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Assessing Postpartum Reproductive Health via Endometrial Cytology and Body Temperature in Mehsana Buffaloes

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Authors' contributions

This work was carried out in collaboration among all authors. Authors RJ and Keshav did conceptualization, data analysis, interpretation and drafting manuscript. Authors HN and BS did the supervision and funding. Authors RJ and HN did sample collection and processing. Authors RJ and Keshav provided technical support in running the sample. Authors RJ, BS and Keshav did data analysis and editing the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to investigate the effect of body temperature and endometrial cytology on postpartum reproductive health in Mehsana buffaloes. A total of twenty-six Mehsana buffaloes were used in this study. Per-rectal and ultrasonography examinations were used to observe the postpartum reproductive function of these buffaloes and on day 60 post natural service, the

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pregnancy was confirmed. Based on fertile estrus, buffaloes were retrospectively divided into two groups: Group I (buffaloes conceiving before 90 days) and Group II (buffaloes conceiving after 90 days). One week before parturition and four weeks after it, the rectal temperature was taken. The cytobrush technique was used to obtain endometrial samples for cytological tests on the 21st and 30th day postpartum. During the final week of pregnancy and the first, second, third, and fourth weeks' post-partum, the mean rectal temperature (ºF) varied from 101.7 ± 0.07 to 102.0 ± 0.06 in Group-I and 101.6 ± 0.07 to 102.1 ± 0.05 in Group-II. During the final week pre-partum and the first week post-partum, the mean rectal temperature (ºF) was shown to be significantly ($p<0.05$) lower than it was during the second, third, and fourth weeks post-partum among the groups. On the 21st and 30th day postpartum during endometrial cytology, the percentage of neutrophils was 14.31 ± 1.56 and 12.23 ± 0.93 in Group I and 17.92 ± 1.51 and 15.08 ± 0.73 in Group II, respectively. On the 30th day, there was a significant difference ($p<0.05$) between the groups in Group II that had a greater mean percentage of neutrophils. When endometrial cytology was performed on buffaloes at various postpartum days, the mean percentage of lymphocytes, endometrial epithelial cells and large vacuolated epithelial cells revealed non-significant changes. On the 30th day, it was discovered that the prevalence of subclinical endometritis in Group I and Group II buffaloes was 7.69 and 23.07 percent, respectively. The postpartum first behavioural estrus and first fertile estrus occurred at 62.00 ± 4.34 and 65.31±4.45 days in Group I and 77.46±11.12 and 130.08±9.26 days in Group II buffaloes, respectively. Although, the average days for first behavioural estrus did not differ significantly between the groups the fertile estrus occurred significantly ($P<0.05$) delayed in Group II buffaloes.

Keywords: Cytobrush technique; endometrial cytology; mehsana buffaloes; polymorphonuclear cells.

1. INTRODUCTION

Buffaloes play a significant role in India's agricultural economy and are mostly used as a source of milk and meat in tropical and subtropical regions. After calving, the health of the uterus has a significant impact on the reproductive success of dairy cows. Reproductive performance is negatively impacted by postpartum endometritis because it lowers the rate of conception and increases services per conception [1]. Compared to cows, buffalo had a significantly higher prevalence rate of uterine infection [2]. There are clinical and subclinical subtypes of endometritis. A uterine discharge that is purulent or mucopurulent and appears 21 or 26 days postpartum is considered clinical endometritis. When uterine cytology samples taken between 21 and 33 days postpartum show more than 18% polymorphonuclear (PMNs) cells or when samples taken between 34 and 47 days postpartum show more than 10% PMNs, it is considered subclinical endometritis. Although subclinical endometritis does not cause uterine discharge, the disease is nonetheless thought to be severe enough to affect a cow's ability to reproduce [3]. Uterine cytology is a new endometritis diagnosis technique that has been employed recently in bovine gynaecology mostly to identify subclinical endometritis in clinically healthy cows. The primary inflammatory cell type observed in intrauterine fluid accumulations is polymorphonuclear cells (PMNs). Research has demonstrated that the relative number of PMNs can predict the reproductive performance of postpartum cows. Gilbert *et al*., [4] Kasimanickam *et al*., [5]. It has been proposed that the cytobrush technique is a more consistent and dependable way to extract inflammatory cells [6]. Dairy producers and veterinary professionals have embraced the methodology for tracking postpartum cows' daily rectal temperatures since it provides an objective response that can be utilized to assess health. The majority of research in the literature now under publication focuses on the connection between puerperal metritis and rectal temperature; however, there is little data connecting postpartum endometrial cytology, subclinical endometritis and rectal temperature in periparturients. While postpartum buffalo rectal temperature is frequently used as a monitoring tool, nothing is known about the use or importance of rectal temperature and postpartum endometrial cytology investigation as diagnostic techniques for sub-clinical endometritis in buffalo. This being the case, the suggested study on rectal temperature and endometrial cytological examination during the periparturient phase and the occurrence of the first post-partum estrous with behavioural indications in Mehsana buffaloes was carried out considering these facts.

2. MATERIALS AND METHODS

2.1 Animals

A total of 26 Mehsana buffaloes, irrespective of parity and body weight with a history of normal calving kept at Livestock Research Station, SDAU, Sardarkrushinagar, Gujarat, were used for the present study. According to the farm's regular feeding schedule, all of the buffaloes were kept in clean well-ventilated sheds and fed fresh fodder, hay and compounded concentrate. Throughout the study period, the zone's average lowest and maximum ambient temperatures as well as relative humidity ranged from 17.95 °C to 32.25 °C and 48.5% to 73%, respectively.

2.2 Body Temperature

The rectal temperature of these buffaloes was recorded in the morning hours from one week prior to parturition to four weeks after parturition with a digital thermometer.

2.3 Uterine Sample Collection

Endometrial samples for cytological examinations were collected on the 21st and 30th days postpartum by using a cytobrush modified for use in large animals. The normal cytobrush was attached to a stainless steel catheter for passage through the cervix. The buffaloes were restrained with their tail secured to one side and the vulva and perianal regions were washed and cleaned. The vulva was dried with a cotton swab prior to passing the instrument through the vagina to the external cervical os and the instrument was advanced through the cervix into the uterus. The cytobrush was exposed against the endometrium by pushing the inner rod of the catheter forward. Endometrial cytology samples were collected by rotating the cytobrush in a clockwise direction while in contact with the uterine wall. The cytobrush was retracted into the stainless steel tube prior to removal from the uterus. The stainless steel device was cleaned with alcohol to avoid contamination between uses.

2.4 Endometrial Cytology

Smears for cytological examination were prepared by rolling the cytobrush on to a clean glass microscope slide and fixing them with methanol for 1 minute. Smears were than stained with field stain (eosin for 45 seconds and methylene blue for 45 seconds) and air-dried. Cytological assessment was performed by counting a total of 100 cells at 400x and 1000x magnification to determine the percentage (%) of neutrophils (PMNs). Initially, the whole slide was assessed and a representative area was selected to determine the neutrophils, lymphocytes, endometrial epithelial cell and large vacuolated epithelial cells. Slides for cytological examination were assessed twice to estimate polymorph nuclear leukocytes/neutrophils per cent (%). Buffaloes with >18 % PMNs in the uterine samples were regarded as affected by subclinical endometritis with no gross signs of endometritis as per Sheldon *et al*., [3].

2.5 Statistical Analysis

The collected data were subjected to statistical analysis using the SPSS software, version 18. Analysis of Variance (ANOVA) was conducted to check for significant differences between the means of rectal temperature as well as endometrial cytology between the groups of animals. As per usual statistical technique, the data gathered from research work were statistically analysed using the "t-test." Snedecor and Cochran, [7]. *p*-value less than .05 was considered as significant.

3. RESULTS AND DISCUSSION

3.1 Rectal Temperature

The buffaloes in Group I and Group II had average rectal temperatures (ºF) ranging from 101.7± 0.07 to 102.0± 0.04 ºF and 101.6±0.07 to 102.0±0.04 ºF, respectively (Table 1 and Fig. 1). The study observed rectal temperature ranges that are in good agreement with Chandra Bhan [8] observations on cattle. In comparison to the second, third and fourth weeks postpartum within the groups, the mean rectal temperature (ºF) was observed to be considerably ($p<0.05$) lower during the last week of prepartum and the first week postpartum. Whereas, the difference observed was non-significant between the groups at all other periods and among the 2nd, 3rd and 4th weeks postpartum within both groups (Table 1). Vickers *et al*. [9] showed higher rectal temperatures in healthy cows compared to the current findings. On the other hand, Wagner *et al*. [10] suggested that tissue damage related to calving trauma could be the cause of an elevated rectal temperature in a healthy cow. According to studies by Suthar *et al*. [11] and Burfeind *et al*. [12] ambient temperature affects body temperature; primiparous cows had a body

temperature that was 0.2°C higher than multiparous cows.

3.2 Endometrial Cytology

3.2.1 Neutrophils

Table 2 and Fig. 2 show that the mean percentage of neutrophils seen during endometrial cytology in buffaloes at the 21st and 30th day postpartum were 14.31 ± 1.56 and 12.23 ± 0.93 in Group I and 17.92 ± 1.51 and 15.08 ± 0.73 in Group II, respectively. A non-significant decline in per cent neutrophils was observed at different days postpartum within the groups of buffaloes at different periods of endometrial cytology. Comparable outcomes were seen using cytobrush techniques in cows at days 21 and 28 postpartum by Saut *et al*. [13] and at day 26 postpartum by Brodzki *et al*. [14].

On day 21, there was no statistically significant difference in the mean percentage of neutrophils in the buffaloes belonging to Group II and Group I. On day 30, a significant difference ($p<0.05$) was noted between the groups, with Group II exhibiting a greater mean percentage of neutrophils in comparison to Group I. The current study's results are consistent with those of McDougall *et al*. [15] who found that cows in the highest quartile for PMNs percent at days 28 and 42 experienced a lower pregnancy rate and a longer time to conception than cows in the lower PMNs percent categories. According to Nibret Moges. [16] following sampling, the cows that conceived during the first artificial insemination had fewer neutrophils overall. Nonetheless, Ahmadi *et al*. [17] found no statistically significant variation in the percentage of cells in cows that were conceived through one or multiple artificial inseminations.

3.2.2 Lymphocytes

In Group-I, the mean percentage of lymphocytes detected during endometrial cytology was 0.31 ± 0.13 and 0.23 ± 0.12, while in Group-II, it was 0.38 ± 0.14 and 0.23 ± 0.12 (Table 2). At various postpartum days, both within and between groups, there was a non-significant decrease in the percentage of lymphocytes. These research results were in good agreement with the findings in cows Oruc *et al*., [18] and buffaloes Selvaraj *et al*., [19]. Variations in the lymphocytic image may result from differences in the species, cytology site, cytological methods, and reproductive phase.

3.3 Endometrial Epithelial Cells (EPC) and Large Vacuolated Epithelial Cells (LVEC)

The mean percentage of endometrial epithelial cells observed during endometrial cytology in buffaloes at 21st and 30th day postpartum were 80.23 ± 2.49 and 84.69 ± 1.97 in Group I and 81.15 ± 1.84 and 83.85 ± 1.04 in Group II, respectively and The mean percentage of large vacuolated epithelial cells observed during endometrial cytology in buffaloes at 21st and 30th day postpartum were 9.77 ± 0.56 and 10.77 ± 0.71 in Group I and 9.85 ± 0.54 and 10.54 ± 0.45 in Group-II, respectively (Table 2). These findings corroborated well with the findings in cows at 25 to 30 days post-parturition [13]. In comparison to these, higher per cent of endometrial epithelial cells have been reported in buffaloes Selvaraj *et al*., [19] and in ewes and dairy cows using cervical and uterine cytology during estrus phase [20]. Whereas, lower values have been reported in cow using cytobrush at luteal and follicular phases of estrus cycle Brodzki *et al*., [21] and Brodzki *et al*., [14] and in dairy cows in cervical and uterine cytology [22].

However, the difference reported by various authors for EPC and LVEC was non-significant. Similarly, a non-significant increase in the per cent EPC and LVEC at different days postpartum within and between the groups was also observed in these studies.

Table 1. Prevalence of subclinical endometritis at different days in different groups of Mehsana buffaloes

Days of Postpartum	Neutrophils Counts (%)	Groups			
		G1 (n=13)		G2 (n=13)	
		Frequency	%	Frequency	%
21st	< 18	11	84.61	9	69.23
	> 18	2	15.38	4	30.76
30th	< 18	12	92.30	10	76.92
	> 18	1	7.69	3	23.07

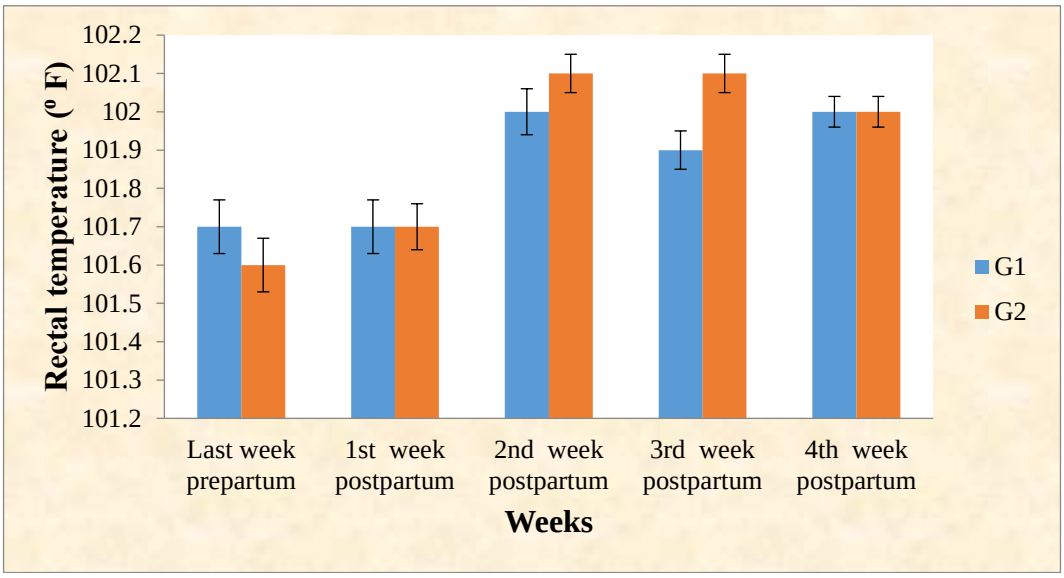

Fig. 1. Rectal temperature (ºF, Mean ± SE) at different weeks in different groups of postpartum Mehsana buffaloes

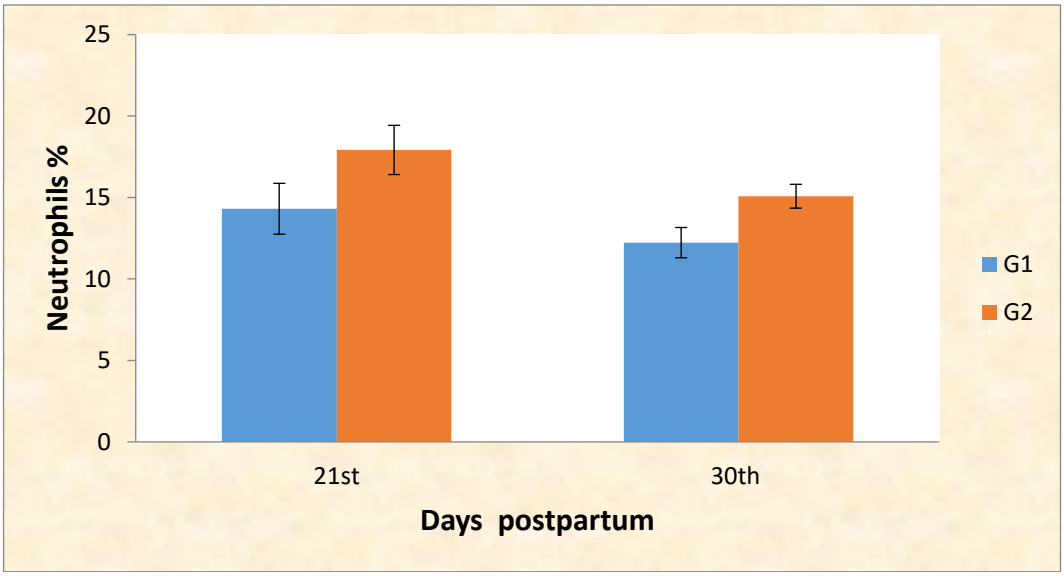

Fig. 2. Per cent neutrophil (Mean ± SE) count during endometrial cytology in different groups of postpartum Mehsana buffaloes

Table 2. First behavioral and fertile estrus (days, Mean ± SE) in postpartum Mehsana buffaloe

Estrus Parameter (Days)	Groups		't' value
	G1 (n=13)	G2 (n=13)	
First behavioral estrus	62.00±4.34	77.46±11.12	1.23^{NS}
Fertile estrus	65.31±4.45	130.08±9.26	6.30^{**}

*NS= Non-significant, ** = Significance at 5% and 1% level.*

3.4 Prevalence of Subclinical Endometritis

Cytological smears are evaluated for their proportion of polymorph nuclear cells (PMNs) in a sample. An increased proportion of PMNs is prognostic for impaired subsequent reproductive performance [5]. In these studies, we adopted the criteria as per Kasimanickam et al. [5] and Sheldon *et al*. [3] who considered cows to suffer

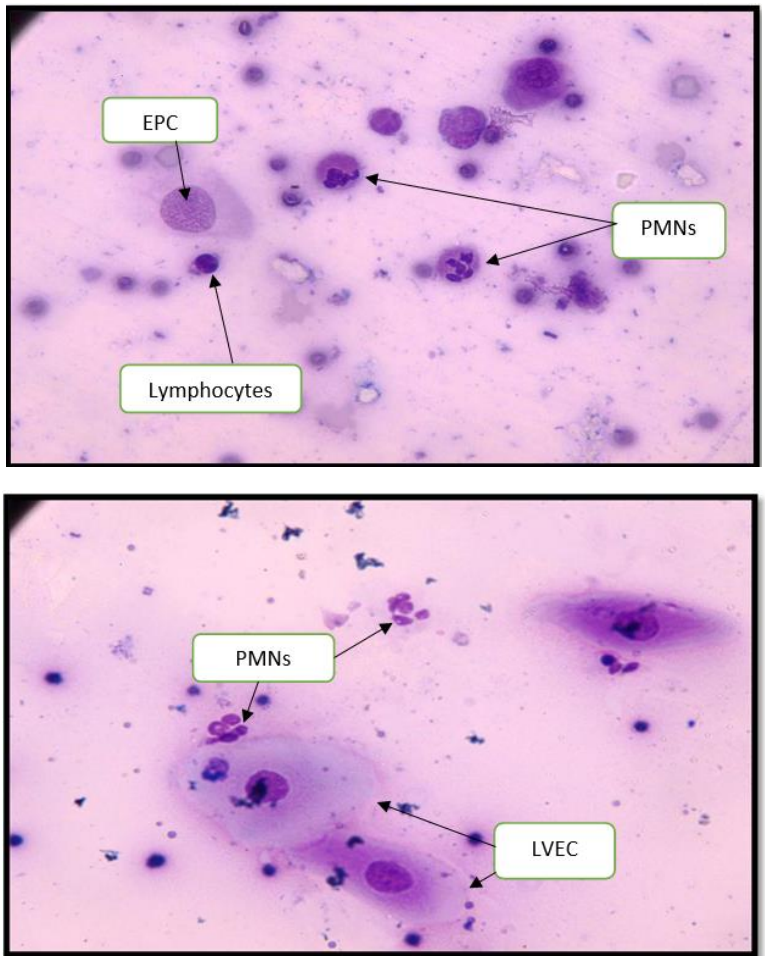

Fig. 3. Different cell types during endometrial cytology at postpartum in Mehsana buffalo (Eosin & Methylene blue stain, 1000X)

Table 3. Rectal temperature (ºF, Mean ± SE) at different weeks in different groups of postpartum Mehsana buffaloes

Weeks	Groups		Overall mean
	G1 (n=13)	G2 (n=13)	
Last week pre-partum	$101.7\pm0.07^{a}_{p}$	$101.6\pm0.07^{a}_{p}$	101.6±0.07
1st week postpartum	$101.7\pm0.07^{b}_{p}$	$101.7\pm0.05^{b}_{p}$	101.7±0.06
2nd week postpartum	$102.0\pm0.06^{c}_{q}$	$102.1\pm0.04^{c}_{q}$	102.0±0.05
3rd week postpartum	$101.9\pm0.05^{d}_{q}$	$102.1\pm0.05^{d}_{q}$	102.0±0.05
4th week postpartum	$102.0\pm0.04^{e}_{q}$	$102.0\pm0.04^{e}_{q}$	102.0±0.04

Means with different superscripts within rows & subscripts within columns differ significantly at 5 per cent level.

from subclinical endometritis if the PMNs exceeded 18% between 20th and 33rd days postpartum. Results show that the prevalence of subclinical endometritis at 21st day postpartum was found to be 15.38 and 30.76 per cent and at 30th day postpartum, it was 7.69 and 23.07 per cent in Group I and Group II, respectively (Table 3). These findings are in accordance with reports in buffaloes Senosy and Hussein, [23] in cows Zobel, [24] and Nibret Moges, [16]. Whereas, Saut *et al*. [13] have reported a higher prevalence in clinically healthy crossbred dairy cows with normal delivery at days 21 and 28 postpartum by cytobrush technique. Similarly, a higher prevalence was observed on the 21st and 30th day postpartum in the group II buffaloes that were conceived after 90 days. Thus, the present study proved that the cytobrush technique can be reliably used to obtain endometrial samples as well as to know the prevalence of subclinical endometritis which is in accordance with the findings of Kasimanickam *et al*., [6].

Table 4. Different cell types (per cent, Mean ± SE) during endometrial cytology of postpartum Mehsana buffaloes

Type of cell	Days of postpartum	Groups		Overall mean
		G1 (n=13)	G2 (n=13)	
Neutrophils	21st	14.31±1.56$^{a}_{q}$	17.92±1.51$^{a}_{p}$	16.11±1.53
	30th	12.23±0.93$^{a}_{q}$	15.08±0.73$^{b}_{p}$	13.65±0.83
Lymphocytes	21st	0.31±0.13	0.38±0.14	0.34±0.13
	30th	0.23±0.12	0.23±0.12	0.23±0.12
Endometrial epithelial cells	21st	80.23±2.49	81.15±1.84	80.69±2.16
	30th	84.69±1.97	83.85±1.04	84.26±1.50
Large vacuolated epithelial cells	21st	9.77±0.56	9.85±0.54	9.81±0.55
	30th	10.77±0.71	10.54±0.45	10.65±0.58

Means with different superscripts within rows & subscripts within columns differ significantly at 5 per cent level for each type of cell

3.5 First Behavioral Estrus and Fertile Estrus

In Group I buffaloes, the mean postpartum first behavioural estrus happened at 62.00 ± 4.34 days, while in Group II buffaloes, it happened at 77.46 ± 11.12 days (Table 4). The findings in buffaloes by Khasatiya et al. [25] and Kalasariya *et al*. [26] are in good agreement with these findings. Whereas, Rijasnaz *et al*. [27] have reported that buffaloes exhibit relatively higher and earlier days of first behavioural estrous. In Group II buffaloes, fertile estrus was seen to occur 130.08±9.26 days later than in Group I buffaloes, with a significant difference (P<0.05). These results are well supported by the reports on crossbred cows and buffaloes with subclinical endometritis compared to those without the condition had significantly (P<0.05) lower first service conceptions and required more services for conceptions (Sinha *et al*., 2002) and Jan Mustafa *et al*. [28]. Therefore, the different management techniques, nutritional status and subclinical uterine infection could contribute to the observed delayed fertile estrus [29].

4. CONCLUSIONS

The present study concluded that the rectal temperature of buffaloes that became pregnant beyond 90 days was noticeably higher in the second postpartum week. Buffaloes who conceived after 90 days demonstrated significantly higher mean percent neutrophils at the 30th day postpartum along with a higher prevalence of subclinical endometritis. Endometrial cytology revealed a significantly decreasing trend in the appearance of neutrophils at the 21st and 30th days postpartum. When it came to the groups' first behavioural oestrus, there was no significant difference. On the other hand, it was discovered that buffaloes that were conceived after 90 days experienced a significant (P<0.05) delay in postpartum fertile oestrus.

ETHICAL APPROVAL

All experimental procedures were conducted as per the guidelines of the Institutional Animal Ethics Committee (IAEC).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Fourichon C, Seegers H, Malher X. Effect of disease on reproduction in the dairy cow: a meta-analysis. Theriogenology. 2000;53:1729–59.
2. Moghaddam AAI, Mamoei M. A survey on some of the reproductive and productive traits of the buffalo in Iran, In 23rd World Buiatrics. Congress Qu and Eacute, be. 2004;1910
3. Sheldon IM, Lewis GS, LeBlanc S, Gilbert RO. Defining postpartum uterine disease in cattle. Theriogenology. 2006;65:1516–1530.
4. Gilbert RO, Shin ST, Guard CL, Erb HN, Frajblat N. Subclinical endometritis.

Prevalence of endometritis and its effects on reproductive performance of dairy cows. Theriogenology. 2005;64(9):1879–1888.

5. Kasimanickam R, Duffield TF, Foster RA, Gartley CJ, Leslie KE, Walton JS, Johnson WH. Endometrial cytology and ultrasonography for the detection of subclinical endometritis in postpartum dairy cows. Theriogenology. 2004;62:9–23.
6. Kasimanickam R, TF. Duffield, RA. Foster, CJ. Gartley, KE. Leslie, John S. Walton, Walter H. Johnson. A comparison of the cytobrush and uterine lavage techniques to evaluate endometrial cytology in clinically normal postpartum dairy cows. Canadian Veterinary Journal. 2005;46:255–259.
7. Snedecor GW, Cochran KG. Statistical Methods. 8th Edition, Oxford and IBH Publishing Co, New Delhi, India; 1994.
8. Chandra Bhan. Influence of temperature variability on physiological, hematological and biochemical profile of growing and adult Sahiwal cattle: Journal of Environmental Research and Development. 2012;7:2A.
9. Vickers LA, Burfeind O, Von Keyserlingk MAG, Veira DM, Weary DM, W. Heuwieser. Comparison of rectal and vaginal temperatures in lactating dairy cows. Journal Dairy Science. 2010;93:5246–5251.
10. Wagner SA, Schimek DE, Cheng FC. Body temperature and white blood cell count in postpartum dairy cows. Bovine Practitioner. 2008;42:18–26.
11. Suthar VS, Burfeind O, Bonk S, Voigtsberger R, Keane C. Heuwieser W. Factors associated with body temperature of healthy holstein dairy cows during the first 10 days in milk. Journal of Dairy Research. 2012;79:135– 42.
12. Burfeind O, Suthar VS, Voigtsberger R, Bonk S, Heuwieser W. Body temperature in early postpartum dairy cows. Theriogenology. 2014;82(1):121-31.
13. Saut JPE, Selwyn Arlington Headley., Nayara Resende Nasciutti., Cícero Fleury Guedes Martins., Suzana Akemi Tsuruta., Alvaro Moriya Shiota., Raphael Soares de Barros Ramos Oliveira., Ricarda Maria dos Santos., Antonio Vicente Mundim. Comparative analysis between the cytobrush and low viloume uterine flush techniques for endometrial cytology in clinically normal postpartum crossbred dairy cows. Ciencias Agrarias, Londrina. 2013;34(5):2329-2340.
14. Brodzki P, Krzysztof Niemczuk., Krzysztof Kostro., Adam Brodzki., Łukasz Kurek and Jan Marczuk. Cytological evaluation of inflammation of the uterus and influence of endometritis on selected reproductive parameters in dairy cows. Bull Vet Inst Pulawy. 2014;58:235-242.
15. McDougall S, Hassan Hussein, Danielle Aberdein, Kelly Buckle, John Roche, Chris Burke, Murray Mitchell, Susanne Meier. Relationships between cytology, bacteriology and vaginal discharge scores and reproductive performance in dairy cattle. Theriogenology. 2011;76:229–240.
16. Nibret Moges. Diagnosis of subclinical endometritis during postpartum period on subsequent pregnancy in small, medium and large scale dairy farms in and around gondar, North West Ethiopia. Journal of Reproduction and Infertility. 2015;6(1):05-10.
17. Ahmadi RM, Saeed Nazifi Ghaisari HR. Comparative cervical cytology and conception rate in postpartum dairy cows. Veterinarski arhiv. 2006;76(4):323-332.
18. Oruc E, YS. Saglam, B. Polat, M. Cengiz, A. Colak, S. Altun, O. Cannazik, KA. Terim kapakin. the evaluation of endometrial cytology in cows with acute and chronic endometritis. Veterinarski Arhiv. 2015;85(2):131-140.
19. Selvaraj J, Murali Manohar B, Prabhakar TG, Balachandran C, Devanathan TG. Endometrial cytology in different pathological conditions of uterus in she-buffaloes; Buffalo Bulletin. 2014; 33:(4).
20. Benbia S, Yahia M, Boutelis S, Chennaf A, Yahia Massinissa. Evaluation of the cytology and histology of uterus and cervix as predictors of estrous stages in ewes and dairy cows. Proceedings of the 2013 International Conference on Biology and Biomedicine; 2013.
21. Brodzki P, Adam Brodzki, Krzysztof Kostro, Lukasz Kurek, Jan Marczuk, Laszek Krakowski. Cytological image of the endometrium in cows in follicular and luteal phases of the ovarian cycle and in cows with follicular and luteal ovarian cysts. Bull vet inst pulawy. 2014b;58:141-147.
22. Yavari M, Haghkhan M, Ahmedi MR, Gheisari HR, Nazif S. Comparison of cervical and uterine cytology between

different classification of postpartum endometritis and bacterial isolates in Holstein dairy cows. International Journal of Dairy Science. 2009;4(1):19-26.
23. Senosy W, Hussein HA. Association among energy status, subclinical endometritis postpartum and subsequent reproductive performance in Egyptian buffaloes. Animal Reproduction Science. 2013;140:40–46.
24. Zobel R. Endometritis in simmental cows: incidence, causes and therapy options. Turkistan Journal Veterinary Animal Science. 2013;37:134-140.
25. Khasatiya CT, Kavani FS, Dhami AJ, Derashri HJ, Panchal MT, Desai PM. Studies on Puerperal Events and Reproductive Efficiency Following Hormone Therapy at Day 42 Postpartum in Surti Buffaloes; International Journal of Agriculture and Biology. 2006;8:132–137.
26. Kalasariya RM, Dhami AJ, Hadiya KK, Borkhatariya DN, Patel JA. Effect of peripartum nutritional management on plasma profile of steroid hormones, metabolites and postpartum fertility in buffaloes, Veterinary World. 2017;10(3):302-310.
27. Rijasnaz V, Pandey HO, Patel BHM, Tomar AKS, Mondal SK, Singh G. Effect of weaning on postpartum reproductive performance of Murrah buffaloes, Livestock Research for Rural Development. 2012;24(5).
28. Jan Mustafa H, Kumar Harendra, Sharma Rakesh K, Kumar Sanjay and Gupta Ashish. Prevalence, Risk Factors and Impact of Subclinical Endometritis on Reproductive Performance of Nili-Ravi Buffalo. Journal of Animal Research. 2019;9(2):2249-5290
29. Reddy AO, Tripathi VH, Raina VS. Factors affecting postpartum reproductive efficiency in Murrah buffaloes. Indian Journal of Animal Science. 1986;56:1224-1228.

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