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Original Research

Vaginal Electrical Resistance (VER) Measurements in Goats in Different Reproductive States

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Abstract

With an objective to evaluate the efficiency of vaginal electrical resistance (VER) measurements in differentiating the stage of the estrous cycle, the VER was recorded in goats (n=62) 12 h before their slaughter and the genitalia were collected to stage the reproductive cycle. Among the genitalia collected, 13 were pregnant and 10, 10, 15, and 14 were in proestrus, estrus, metestrus and diestrus, respectively. The VER was 37.5±0.81, 36.6±1.14, 47.27±1.82, 51.28±2.45 and 43.54±2.39 Ohms, respectively for the respective stages of proestrus, estrus, metestrus, diestrus and pregnancy. Significantly lower (P<0.05) VER was found in proestrus, and estrus compared to other reproductive stages. The VER was not significantly different in goats that were pregnant or in diestrus. It was concluded that VER in goats is low during proestrus and estrus and can be used to stage estrus in goats but not for pregnancy diagnosis.

Keywords: Goats, Estrus, Diestrus, Pregnancy, Vaginal Electrical Resistance

Introduction

The only field indicator that a female goat is in estrus is her acceptance of the male mounting (Alhamada *et al.*, 2016). Using this indicator, the most widely used technique for recording the occurrence of estrus employs a marker crayon on the male (Radford *et al.*, 1960; Yong and Lee, 2014). With increased use of estrus synchronization (Wildeus, 2000; Whitley and Jackson, 2004; Fonseca *et al.*, 2005) and artificial insemination in goats (Wani *et al.*, 1980; Omontese, 2018) the importance of estrus detection is increasing. Approaches for estrus detection in sheep and goats include the use of vasectomized males (Nogueira *et al.*, 2011), pedometers (Doherty *et al.*, 1987), electronic mount detectors (Alhamada *et al.*, 2016) and video tracking of behavioral patterns (Endo *et al.*, 2016). Vaginal electrical resistance (VER) has been evaluated in a number of species including cattle (Purohit and Gupta, 2000; Meena *et al.*, 2003), buffalo (Gupta and Purohit, 2001a; Gupta and Purohit, 2001b), pigs (Rezac *et al.*, 2002) and camel (Vyas *et al.*, 2009; Dholpuria et al., 2014) to detect estrus and time insemination. Low values of vaginal electrical impedance were observed at estrus in ewes (Bartlewski *et al*., 1999). Theodosiadou and Tsiligianni (2015) suggested that VER could be useful for the detection of proper time of mating after estrus synchronization in ewes. Similarly, Krivanek, (2008) stated that cyclic changes occur in the vaginal impedance in goats and are closely related to estrus behavior. Recently, Murtaza *et al.* (2020) found that the VER in cyclic Beetal goats decline significantly 12 h after estrus onset. The present study evaluated the VER in goats during different reproductive stages.

Materials and Methods

Goats (n=62) between 2-4 years of age presented to a local abattoir were selected for the present study during the breeding season (August-October 2019). Twelve hours before slaughter the vaginal electrical resistance (VER) was recorded by placing a commercially available resistance probe (Heat Detector for cattle, Hauptner, Germany) in the vagina (Fig. 1) during the evening hours. Two readings were taken and the average recorded as the VER for that animal. The probe was sanitized using 1% chlorhexidine before use and washed with water after use. Any goat showing clinical evidence of vaginal discharge or visible abnormality was excluded from the study. The goats were slaughtered 12 h after VER recording and the complete genitalia were collected and brought to the laboratory to evaluate the stage of estrous cycle or pregnancy. The stage of estrous cycle was evaluated based on ovarian structures evaluated during the different stages in previous studies (Camp *et al.*, 1983; Medan *et al.*, 2005; Miranda-Moura *et al.*, 2010; Fatet *et al*., 2011). Briefly, proestrus phase was characterized by the presence of a regressing CL with a developing follicle and small follicles. Estrus phase was characterized not only by the presence of regressed CL with no vasculature, cream color and hard texture in cut surface but also with at least one 5-10 mm or above diameter follicle and appearance of rughae on uterine horn (Fig. 2). Diestrus phase was characterized by red to brown early developed CL alone or with small follicles (Fig. 3). Metestus phase was considered when there was presence of a corpus hemorhagicum and/or small follicles (Fig. 4) and a growing CL. Pregnancy was grossly visible by enlarged fluid filled uterine horn with enlarged cotyledons (Fig. 5). The VER recordings were grouped according to the stage of estrous cycle or pregnancy and the data was analyzed by one-way ANOVA and Turkey Post Hoc HSD test to compare the Mean ± SE obtained for different reproductive stages.

Figure 1: VER recording in a goat using a VER probe

Figure 2: A goat genitalia in estrus showing a large follicle

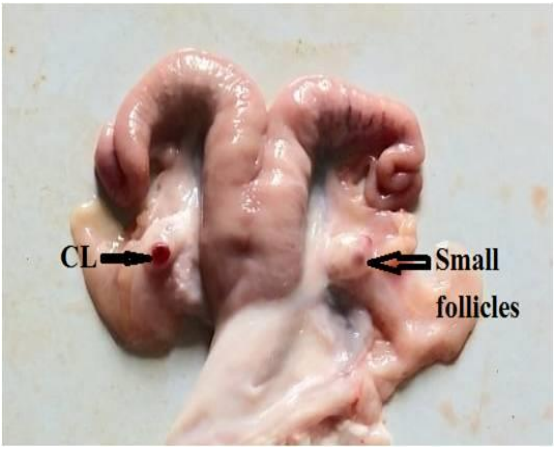

Figure 3: A goat genitalia in diestrus showing a fully grown CL and small follicles

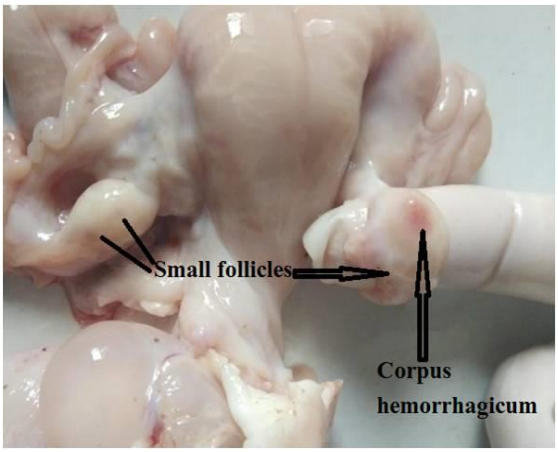

Figure 4: A goat genitalia in metestrus showing corpus haemorrhagicum and small follicles

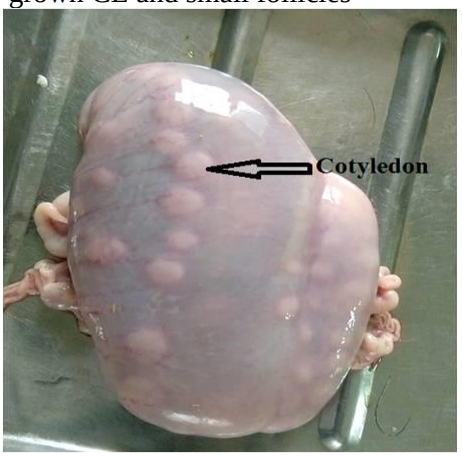

Figure 5: A pregnant goat genitalia showing the fluid filled enlarged uterus and cotyledons

Results

Evaluation of structures on the ovaries and the evaluation of uterus revealed that goats were in either proestrus (n=10), estrus (n=10), metestrus (n=15), diestrus (n=14) or were pregnant (n=13). The VER for goats in proestrus and estrus was lower compared to metestrus, diestrus and pregnancy (Table 1). Analysis of variance and post Hoc test revealed that goats in proestrus evidenced significantly lower ($P<0.05$) VER compared to VER in goats at metestrus. The VER in goats in estrus was only slightly lower compared to that in proestrus. Goats in diestrus revealed non-significantly higher VER compared to that in goats in metestrus and pregnant goats.

Table 1: VER in goats in different stages of reproduction

	Proestrus	Estrus	Metestrus	Diestrus	Pregnant
Number of goats	10	10	15	14	13
VER in Ohms (Mean±SE)	37.5 ± 0.81^{a}	36.6 ± 1.14^{a}	47.27 ± 1.82^{b}	51.28 ± 2.45^{b}	43.54 ± 2.39^{b}

Values with different superscripted letters in the same row are significantly different ($P<0.05$)

Table 2: ANNOVA table for VER in different reproductive stages in goats

Source	***SS***	***Df***	***MSS***	
Between-treatments	1875.4981	4	468.8745	
Within-treatments	2871.9212	57	50.3846	$F = 9.30591$
Total	4747.4194	61		

Significant at $P < 0.05$

Discussion

The present study found that VER was significantly low in goats found in proestrus and estrus and was high in goats in metestrus and diestrus or pregnancy. A previous study in goats had recorded similar findings (Krivanek, 2008). Daily recording of VER in Bangladeshi ewes revealed a significant drop in VER at estrus (Talukder *et al.,* 2018). The VER values in metestrus, diestrus and pregnant goats were not significantly different in the present study. This finding reflects that the VER in pregnant and diestrus goats are not different and that the decline in VER is synchronous to the onset of estrus as also shown in previous studies on buffalo (Gupta and Purohit, 2001a), cattle (Meena *et al.,* 2003) and ewes (Talukder *et al.,* 2018). In cattle many studies also recorded decline in VER during estrus and increase thereafter (Patil and Pawshe, 2011; Ahmed *et al.,* 2017) and thus can be used to time artificial insemination (Purohit and Gupta, 2000). However, Krivanek (2008) found that the VER values were low at proestrus in goats but increased at estrus. In a recent study the VER was less ($P < 0.05$) at 12h than at 0 h and 36 h after estrous onset in Beetal goats (Murtaza *et al.,* 2020). Elevated level of estrogen during the follicular phase of the ovarian cycle induces hydration of vaginal and vulvar tissue, which in turn increases the electrical conductivity of the vaginal mucus and epithelium (Ezov *et al.,* 1990; Schindler *et al.,* 1990).

Conclusion

The present study recorded VER values of less than 40 Ohms in goats that were either in proestrus or estrus. Similar to the present study a previous study that evaluated VER in two breeds of ewes found VER less than 40 Ohms at estrus (Bartelewski *et al.,* 1999). It was concluded that VER in goats is low during proestrus and estrus and can be used to stage estrus in goats but not for pregnancy diagnosis.

Conflict of Interests

There is no conflict of interest.

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