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**Research Article**

# ULTRASONOGRAPHIC ANATOMY OF UDDER IN INDIGENOUS MADRAS RED SHEEP

S. SENTHILKUMAR*, T.A. KANNAN, R. GNANADEVI, GEETHA RAMESH and D. SUMATHI[1]
Department of Veterinary Anatomy, [1]Department of Veterinary Clinical Medicine,
Madras Veterinary College, TANUVAS Chennai-600 007, India

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## ABSTRACT

Two-dimensional ultrasonographic examination of the udder and teats were performed in lactating and non-lactating Madras Red ewes (n=6 each) using 7.5 to 12.5 MHz linear transducer in a transverse and longitudinal plane by the direct contact method. In both lactating and non-lactating animals, the mammary parenchyma was uniformly echogenic. However, in lactating animals, the parenchyma showed increased anechoic fields within it, due to the accumulation of milk and increased vascularity. Right and left teats were examined by the water bath technique. In teat, three different layers were observed *viz*., anechogenic teat cistern, hyperechogenic teat skin, moderately echogenic middle layer and hyperechogenic inner teat mucosa. Furstenberg's rosette region appeared as a round, homogenous hypoechoic or anechoic structure. Teat orifice was hyperechoic, a teat canal observed as a thin hyperechoic line between two thicker parallel hypoechoic bands. Though, there was no difference in the structural composition of mammary gland and teat between lactating and non-lactating animals, the clarity of structures were found to be more in lactating animals. Statistical analysis revealed no significant difference in Teat canal length (TCL), Teat canal width (TCW), Teat cistern diameter (TCD), Teat wall thickness (TWT) and Diameter at Furstenberg's rosette (DFR) in both lactating and also non-lactating animals of Madras Red ewes.

**Keywords**: Madras Red ewe, Teat, Udder, Ultrasonography

In the field of medical imaging, ultrasonography plays a vital role and serves as a unique imaging modality to examine the soft tissue structures in the body (Yalavarthy, 2005). As this technique involves non-invasiveness, is free from radiation hazards, it provides instant and dynamic visualization of the organs (Barbagianni *et al*., 2016). In ruminants, the ultrasonographic imaging technique is used in the diagnosis of various physiological and pathological conditions of the reproductive organs (Bradley *et al*., 2001). Mammary ultrasonography is an efficient technique to evaluate the size and internal consistency which in turn reflects the health status of the mammary gland. The technique is helpful in the correlation of mammary structures with milk production (Adam *et al*., 2017).

Knowledge of ultrasonographic anatomy of the mammary gland and teat in healthy adult sheep and goat is essential to understand the functional status and also to rule out pathological alterations occurring in mammary glands such as preclinical mastitis. Ultrasonographic examination of udder and teat has been studied in various sheep and goat breeds of the world.

Madras Red sheep is a medium-sized breed present in the northern regions of Tamil Nadu and also one of the native sheep breed of India recognized by the Indian Council of Agricultural Research. Considering the economic importance of this breed and due to scarcity of literature, the present study was conducted to establish a basic data about ultrasonographic details of mammary gland and teat in lactating and non-lactating animals, which are manually milked.

*Corresponding author: senthilkumarvetpg@gmail.com

## MATERIALS AND METHODS

The present study was conducted in Madras Red ewes (n=6 each) at the Post Graduate Research Institute in Animal Sciences unit of Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam, Chengalpet. The ultrasonographic variables were taken in two different groups, lactating and non-lactating. The study was conducted in early morning in manually milked ewes.

The animals were placed over a table on a non-slippery surface, restrained and placed in standing position with their legs perpendicular to the long axis of the body. B-Mode ultrasonography of udder was carried out in longitudinal and transverse planes using DS50 plus Sonoray machine. 7.5 to 12.5 MHz Linear transducer was used. Ultrasonographic examination of the udder was performed after applying the contact gel directly to the external skin surface (direct gel contact method). The transducer was placed both vertically and horizontally over the skin.

Ultrasonographic examination of the teat was done by filling the warm water inside the plastic cup followed by immersion of teats into the cup. Contact gel was applied to the external surface of the cup. Then the probe was placed over the cup surface (Cartee *et al*., 1986). The ultrasound measurements such as teat canal length (TCL), teat canal width (TCW), teat cistern diameter (TCD), teat wall thickness (TWT) and diameter at Furstenberg's rosette (DFR) were made on both right and left side teats.

Supramammary lymph node was examined at the base of udder at the caudal aspect of udder halves (Couture and Mulon, 2005). Data obtained from micrometry were subjected to statistical analysis by SPSS® 26.0 for Windows.

## RESULTS AND DISCUSSION

In the present study, B-mode ultrasonography of the mammary gland in ewes and she-goats revealed the different anatomical structures of the mammary parenchyma. However, the clarity of visualization was found to be more in lactating animals than non-lactating animals. In lactating ewes, mammary gland parenchyma was observed as a homogenous and uniformly echogenic structure (Fig. 1). Gland cistern appeared as anechoic structure (Fig. 2). Distribution of anechoic zones within the parenchyma helped to visualize the blood vessels, alveoli and lactiferous ducts. The results were in accordance with the findings of Diaz *et al*. (2013) and Fasulkov *et al*. (2010) in ewes and she-goats. In non-lactating groups, the echogenic pattern was similar to lactating groups. However, the amount and distribution of anechoic pattern indicated the blood vessels and lactiferous ducts were found to be less and hence, poorly visualized in the non-lactating group. This is in total agreement with the findings of Fasulkov *et al.* (2014) in cows.

For visualization of different anatomical structures in the teat, both water bath technique and direct gel method was adopted. Ultrasound image of the teat wall in both lactating and non-lactating ewes appeared as a tri-laminar structure. The outermost layer (teat skin) was seen as a mild hyperechoic line, the middle layer (fibromusculo-vascular layer) was found to be homogenous and thick with moderate echogenicity (hypoechoic layer). The

**Table 1**

**Mean ± SE (mm) of various ultrasonographic parameters in the mammary gland of Madras Red ewes**

| Parameters | Lactating (N=6) | Non-lactating (N=6) | t value |
|---|---|---|---|
| R-TCL | 4.75 ± 0.56 | 6.04 ± 0.98 | 1.14$^{NS}$ |
| R-TCW | 1.22 ± 0.07 | 0.99 ± 0.10 | 1.78$^{NS}$ |
| R-DFR | 1.25 ± 0.10 | 1.46 ± 0.26 | 0.76$^{NS}$ |
| R-TCD | 3.53 ± 0.44 | 3.76 ± 0.63 | 0.29$^{NS}$ |
| R-TWT | 4.10 ± 0.26 | 4.71 ± 0.33 | 1.44$^{NS}$ |
| L-TCL | 4.53 ± 0.62 | 5.76 ± 0.93 | 1.10$^{NS}$ |
| L-TCW | 1.30 ± 0.07 | 1.19 ± 0.18 | 0.53$^{NS}$ |
| L-DFR | 1.13 ± 0.26 | 1.49 ± 0.25 | 1.31$^{NS}$ |
| L-TCD | 3.62 ± 0.62 | 3.72 ± 0.64 | 0.11$^{NS}$ |
| L-TWT | 4.19 ± 0.35 | 4.40 ± 0.23 | 0.49$^{NS}$ |

$^{NS}$ - No significant difference between lactating and non-lactating groups (P<0.05)


Fig. 1. Two-dimensional ultrasonographic image of the mammary gland of adult non-lactating Madras Red ewe showing alveoli (arrow) and parenchyma (P)


Fig. 2. Two-dimensional ultrasonographic images of gland cistern of lactating adult ewe showing anechoic gland cistern (GC)


Fig. 3. Two-dimensional ultrasonographic images of adult lactating she-goat showing the Teat canal length(TCL), Teat canal width (TC), Diameter of Furstenberg's rosette (FR), Teat Cistern Diameter (TCD) and Teat wall thickness (TWT).

innermost layer, teat mucosa was identified as a hyperechoic layer (Fig. 3). A similar observation was made in ewes by Franz *et al*. (2009), in Murciano-Granadina goats by Franz *et al*. (2003) and local Bulgarian goats by Franz *et al*. (2001). Whereas, five differentiated layers in the teat wall of cows was observed by Ragab *et al*. (2017). They were skin, hyperechoic musculature, connective tissue, submucosa and mucosa. This might be due to differences in echogenicity. Teat cistern appeared as anechoic structure. The transition area of the teat cistern into a narrow teat canal was designated as Furstenberg's rosette. On ultrasonography, it was observed as a round, homogenous hypoechoic or anechoic structure. This is in agreement with the findings of Rambabu *et al*. (2009) in buffaloes. However, this region was observed as a hyperechoic structure in cows. Teat canal observed as the thin hyperechoic line between two thicker parallel hypoechoic bands. These results are in concurrence with the findings of Franz *et al*. (2009) in ewes. Teat orifice was observed as a hyperechoic structure. The finding was supported by earlier findings in cows by Ragab *et al.* (2017) and Sendag and Dinc (1999). However, teat orifice appeared as an anechoic structure in cows as reported by Rovai *et al*. (2004).

The mean ± SE of various ultrasonographic parameters of both right and left teat in lactating and non-lactating Madras Red ewes are presented in Table 1. No significant difference was observed in R-TCL and L-TCL of both groups in ewes. Teat canal width, Furstenberg's rosette diameter, teat cistern diameter and the teat wall thickness of the right and left teats did not differ significantly between lactating and non-lactating ewes. In the present study, an ultrasound image of supramammary lymph nodes showed echogenic capsule, hypoechoic cortex and hyperechoic inner medullary area in both ewes. These findings are supported by earlier findings in supramammary lymph node of cows by Szenziova and Strapak (2012).

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