A Seminar Paper on

Evaluation of Reproductive Health through Vaginal Examination in Black Bengal Goat

Course Title: Seminar Course

Course Code: GOR 698

Term: Winter, 2022

Submitted to

Course Instructors

Dr. A. K. M. Aminul Islam
Professor
Dept. of Genetics and Plant Breeding,
BSMRAU

Dr. Satya Ranjan Saha
Professor
Department of Agroforestry and Environment,
BSMRAU

Dr. Dinesh Chandra Shaha
Associate Professor
Department of Fisheries Management,
BSMRAU

Dr. Shaikh Shamim Hasan
Professor
Department of Agricultural Extension,
BSMRAU

Major professor

Dr. Ziban Chandra Das
Associate Professor
Dept. of Gynecology, Obstetrics and Reproductive Health,
BSMRAU

Submitted by

Taniya Sultana
Reg. no: 16-05-4006
MS student
Dept. of Gynecology, Obstetrics and Reproductive Health
BSMRAU

Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706

Evaluation of Reproductive Health through Vaginal Examination in Black Bengal Goat[1]

By

Taniya Sultana[2]

ABSTRACT

Vaginal examination is a good aid to evaluate the reproductive health of Black Bengal goat. Vaginal examination can be done by vaginoscopy, metricheck and vaginal cytology technique. It is done to detect the normal physiological conditions (e.g. healthy reproductive tract, estrous cycle, earliest stages of pregnancy) and pathological conditions (e.g. clinical endometritis, metritis, pyometra, cervicitis & vaginitis etc.) in Black Bengal goat. A comprehensive literature review was conducted to detect endometritis and other reproductive illnesses (including metritis, cervicitis, and vaginitis etc.) and also to identify different stages of estrous cycle and pregnancy. The seminar paper is a review paper and all the data and relevant information were collected from the secondary sources. This review paper describes the way to detect the incidence of endometritis and other reproductive diseases by using vaginoscopy and metricheck device technique. The incidence of clinical endometritis was observed 1.3% and 13.3% to19.3%. This review paper also describes the detection of subclinical and clinical endometritis and different stages of estrous cycle and pregnancy using vaginal cytology. Neutrophil percentage in estrus, metestrus and early, mid and late diestrus was observed 3.0%, 0.9% and 0.5, 0.5 and 0.55% respectively. Furthermore, the study highlights along with vaginoscopy examination, metricheck device and cytological examination of vaginal mucus samples might be the most definite diagnosis tool to determine the presence or absence of infections or inflammations in reproductive tract and also to identify different stages of estrous cycle and pregnancy.

Keywords: Black Bengal goat, Reproductive disease**,** Reproductive health, vaginoscopy, vaginal cytology

---

[1]A seminar paper for the course GOR 698, winter, 2022

[2]MS student, Department of Gynecology, Obstetrics and Reproductive Health, BSMRAU, Gazipur-1706

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Bangladesh is a south Asian developing nation with a big population that mostly relies on agriculture for its economy. The livestock sector is a crucial component of Bangladesh's agricultural economy. In addition to being a significant source of animal protein, the livestock industry is also crucial for eradicating poverty, creating jobs, empowering women, and generating foreign money. Goats are crucial to the sustainability of the smallholder agricultural system. The goat, a multipurpose animal, is very important to Bangladesh's rural economy. Many small farmers, notably women, landless, and marginal farmers-who seldom ever have any other means of support, rely on it heavily for their livelihood (Choudhury *et al*., 2012).

Reproductive health in animals refers to the overall well-being of an animal's reproductive system, including its ability to produce viable offspring. It encompasses various aspects such as reproductive anatomy and physiology, hormonal regulation of the reproductive system, and the animal's ability to mate and conceive. Reproductive competence is undoubtedly a trait of great importance for the livestock sector. A healthy reproductive tract is a must for better reproductive performance. However, reproductive diseases may substantially impair reproductive efficiency of goat. Therefore, maintaining proper reproductive health of a goat is essential for a sustainable farming system. It is to be noted that mucopurulent vaginal discharge is one of the major clinical findings with predictive value for decreased fertility (Leblanc *et al.*, 2002).

Vaginal examination is a common practice in animal husbandry, particularly in the breeding of livestock. It is performed to assess the reproductive status of female animals and to determine the best time for breeding. In Black Bengal goats, vaginal examination may be performed to assess the readiness of the female for breeding or to determine if she is pregnant. Regular vaginal examination in Black Bengal goats can help to detect any reproductive health problems. Early detection of such issues can lead to prompt treatment, resulting in improved reproductive performance and increased herd productivity. Moreover, regular vaginal examination can help to identify the optimal time for breeding, which can improve the chances of successful fertilization and pregnancy.

An accurate early pregnancy diagnosis is now more important than ever because of the extensive Black Bengal goat production and the widespread use of controlled breeding

procedures like artificial insemination (Doize *et al.*, 1997). Besides, natural breeding and artificial insemination is done in the estrus stages of estrous cycle. So, identifying different stages of estrous cycle is also very important to obtain successful reproduction. Otherwise if breeding is done in wrong time, though the goat is healthy, successful reproduction cannot be achieved. Besides if breeding is done in goat which have reproductive diseases, then successful reproduction is impossible. However, recently, several researchers have taken the initiative to use ultrasonography to diagnose pregnancy in both large and small ruminants. But by ultrasonography, it is not possible to identify the stages of estrous cycle, and also the presence of reproductive tract diseases. Measurement of the sensitivity and specificity of clinical endometritis is challenging due to the lack of a "gold standard" for the diagnosis of uterine illness. Thus, examinations of vagina using various techniques could provide us a status of the reproductive health of goat, which would be helpful to identify the goats having subclinical infections of the reproductive tract, especially the uterine infection. As a healthy reproductive tract is the main criteria for optimal reproductive success, so the seminar paper has prepared to evaluate the reproductive health through vaginal examination by identifying the physiological conditions (e.g. healthy reproductive tract, estrous cycle, earliest stages of pregnancy) and pathological conditions (e.g. clinical endometritis, metritis, pyometra, cervicitis & vaginitis etc.) of Black Bengal goat.

Objectives

Considering the conditions stated above, the seminar paper has been prepared with the following objectives:

I. To evaluate the reproductive health of Black Bengal goat using different vaginal examination technique (vaginoscopy, metricheck and vaginal cytology)
II. To identify the stages of estrous cycle and pregnancy using vaginal cytology

CHAPTER II

MATERIALS AND METHODS

The seminar paper is exclusively a review paper. As a result, no particular technique is used to gather data. The data and relevant information were collected from the secondary sources.

- It has prepared after thorough analysis of different research papers, articles, and reports in various journals and websites available on the internet.
- Good suggestions, valuable information and kind consideration from my honorable major professor, course instructors and other resources personnel were taken to enrich this paper.

After collecting necessary information, it has compiled and arranged chronologically for better understanding and clarification. Graphical representation of sources of data and information used in the present paper is shown in figure 1.

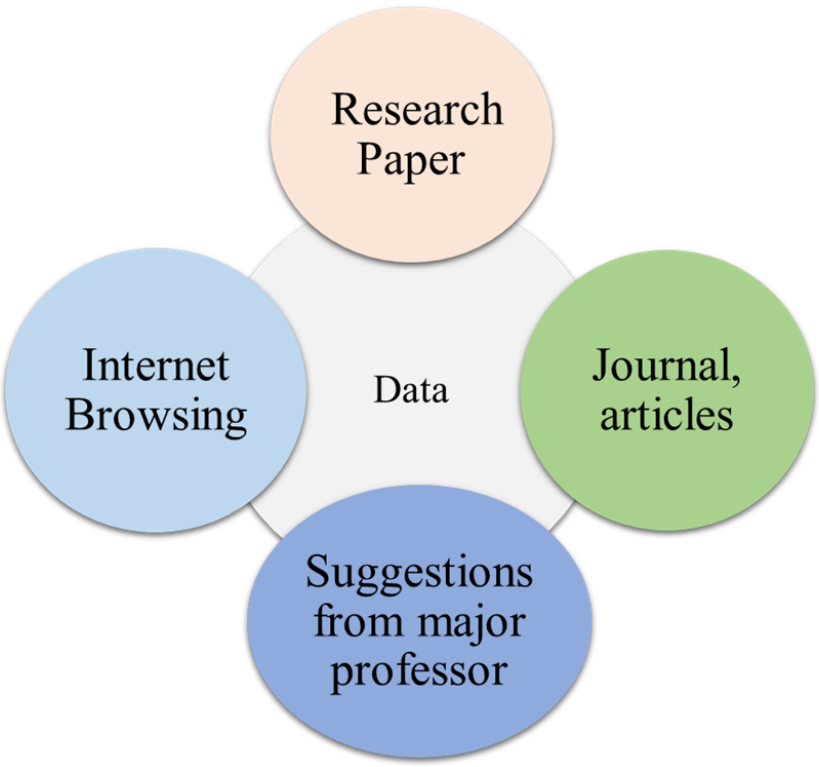


Figure 1. Sources of data and information used in the present paper

CHAPTER III

REVIEW OF FINDINGS

3.1 Reproductive Health

The ability of an animal's reproductive system to create healthy offspring is considered to be one of the main indicators of an animal's reproductive health. It includes a number of elements such healthy reproductive tract and physiology, hormonal control of the reproductive system, and the animal's capacity for mating and conception. Better reproductive performance depends on having a healthy reproductive system (Leblanc *et al.*, 2002).

Criteria for evaluating reproductive health of Black Bengal goat is to identify the physiological conditions (e.g. healthy reproductive tract, estrous cycle, earliest stages of pregnancy) and pathological conditions (e.g. reproductive dseases) of Black Bengal goat.

3.2 Estrous Cycle in Black Bengal goats

The period between two estrus dates is referred to as the estrous cycle. Female goats go through their estrous cycle for 17 to 24 days. The four phases of this cycle are estrus, metestrus, diestrus, and proestrus (Martin *et al*., 2004).

The proestrus, or preparing phase, lasts two to three days. It is the stage when a number of follicles begin to grow in the ovaries under the influence of follicle stimulating hormones (FSHs). Some does may have vaginal secretions at this period, but they are not sexually open to the male (Hafez *et al*., 2000).

Estrus or the heat phase can last anywhere from 12 and 48 hours, but 36 hours is the average. For artificial insemination plans and improved control of mating systems, it is crucial to be able to recognize the onset of heat (Hafez *et al.,* 2000). These mating protocols must be timed correctly to be successful.

Metestrus is the phase that lasts two to three days. As the estrus cycle ends, the doe stops being receptive to the buck, and this is when it all starts. Twelve to thirty-six hours after standing heat ends, does ovulate (Hafez *et al*., 2000).

The cycle's diestrus phase lasts for 15–19 days. There isn't any sexual activity during this protracted interval. Over 14 to 16 days, the corpus luteum (CL) continues to produce progesterone (Hafez *et al.,* 2000). If a doe is not bred and does not become pregnant, the CL in

the doe will regress to terminate diestrus under the influence of prostaglandin-PGF2 released in the uterus.

3.3 Reproductive Diseases

For adequate reproductive performance, a healthy reproductive system is necessary. Postpartum uterine illnesses have a detrimental effect on the ability to reproduce in the future (Runciman *et al*., 2008). For both economic and animal welfare reasons, uterine illnesses are significant. The bacterial infection of the uterus can happen during or right after delivery, coitus, or artificial insemination (Deori *et al.*, 2015). Animal reproductive inefficiency is most commonly caused by postpartum uterine illness (Pascottini *et al*., 2016). The main causes of infertility in goat are metritis, endometritis, pyometra, retention of fetal membranes, and various non-specific uterine infections. Yet, harmful bacteria frequently cause uterine diseases, which impair fertility and output (Sheldon *et al.*, 2017).

3.3.1 Endometritis

Endometritis is inflammation of the endometrial layer of the uterus. There are two different forms of endometritis: subclinical and clinical. Purulent or mucopurulent uterine exudates that can be seen in the vagina after 21 days postpartum are indicative of clinical endometritis (Sheldon *et al.,* 2006). In the absence of purulent discharge from the vagina, subclinical endometritis is characterized as endometrial inflammation as detected by cytology of samples obtained by flushing the uterine lumen or by endometrial cytobrush (Gilbert *et al.,* 2005). Different cutoff criteria for neutrophils in uterine cytology have been used to diagnose subclinical endometritis (Locatelli *et al*., 2013).

3.3.2 Metritis

Inflammation of uterus is called metrits. Within 21 days of delivery, metritis is characterized by an unusually enlarged uterus and a fetid, watery, red-brown uterine discharge. Puerperal metritis is the correct phrase to use when metritis is accompanied with symptoms of a systemic disease (such as dullness, or other toxemia-related symptoms) and a fever more than 39.5°C (Martinez *et al*., 2012). It also has an impact on reproductive failure since animals with metritis have reduced conception rates (Giuliodori *et al.,* 2013).

3.3.3 Pyometra

Pyometra is characterized by the buildup of purulent or mucopurulent material inside the uterine lumen and uterine distension when the corpus luteum is active. As the corpus luteum develops and pyometra occurs, there is frequently an increase in the number of harmful bacteria in the uterine lumen (Grégoire *et al*., 2021).

3.3.4 Cervicitis and vaginitis

Inflammation of cervix is known as cervicitis and inflammation of vagina is called vaginitis. Different infectious organisms and trauma can lead to these diseases. Both of the diseases have strong impact on reproductive failure (Dubuc *et al.,* 2010).

3.4 Different diagnostic method

Different diagnostic techniques such as vaginoscopy, gloved hand, metricheck instrument, vaginal cytology are used for the diagnosis of reproductive diseases (Barlund *et al.,* 2008). Vaginal discharge can be connected to uterine inflammation when it is caused by vaginitis or cervicitis (McDougall *et al*., 2007). Uterine inflammation is diagnosed by vaginoscopy and the use of a vaginal mucus collecting device (Metricheck). For the purpose of identifying clinical endometritis, uterine bacteriology and cytology were used by vaginoscopy (Williams *et al*., 2005). The inspection of the vagina with a vaginoscope is a standard technique for diagnosing vaginal discharge.

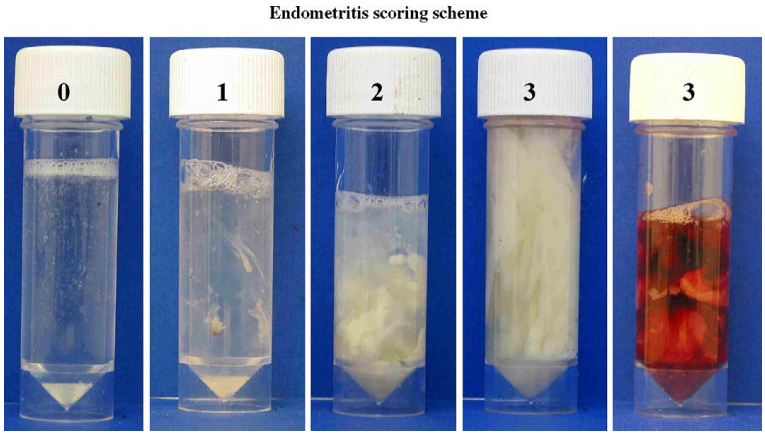
3.5 Vaginoscopy

For determining the kind and severity of reproductive diseases, a vaginoscopy is a helpful diagnostic procedure. It is simple and easy to perform using a vaginal speculum on a goat (Johnson *et al*.,1991). The external cervical os and the lateral, dorsal, and ventral walls of the vagina could be seen when a speculum (SPC) was put into the vagina far enough to allow for this. The only source of illumination was a flashlight. The lack of vaginal distension and the limited visibility of this procedure are its drawbacks.

3.5.1 Vaginoscopy for diagnosing endometritis in Black Bengal goat

According to a study done by (Sheldon *et al*., 2006), total 1281 goats vaginal discharge were taken. Among them, some goats had the incidence of retention of fetal membrane (RFM), metritis etc. The authors detected goats with clinical endometritis by grading the discharge according to a scoring system. This scoring system has been utilized as a prediction of the severity of the infectious process. The discharge was graded based on the color, consistency,

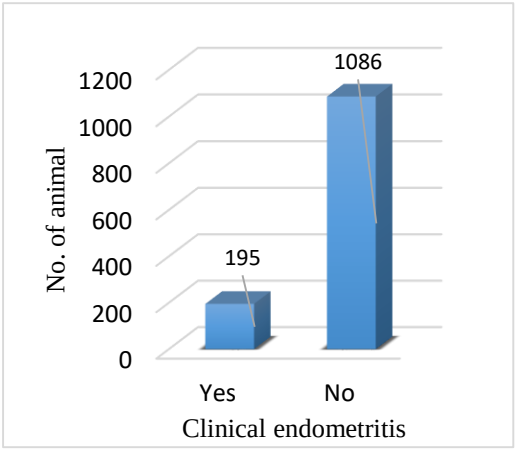
and smell of the contents. The following scale was used to rate the vaginal discharge scores: 0: no discharge; 1: clear mucus; 2: flecks of purulent material in otherwise clear mucus; 3: mucopurulent with less than 50% purulent material; 4: yellowish or brownish discharge with >50% purulent material and no foul smell; 5: yellowish or brownish discharge with >50% purulent material with foul smell (Sheldon *et al.*, 2006). Typical samples of vaginal mucus character is shown in figure 2.



(Source: Sheldon *et al.*, 2006)

Figure 2. Typical samples of vaginal mucus character

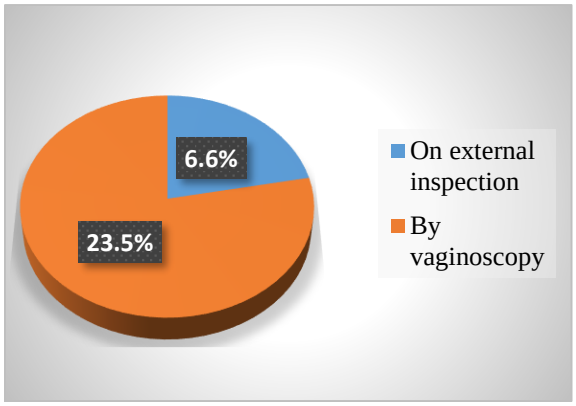
Note: Here, score 0 = clear or translucent mucus; score 1 = mucus containing flecks of white or off-white pus; score 2 = discharge containing 50% white or off-white mucopurulent material; and score 3 = discharge containing 50% purulent material, usually white or yellow, but occasionally sanguineous. Clinical endometritis was characterised by the presence of purulent (>50% pus) or mucopurulent (approximately 50% pus, 50% mucus) uterine exudate in the vagina. The result of the study done by (Sheldon *et al.*, 2006) is summerised in the figure 3.



(Source: Sheldon *et al.*, 2006)

Figure 3. Total no. of goats having clinical endometritis

Another study done by (Leblanc *et al*., 2002), where total 1865 goats were taken and collection of data was continued through November 1999, after it started in July 1998. Goats were first checked during examination to see if the vulva had any discharge. Vaginoscopically checked if discharge was not visible from the outside. The prevalence of clinical findings relevant to endometritis is shown in figure 4 & table 1.



(Source: Leblanc *et al*., 2002)

Figure 4. Prevalence of visible pus discharge

Table 1. Clinical findings in goats undergoing routine reproductive examination by vaginoscopy

Character of discharge	**Vaginal discharge score**	**Total no. of goats**	**Prevalence (%) of goat**
None	0	1865	40.5
Clear mucus	1		29.4
Mucus with flecks of pus	2		10.0
Mucopurulent	3		12.2
Purulent	4		6.6
Foul	5		1.3

(Source: Leblanc *et al*., 2002)

Note: Endometritis was indicated by mucopurulent, purulent & foul vaginal discharge.

According to another study which was done by (Okawa *et al*., 2017), 229 goats were used in the trial, which lasted 27 months from September 2013 to December 2015. Table 2 shows incidence of clinical endometritis obtained from the study.

Table 2. Incidence of endometritis obtained from the study

Group	Vaginal discharge score (VDS)	No. of goat
Non-endometritis	0	168
Mild endometritis	1	30
Severe endometritis	2	20
Severe endometritis	3	11

(Source: Okawa *et al.*, 2017)

Note: Among 229 goats, non-endometritis, mild endometritis and severe endometritis is seen in 168 goats, 30 goats and 31 goats respectively.

Study done by (Leutert *et al*., 2012), total 386 goats were examined by 3 independent investigators twice within 10 min. Four goats had vaginal injuries and two had pyometra, so six goats were cut out of the analysis since their illnesses affected the results of the investigation. Investigator 2 was unable to evaluate 41 goats due to illness. All in all, for all three investigators, 339 paired examination results were available for analysis, and for investigators 1 and 3, 380 paired observations were accessible for analysis. Result of the examination of vaginal discharge scores in goat examined by 3 independent investigators twice within 10 min is shown in table 3.

Table 3. Vaginal discharge scores in goats examined by 3 independent investigators twice within 10 min

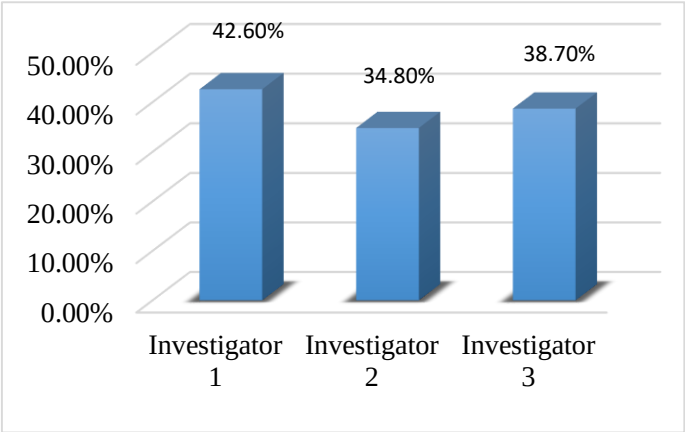
Investigator	Vaginal examination	Number of goats	No. of goats			
			Score 0	Score 1	Score 2	Score 3
1	First	380	218	68	55	39
	Second	380	202	77	60	41
2	First	339	221	45	38	35
	Second	339	214	54	33	38
3	First	380	233	63	45	39
	Second	380	214	83	39	44

(Source: Leutert *et al.*, 2012)

Note: Second vaginal examination was conducted within 10 min after the first examination.

Vaginal discharge score: 0 = clear mucus, 1 = mucus containing flecks of pus, 2 = discharge containing less than 50% pus, 3 = discharge containing more than 50% pus. Score 0 indicated no endometritis, score 1 indicated mild endometritis and score 2 & 3 indicated clinical endometritis.

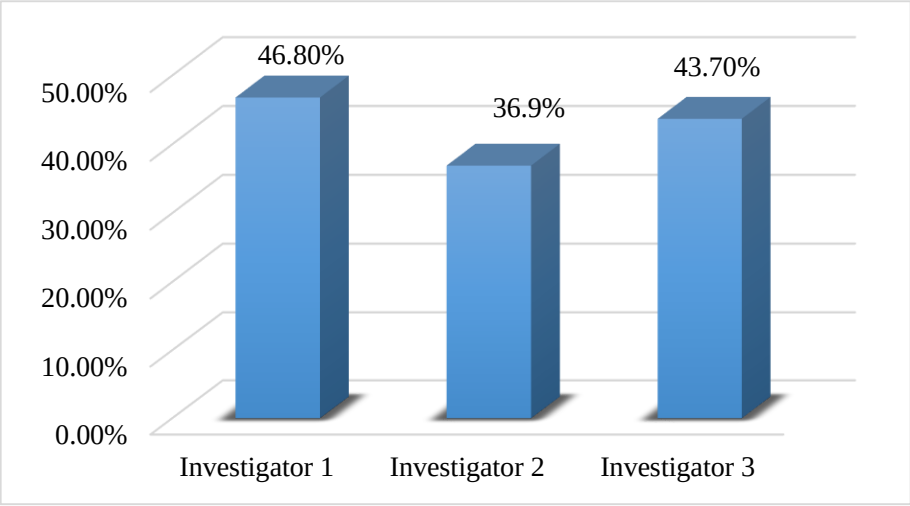
Prevalence of clinical endometritis in first and second vaginal examination is shown in figure 5 & 6 respectively.



(Source: Leutert *et al*., 2012)

Figure 5. Prevalence of clinical endometritis in case of first vaginal examination

Note: The prevalence of clinical endometritis was 42.6%, 34.8%, and 38.7% at the first Vaginal examination for investigators 1, 2, and 3, respectively.



(Source: Leutert *et al*., 2012)

Figure 6. Prevalence of clinical endometritis in case of second vaginal examination

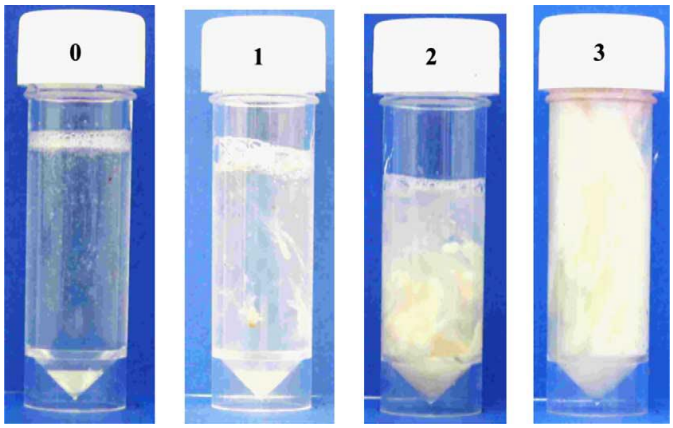
Note: The prevalence of clinical endometritis was 46.8%, 36.9%, and 43.7% at the second vaginal examination for investigators 1, 2, and 3, respectively.

3.6 Metricheck device technique

Just before the vaginal examination, an arm-length gloves is removed from a dispenser box. The vulva and perineum is sprayed with povidone iodine and wiped with dry paper towels before the tool's insertion in order to reduce contamination of the vagina. Before inspection, each tool is moistened with 20 mL of sterile saline solution (0.9%). In the metricheck device (MD) group, the metricheck device is advanced to the cranial extent of the vaginal fornix before retracting caudally. Visual evaluation is done of any material clinging to the silicon hemisphere's surfaces.

3.6.1 Metricheck device for the diagnosis of clinical endometritis

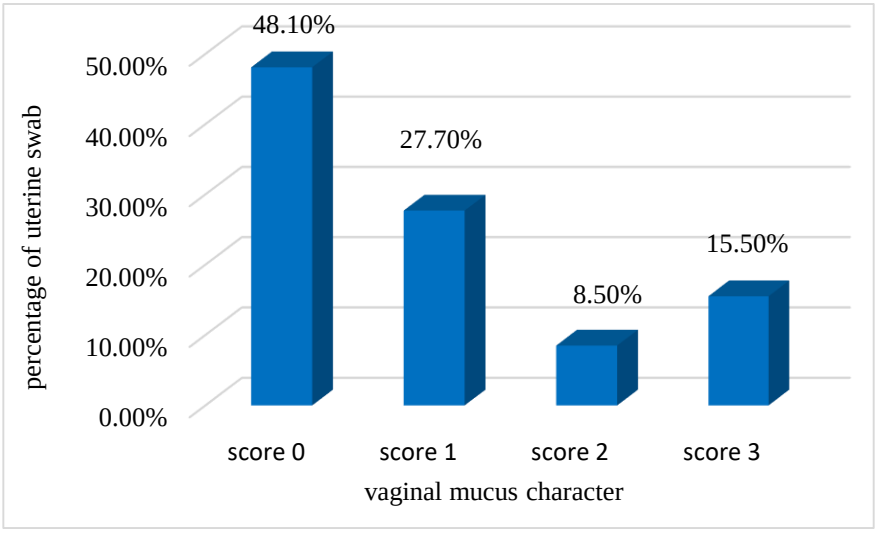
According to (Williams *et al*., 2005), the study included 70 goats in 1999–2000 and 94 goats in 2002–2003; 27 goats were present in both study years. There were 328 uterine lumen swabs collected during the study. The result of the study is presented below in figure 7.



(Source: Williams *et al*., 2005)

Figure 7. Typical samples of vaginal mucus character

Percentages of uterine swab containing vaginal mucus character is shown in figure 8.

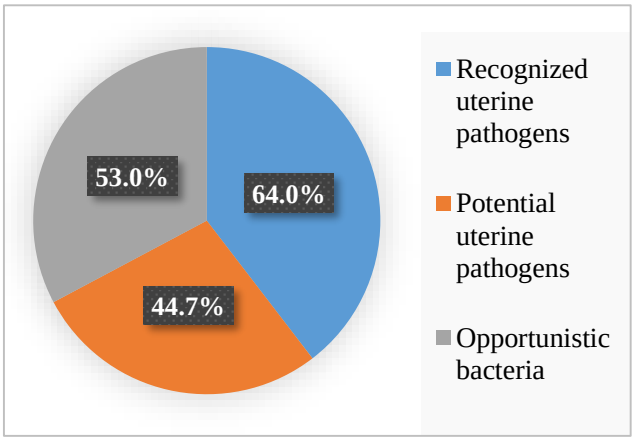


(Source: Williams *et al*., 2005)

Figure 8. Percentages of uterine swab containing vaginal mucus character

Note: Here, 48.1% uterine swab had clear or translucent vaginal mucus (score 0), 27.7% had clear mucus with flecks of pus (score 1), 8.5% had mucopurulent mucus (score 2) and 15.5% had purulent mucus (score 3). The total prevalence of endometritis was 24.0% of goats based on the presence of mucopurulent or purulent mucus.

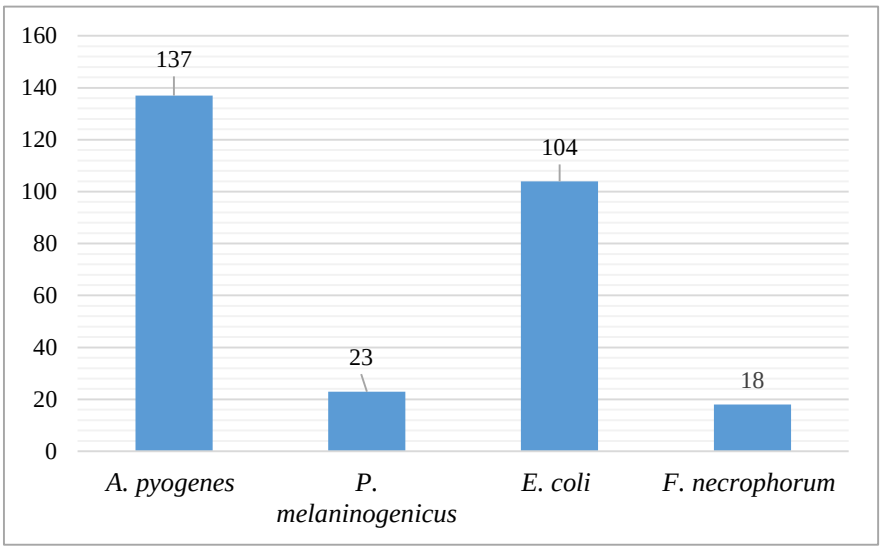
Bacteria were isolated from 88.7% of the swabs, and the result is presented in figure 9.



(Source: Williams *et al*., 2005)

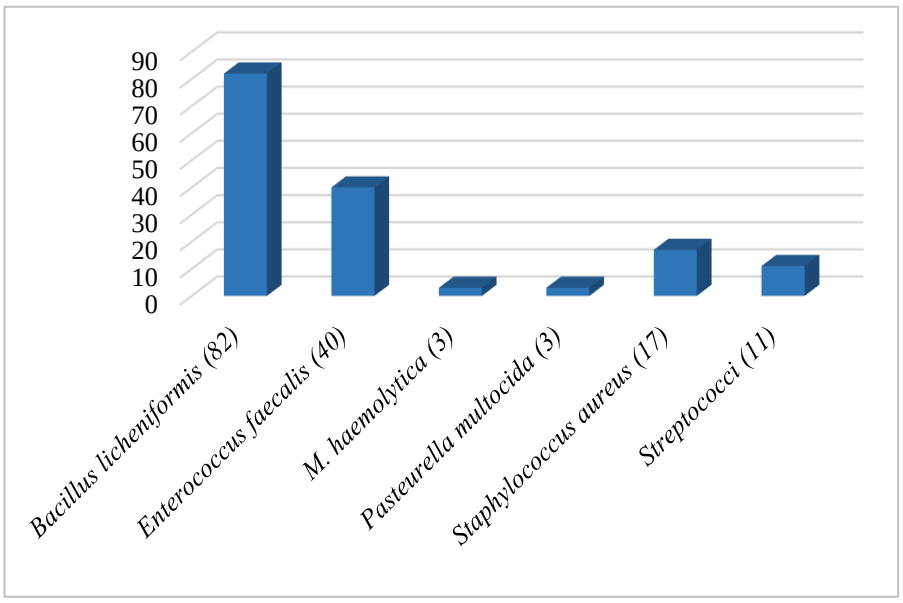
Figure 9. Percentages of bacteria isolated from uterine swab

The prevalence of bacteria is indicated in figure 10, 11 & 12 respectively.



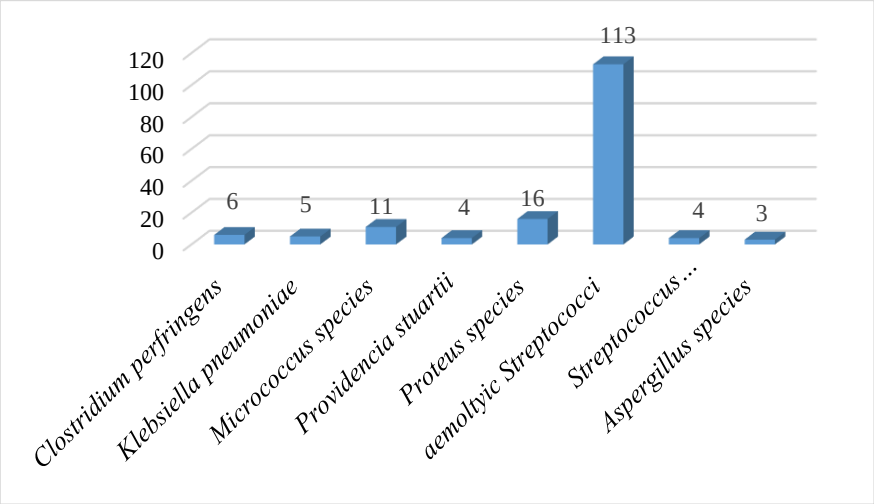
(Source: Williams *et al*., 2005)

Figure 10. Graphical representation of recognized uterine



(Source: Williams *et al*., 2005)

Figure 11. Graphical representation of potential pathogens



(Source: Williams *et al*., 2005)

Figure 12. Graphical representation of opportunistic bacteria

According to another study which was done by (Runciman *et al*., 2008) to diagnose endometritis. Total 1265 goats were used in the trial. Visual vaginal (VV) score at time of examination is shown in table 4.

Table 4. Visual vaginal (VV) score at time of examination

Visual vaginal (VV) score	**Vaginal discharge character**	**No. of goat**
0	No or clear mucus	956 (76%)
1	Mucus with particles of purulent white or off-white material	173 (14%)
2	Discharge containing less than 50% purulent material	80 (6%)
3	Discharge containing more than 50% purulent material	56 (4%)
Total		1265

(Source: Runciman *et al.*, 2008)

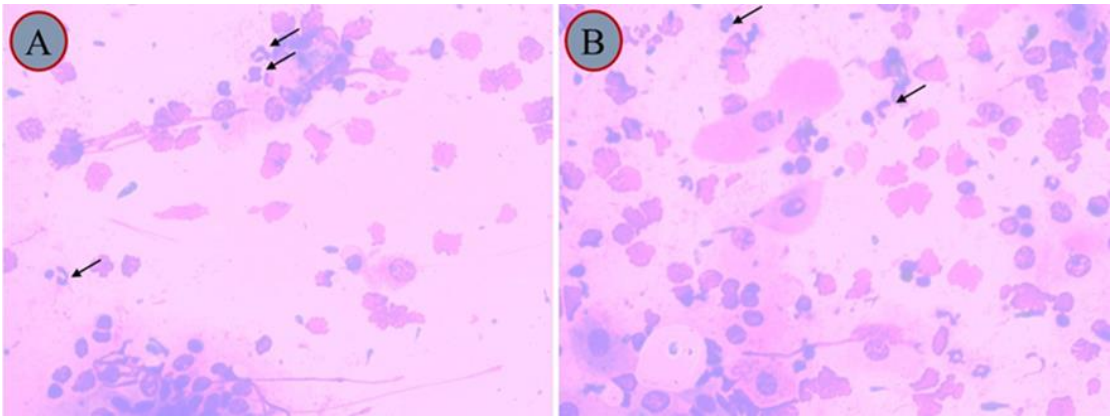
Note: Here, the presence of Visual vaginal (VV) score 1indicated mild infection of uterus or cervix or vagina and visual vaginal (VV) score 2 & 3 indicated the presence of endometritis or cervicitis or vaginitis.

3.7 Vaginal cytology

According to the relative percentages of neutrophil in the vaginal smear cytology, the reproductive cycle's stage status and the amount of infection or contamination in the reproductive tract are both determined (Azawi *et al.*, 2008). Neutrophil presence in the vaginal smear cytology has a healthy threshold of 4.0% and a pathological threshold of >4.0%. (Azawi *et al*., 2008; Leblanc *et al*., 2002; Dubac *et al*., 2010).

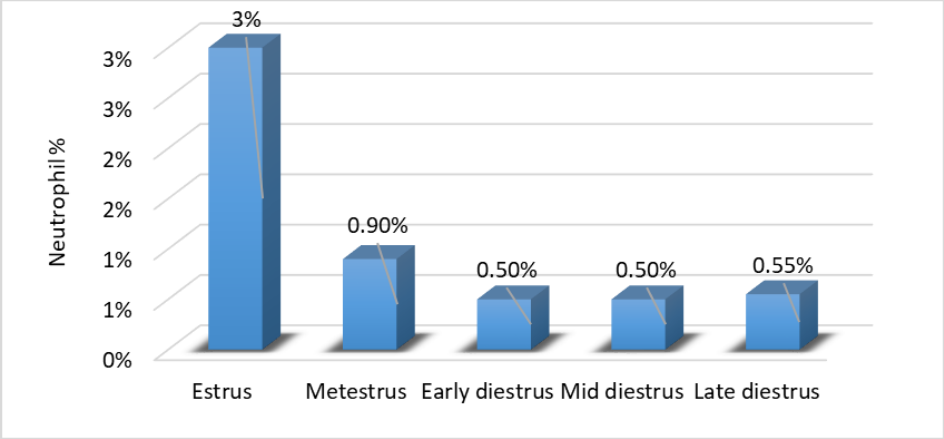
3.7.1 Vaginal cytology examination of goats in different stages of estrous cycle

The study done by (Azawi *et al*., 2008) include 30 goats and used vaginal cytology examination. Here, percentage of neutrophil was detected to identify different stages of estrous cycle. For neutrophil count of 100 cells on each slide, 400x magnification was used. Figure 13 (A, B) shows vaginal cytology examination. Neutrophil percentage in different stages of estrous cycle is shown in figure 14.



(Source: Azawi *et al.*, 2008)

Figure 13. Vaginal cytology examination in goat (Arrows indicate the presence of neutrophils, 13A and 13B)



(Source: Azawi *et al.*, 2008)

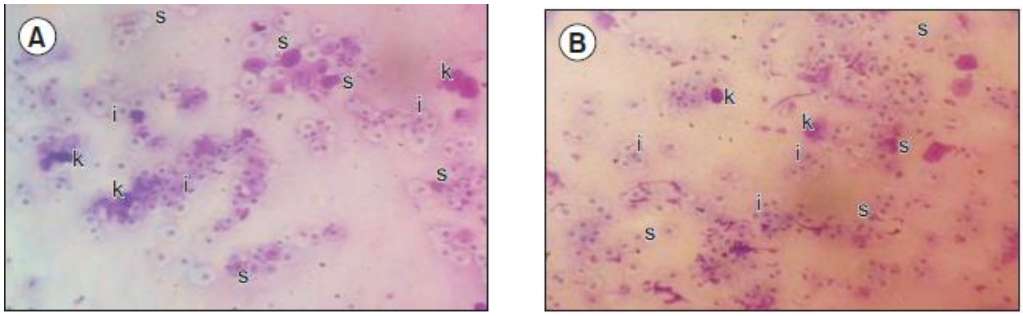
Figure 14. Neutrophil percentage in different stages of estrous cycle

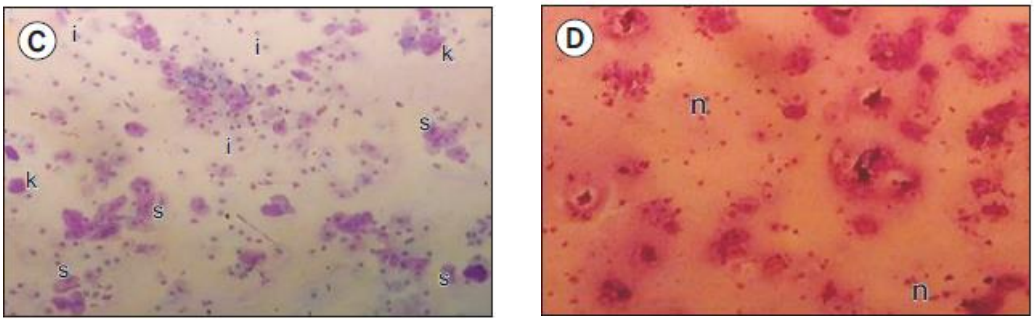
Note: Here, the percentage of neutrophils in the cytologic samples from goats in estrus is 3.0%. Neutrophil percentages in metestrus goat cytologic samples were 0.9% (less than 1%). The cytologic samples from goats in early, mid, and late diestrus had neutrophil percentages of 0.5, 0.5, and 0.55%, respectively, which fell within the physiological range (< 4.0%).

3.7.2 Pregnancy diagnosis in goat by using vaginal cytology

According to a study done by (Ali *et al.*, 2020), 17 pregnant goats were taken and a small scale goat farm in Paharpur, Dinajpur was the site of the study. The percentage of vaginal cells was calculated by dividing the total number of cells observed within three microscopic fields by the number of each type of cell.

5 distinct types of vaginal cells were identified and illustrated in figures (Fig. 15A-D). Figure 1 shows different exfoliative vagina cells during various days of the gestation period of goat.





(Source: Ali *et al*., 2020)

Figure 15: Photomicrographs of exfoliative vagina cells during various days of the gestation period of does

Note: Here, figure 15A: smear of day 24, figure 15B: smear of day 29, figure 15C: smear of day 33, figure 15D: smear of day 39). Name of the vaginal epithelial cells shown as, intermediate (i), superficial (s), keratinized (k) and neutrophil (n).

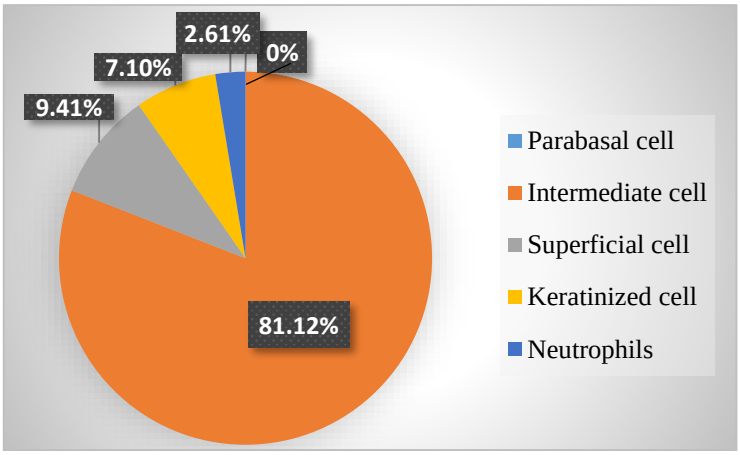
Table 5 shows the percentages of vaginal epithelial cells for various gestational day lengths that was obtained from the study. The parabasal cells were absent during the early stages of pregnancy.

Table 5. Percentage of different exfoliative cells of vaginal smears in early stages of pregnancy in goat

Gestation length (days)	Average percentage of vaginal cells				
	Parabasal (%)	**Intermediate (%)**	**Superficial (%)**	**Keratinized (%)**	**Neutrophils (%)**
22-25	0	78.84	9.61	6.87	4.68
26-30	0	84.15	7.76	5.64	2.45
31-35	0	81.73	9.90	7.34	1.95
36-40	0	79.74	10.35	8.54	1.37
Average (22-40)	0	81.12	9.41	7.10	2.61

(Source: Ali *et al*., 2020)

Average percentage of vaginal cells in gestation length (22-40) days is shown in figure 16.



(Source: Ali *et al*., 2020)

Figure 16. Average percentage of vaginal cells in (22-40) days of gestation length

3.7.3 Vaginal cytology examination of Black Bengal goat for the detection of subclinical endometritis

According to the study done by (Kasimanickam *et al*., 2004), 228 goats were taken. This study only included goats with normal discharge. Clinical endometritis was identified in the goats with abnormal uterine discharge, and they were removed from the study. With the aid of vaginal cytology, subclinical illness was identified in goats that showed no symptoms of clinical endometritis by calculating the fraction of neutrophils present in a sample. Through the use of cytological analysis, the proportion of neutrophils was calculated by counting at least 100 cells at a magnification of 400x. The neutrophil percentages obtained from the study were shown in table 6.

Table 6. Average neutrophil percentage in goat

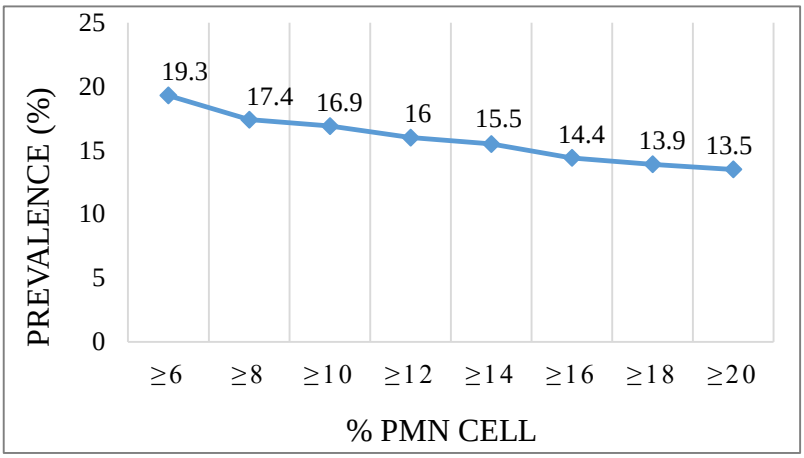
No. of the goats	Days after delivery	Average neutrophil percentage
45	20-30	20–22%
30	20-30	16-20%
60	20-30	18-20%
55	35-45	14-15%
38	35-45	12-14%

(Kasimanickam *et al.*, 2004)

Note: The presence of >18% neutrophils in uterine cytology samples obtained 20–33 days after delivery or >10% neutrophils at 34–47 days after delivery was used to identify subclinical endometritis (Kasimanickam *et al*., 2004).

3.7.4 Vaginal cytology examination of Black Bengal goats for the detection of postpartum endometritis

According to a study done by (Dubuc *et al.*,2010), total 1044 goats were taken for the study. The study was placed in southwestern Ontario (Canada). From September 2007 to November 2008, data were gathered. Between 35 and 56 days after giving birth, all goats were checked for postpartum endometritis. For a differential cell (polymorphoneuclear and endometrial cells) count of 100 cells on each slide, 400x magnification was used. Percentage of polymorphonuclear cell was used to describe the examination's outcome. Prevalence (%) of endometritis from cytological findings of goats between 35 and 56 days after parturition is shown in figure17.



(Source: Dubuc *et al.*, 2010)

Figure 17. Prevalence (%) of endometritis from cytological findings of goats between 35 and 56 days after parturition

Note: Endometritis was indicated by >6% polymorphoneuclear cells. The prevalence (%) of endometritis of goats between 35 and 56 days after parturition ranges from 19.3% to 13.5%.

CHAPTER 4

CONCLUSION

Vaginal examinations evaluate the reproductive health of Black Bengal goat. It is used to identify the physiological and pathological conditions in Black Bengal goat. To assess the reproductive health through vaginal examination, different diagnostic techniques is used including vaginoscopy, metricheck, and vaginal cytology. In the above study it can be evaluated that the incidence of clinical endometritis is 1.3% and 13.3% to19.3%.

Different stages of estrous cycle and pregnancy is identified using vaginal cytology. The percentage of neutrophils in estrus, metestrus and early, mid and late diestrus are 3.0%, 0.9% and 0.5, 0.5 and 0.55% respectively. In the early stages of pregnancy, the average percentage of intermediate cells, superficial cells and keratinized cells are 78.84%, 9.61% and 6.87% respectively. The parabasal cells are absent during the early stages of pregnancy.

Early identification of such issues can result in quick therapy, improving reproductive efficiency and raising herd output. For further accuracy of vaginal examinations, culture-based isolation and identification of bacterial infections' presence or absence in the uterus of goat can be done in future.

REFERENCES

Ali, M. A., Islam, M. F., Rahman, S. L., & Zohara, B. F. (2020). Pregnancy diagnosis in goat by using vaginal cytology and trans-abdominal ultrasonography. *Journal of Animal Reproduction and Biotechnology*, *35*(4), 338-346.

Azawi, O. I. (2008). Postpartum uterine infection in goat. *Animal Reproduction Science*, *105*(3-4), 187-208.

Barlund, C. S., Carruthers, T. D., Waldner, C. L., & Palmer, C. W. (2008). A comparison of diagnostic techniques for endometritis in goat. *Theriogenology*, *69*(6), 714-723.

Barbeau-Grégoire, N., Boyer, A., Rousseau, M., Gauthier, M. L., & Dubuc, J. (2021). Validation of on-farm bacteriological systems for endometritis diagnosis in postpartum dairy cows. *Animals*, *11*(9), 2695.

Choudhury, M. P., Sarker, S. C., Islam, F., Ali, A., Bhuiyan, A. K. F. H., Ibrahim, M. N. M., & Okeyo, A. M. (2012). Morphometry and performance of Black Bengal goats at the rural community level in Bangladesh. *Bangladesh Journal of Animal Science*, *41*(2), 83-89.

Doize, F., Vaillancourt, D., Carabin, H., & Belanger, D. (1997). Determination of gestational age in sheep and goats using transrectal ultrasonographic measurement of placentomes. *Theriogenology*, *48*(3), 449-460.

Dubuc, J., Duffield, T. F., Leslie, K. E., Walton, J. S., & LeBlanc, S. J. (2010). Definitions and diagnosis of postpartum endometritis in goat. *Journal of Dairy Science*, *93*(11), 5225-5233.

Deori, S., & Phookan, A. (2015). Caprine postpartum metritis and its therapeutics: A Review. *Indian Journal of Science and Technology*, *8*(23), 1.

Gilbert, R. O., Shin, S. T., Guard, C. L., Erb, H. N., & Frajblat, M. (2005). Prevalence of endometritis and its effects on reproductive performance of goat. *Theriogenology*, *64*(9), 1879-1888.

Giuliodori, M. J., Magnasco, R. P., Becu-Villalobos, D., Lacau-Mengido, I. M., Risco, C. A., & de la Sota, R. L. (2013). Metritis in dairy cows: Risk factors and reproductive performance. *Journal of Dairy Science*, *96*(6), 3621-3631.

Hafez, E. S. E., & Hafez, B. (2000). Reproduction in Farm Animals, Ed. *Folliculogenesis, Egg Maturation, and Ovulation, 5*, 68-81.

Johnson, C. A. (1991). Diagnosis and treatment of chronic vaginitis in the goat. *Veterinary Clinics of North America: Small Animal Practice*, *21*(3), 523-531.

Kasimanickam, R., Duffield, T. F., Foster, R. A., Gartley, C. J., Leslie, K. E., Walton, J. S., & Johnson, W. H. (2004). Endometrial cytology and ultrasonography for the detection of subclinical endometritis in goat. *Theriogenology*, *62*(1-2), 9-23.

Leblanc, S. J., Duffield, T. F., Leslie, K. E., Bateman, K. G., Keefe, G. P., Walton, J. S., & Johnson, W. H. (2002). Defining and diagnosing postpartum clinical endometritis and its impact on reproductive performance in dairy cows. *Journal of Dairy Science*, *85*(9), 2223-2236.

Leutert, C., Von Krueger, X., Plöntzke, J., & Heuwieser, W. (2012). Evaluation of vaginoscopy for the diagnosis of clinical endometritis in goat. *Journal of Dairy Science*, *95*(1), 206-212.

Locatelli, C., Scaccabarozzi, L., Pisoni, G., Bronzo, V., Casula, A., Testa, F., ... & Moroni, P. (2013). Helcococcus kunzii and Helcococcus ovis isolated in dairy cows with puerperal metritis. *The Journal of General and Applied Microbiology*, *59*(5), 371-374.

Martin, G. B., Rodger, J., & Blache, D. (2004). Nutritional and environmental effects on reproduction in small ruminants. *Reproduction, Fertility and Development*, *16*(4), 491-501.

McDougall, S., Macaulay, R., & Compton, C. (2007). Association between endometritis diagnosis using a novel intravaginal device and reproductive performance in goat. *Animal Reproduction Science*, *99*(1-2), 9-23.

Martinez, N., Risco, C. A., Lima, F. S., Bisinotto, R. S., Greco, L. F., Ribeiro, E. S., ... & Santos, J. E. P. (2012). Evaluation of peripartal calcium status, energetic profile, and neutrophil function in goat at low or high risk of developing uterine disease. *Journal of Dairy Science*, *95*(12), 7158-7172.

Okawa, H., Fujikura, A., Wijayagunawardane, M. M., Vos, P. L., Taniguchi, M., & Takagi, M. (2017). Effect of diagnosis and treatment of clinical endometritis based on vaginal

discharge score grading system in goat. *Journal of Veterinary Medical Science*, *79*(9), 1545-1551.

Pascottini, O. B., Hostens, M., Dini, P., Vandepitte, J., Ducatelle, R., & Opsomer, G. (2016). Comparison between cytology and histopathology to evaluate subclinical endometritis in goat. *Theriogenology*, *86*(6), 1550-1556.

Runciman, D. J., Anderson, G. A., Malmo, J., & Davis, G. M. (2008). Use of postpartum Metricheck (visual vaginal) examination of goats for the diagnosis of endometritis and the association of endrometritis with reduced reproductive performance. *Australian Veterinary Journal*, *86*(6), 205-213.

Sheldon, I. M., Lewis, G. S., LeBlanc, S., & Gilbert, R. O. (2006). Defining postpartum uterine disease in goat. *Theriogenology*, *65*(8), 1516-1530.

Sheldon, I. M., Owens, S. E., & Turner, M. L. (2017). Innate immunity and the sensing of infection, damage and danger in the female genital tract. *Journal of Reproductive Immunology*, *119*, 67-73.

Williams, E. J., Fischer, D. P., Pfeiffer, D. U., England, G. C., Noakes, D. E., Dobson, H., & Sheldon, I. M. (2005). Clinical evaluation of postpartum vaginal mucus reflects uterine bacterial infection and the immune response in goat. *Theriogenology*, *63*(1), 102-117.