO EXPERT VET) device.

The four required measurements we documented were (TCL, TD, TCD, TWT) and the images were computerized to be arranged within the research.

Ultrasonographic appearance of buffalo teat with the water bath method. (Vertical scan, CHISON ECO3 EXPERT VET using a macro convex transducer with a 6 MHz): 1= TCL: teat canal length,2 and 3 =TWT: teat wall thickness, 4 =TCD: teat cisternal diameter, 5=TD: teat diameter.

2.3. Statistical analysis

The statistical Analysis System – [16] programme was used to detect the effect of difference groups (Effect of milking time; effect of measurement time), in study parameters. Independent T test was used to compare significance of differences between means in the study.

3. Results

In this study, the measurements of Iraqi buffalo's teat were taken by ultrasonic device and the mean± S. E of the teat canal length (TCL), teat diameter (TD), teat cistern diameter (TCD), teat wall thickness (TWT). Primiparous buffalo measurements were 9.06± 0.54,31.25± 2.06, 19.73 ±0.95,6.55±0.44 mm respectively, while the measurements of multiparous buffaloes were (3-7 births) in the same order 12.53±, 0.74, 39.69±3.11, 25.0±1.35, 7.15±0.78 mm respectively.

Table 1 Performance Data of 10 Lactating Buffalo Cows

Parameters	**Farm 1** **White Gold Village**	**Farm 2** **Agricultural Research Station**	**Farm 3** **Aqarquf area**
Number of buffalo examined	2	2	6
Mean daily milk yield (Kg)	8(min, 6; max, 10)	10(min,7.0; max,13.0)	12(min, 7.0; max, 17.0)
Mean age of buffalo (years)	11 (min, 3.0; max, 18.0)	9(min, 3.5; max,15)	7.5(min,3.0; max, 12.0)
Mean lactation period (month)	10.5(min, 7; max, 14)	8	10(min,8.0; max, 12.0)

Table 2 Illustrated the results of ultrasound measurements of teat measurements for 10 Mesopotamian buffaloes

Table 2 Some teats measurements

Parity	**n**	**TCL**	**TD**	**TCD**	**TWT**
Primiparous	5	9.06±0.54b	31.05±2.06b	19.73±0.95b	6.55±0.44a
Multiparous	5	12.53±0.74a	39.69±3.11a	25.0±1.35a	7.15± 0.78a

4. Discussion

4.1. Primiparous

Table (3) summarizes the effect of measuring time (before and after milking), as well as milking time (morning and evening) on TCL. It has been noticed that there are significant differences (P≤0.05) between before milking and after milking. While there was no significant effect for morning and evening milking according to the T- test. The averages of morning milking were (7.78 ±0.41 to 10.04 ±0.58 mm) while in evening milking (8.22 ±0.56 to 10.22 ±0.64 mm) before and after milking respectively.

Table 3 Effect of Time/ in Teat canal length-TCL mm at before and after milking/primiparous

Time	Mean ± SE of TCL		T-test
	Before milking	After milking	
Morning	7.78 ±0.41	10.04 ±0.58	2.019 *
Evening	8.22 ±0.56	10.22 ±0.64	1.966 *
T-test	1.783 NS	1.094 NS	---

* (P≤0.05), NS: Non-Significant.

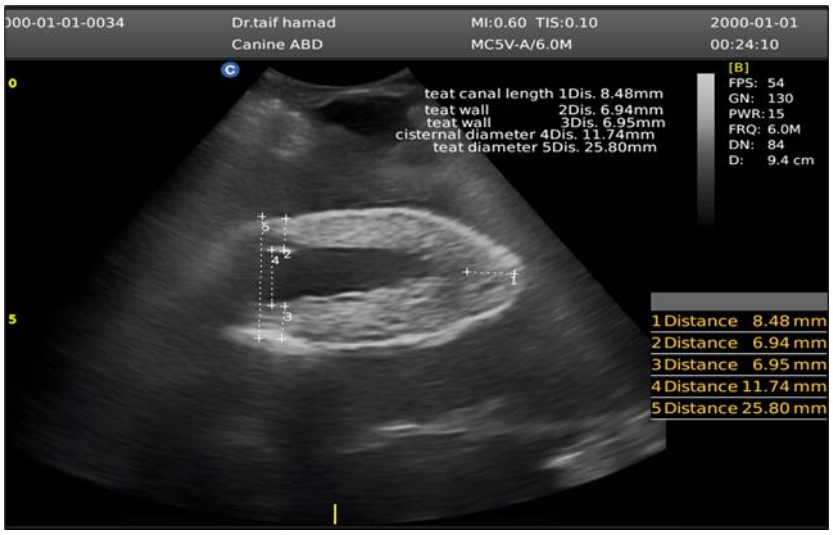

Figure 1 Ultrasonographic appearance of buffalo teat with the water bath method. (Vertical scan, CHISON ECO3 EXPERT VET using a macro convex transducer with a 6 MHz): 1= TCL: teat canal length,2 and 3 =TWT: teat wall thickness, 4 =TCD: teat cisternal diameter, 5=TD: teat diameter

A significant increase has been noticed in this characteristic after morning and evening milking due to emptying of the teat cistern of milk which puts pressure on the teat canal as shown in Figures (2, 3).

Figure 2 1=TCL: teat canal length before milking

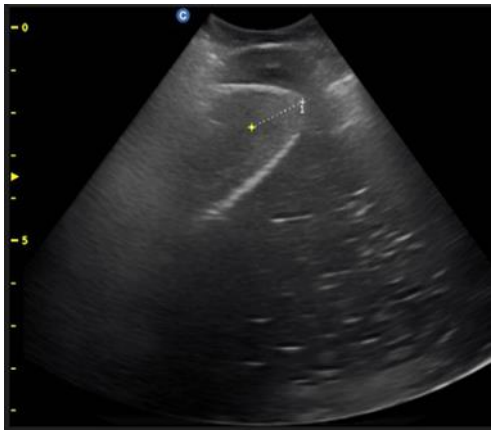

Figure 3 1=TCL: teat canal length after milking

Additionally, previous research conducted by Ozenc et al.,[17] established baseline average TCL lengths of 24.20±0.31 mm for closed teats and 16.18±0.36 mm for opened teats in the right front and right rear. However, with the TD as it is clear that there are significant differences at the level(P≤0.05) before milking and after milking for this character. It shows no differences during morning and evening milking. The amount of shrinkage has been calculated before and after milking for this character and there were no significant differences during morning milking and evening milking. The averages during the morning milking were ranged from 36.86 ± 2.37 mm to 26.58± 1. 63mm. Meanwhile, it was 35.10 ±1.98mm to 25.68 ±1.27.68 mm during the evening milking. The amount of shrinkage after morning milking (38.67%) and after evening milking (36.68%) is noticeable during the process (figures 4,5). All results are presented in table 4. As for the characteristic of TCD, Table 5 shows a significant difference(P≤0.05) between the measurements before and after milking, while there was no significant effect on time of milking. The test shows a contraction after morning milking and after evening milking. We observed in table 6 the thickness of the teat wall (TWT), noticing a slight difference after milking in the morning and evening sessions. This difference is attributed to teat contraction post-milking; however, no significant variations were found before milking in the morning and evening when comparing measurements after and before milking. (Figure 4,5)

Table 4 Effect of Time/ on Teat diameter-TD mm at before and after milking/primiparous

Time	Mean ± SE in TD		T-test
	Before milking	After milking	
Morning	36.86 ±2.37	26.58 ±1.63	4.921 *
Evening	35.10 ±1.98	25.68 ±1.27	5.246 *
T-test	3.092 NS	2.887 NS	---

* (P≤0.05), NS: Non-Significant.

Table 5 Effect of Time/ in Teat cistern diameter-TCD in mm at before and after milking// Primparous

Time	Mean ± SE in TCD		T-test
	Before milking	After milking	
Morning	23.40 ±1.28	17.28 ±0.78	4.061 *
Evening	20.90 ±0.93	17.36 ±0.81	3.022 *
T-test	2.869 NS	1.855 NS	---

* (P≤0.05), NS: Non-Significant.

Table 6 Effect of Time/ in Teat wall thickness-TWT at before and after milking// prim parous

Time	Mean ± SE in TWT		T-test
	Before milking	After milking	
Morning	5.89 ±0.32	7.96 ±0.48	1.385 *
Evening	6.64 ±0.44	8.12 ±0.51	1.492 *
T-test	0.894 NS	0.705 NS	---

* (P≤0.05), NS: Non-Significant.

Figure 4 2 =TWT: teat wall thickness, 3 =TCD: teat cisternal diameter, 4 = TD: teat diameter after milking

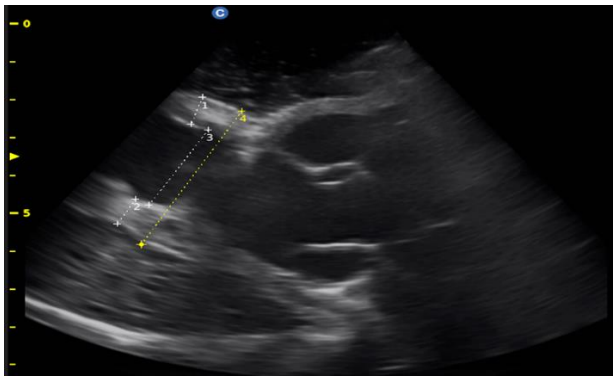

Figure 5 1 and 2 =TWT: teat wall thickness, 3 =TCD: teat cisternal diameter, 4 = TD: teat diameter before milking

4.2. Multiparous

In Table 7 the TCL character undergoes an increase with significant differences (P≤0.05) in averages before and after morning milking (9.32 ±0.62 mm) before morning milking and also (15.06 ±0.81) after morning milking the same before and after evening milking (9.94 ±0.75) before evening milking and (15.78 ±0.77) after evening milking, while there were no significant differences for (P≤0.05) between morning milking and evening milking for this studied trait.

Table 7 Effect of Time/ in Teat canal length-TCL/ mm at before and after milking// multi parous

Time	Mean ± SE of TCL		T-test
	Before milking	After milking	
Morning	9.32 ±0.62	15.06 ±0.81	2.641 *
Evening	9.94 ±0.75	15.78 ±0.77	2.085 *
T-test	1.355 NS	1.0067 NS	---

* (P≤0.05), NS: Non-Significant.

In table 8 the (TD) characteristic shows dimensional reduction with significant differences before and after morning milking, and the averages before morning milking was (49.52±2.07) mm, while after morning milking the average was (30.98 ±1.66) mm. Although there were significant differences(P≤0.05) before and after evening milking and the averages were before and after evening milking (47.94 ±1.85) mm and (30.32 ±1.48) mm respectively. The amount of shrinkage in both cases were calculated and reported respectively. There were no significant differences between morning and evening milking by comparing the measurements before milking (morning and evening) or after milking (morning and evening) according to this studied.

Table 8 Effect of Time/ in Teat diameter -TD in mm before and after milking/ multi parous

Time	Mean ± SE in TD		T-test
	Before milking	After milking	
Morning	49.52 ±2.07	30.98 ±1.66	5.802 *
Evening	47.94 ±1.85	30.32 ±1.48	5.913 *
T-test	3.771 NS	3.162 NS	---

* (P≤0.05), NS: Non-Significant.

(TCD) character in table (9) shows significant differences(P≤0.05) showing the effect of before and after milking with a high reduction in the averages TCD.

Table 9 Effect of Time/ in Teat cisternae diameter-TCD at before and after milking// multi parous

Time	Mean ± SE in TCD		T-test
	Before milking	After milking	
Morning	35.98 ±2.36	15.02 ±0.61	5.944 *
Evening	34.64 ±1.97	14.40 ±0.48	6.152 *
T-test	3.273 NS	2.081 NS	---

* (P≤0.05), NS: Non-Significant.

TCD was bigger before milking than it is after milking. No significant differences between morning and evening milking time, no mean significant differences were observed between the morning and evening milking and thereafter, as evidenced by the measurement of (TCD)subsequently, for study of [15] about Mediterranean Italian buffalo cows they found that correlation between certain teat structures and machine milk ability besides to TCL measured by ultrasound has positive correlation to milk flow and milking time.

As for the TWT characteristic, this appears in table (10). There were no significant differences in morning milking and evening milking. as well as in before and after milking. the differences in the means were slight which indicates that the thickness of the teat wall was not greatly affected during milking at both times and also before and after milking. Milking study has indicated by [19]. pre-stimulation ensures that the teat rosette of Fürstenberg opens and their subsequent milk flow.

Table10 Effect of Time/ in Teat wall thickness-TWT in mm at before and after milking/ multi parous

Time	Mean ± SE in TWT		T-test
	Before milking	After milking	
Morning	6.83 ±0.35	6.48 ±0.47	0.795 NS
Evening	6.10 ±0.41	6.81 ±0.55	0.806 NS
T-test	0.852 NS	0.689 NS	---

NS: Non-Significant.

5. Conclusion

In this pioneering study, the using of sonography in Iraq conducted at the behest of the International Buffalo Federation (I.B.F).

Within the context of traditional buffalo management practices in Iraq, which rely exclusively on poor ration and unhygienic measure to control buffalo especially after calving and hand milking; the results of the current study underline the potentials to transitioning from outdated manual milking methods to modern milking machines.

This transition has shown promising results in enhancing milk and promoting udder hygiene. Also, through this study, we aspire to prove the relationship of genetic inheritance to the morphological characters of the teats and udders of buffalo.

There are few studies on udder and teat measurements in buffaloes, and this information would add in understanding how they correlate with milk yield and milk ability [12].

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares no conflict of interest. The manuscript has not been submitted for publication in other journal.

AI usage declaration

We confirm that we did not use artificial intelligence in writing this research in any way.

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