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Physical Properties of Estrus Mucus in Relation to Conception Rates in Dairy Cattle

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ABSTRACT

The study aimed to determine the physical characteristics of estrus mucus and conception rates in dairy cattle. Samples of estrus mucus from the cervix were collected from 108 dairy cattle during heat and were examined for color and consistency. Samples were taken from bred animals at starting from day of breeding to the completion of one estrus cycle. The color of the cervical mucus was studied based on its transparency while the consistency was based on the thinness and thickness of the cervical mucus. The dairy cattle were bred and the pregnancy diagnosis was performed at the 60th day post breeding. Findings showed that the estrus mucus of the dairy cattle was transparent in 58.3%, turbid in 31.5% and dirty in 10.2%. It was further observed that the mucus consistency of the dairy cattle was thin in 74.1% and thick in 25.9%. In the pregnant group, 67.3% mucus samples were found transparent, turbid in 23.6% and dirty in 9.1%. However, the corresponding figures for the non-pregnant group had 49.1%, 39.6% and 11.3%. The consistency of cervical mucus was found to be thin in 74.1% and thick in 25.9% of dairy cattle. The conception rates of dairy cattle with thin and thick consistency of cervical mucus were 81.8% and 18.2%, respectively. Pregnant was associated with consistency of cervical mucus (p<0.10). Findings indicated that dairy cattle with thin consistency of cervical mucus and had clear discharge were pregnant cows.

(Key words: dairy cows, estrual cervical mucus, physical characteristics)

INTRODUCTION

Reproductive performance is essential for well-managed and profitable dairy farms (Nebel and Jobst, 1998). The low reproductive efficiency in dairy cattle is usually considered a difficult management problem in dairy farms. With the decreasing profit trends in dairy farming which is reported worldwide, it is necessary to identify the process to improve its efficiency (Bishop, 1964).

The cervix and its secretions play pivotal roles in the reproductive performance of mammals (Hafez and Kanagawa, 1972; Matner, 1973). Cervical mucus (CM) is continuously produced by the secretory cells of the endocervix, and its quality and quantity vary depending on the gonadal hormonal status of the estrus cycle (Elthohamy *et al.*, 1990; Noonan *et al.*, 1995; Tsiligianni *et al.*, 2001). Variations in cervical mucus rheology - flow and deformation properties during the estrus cycle reflect, in part, the response of the cervical epithelium to steroid hormones (Carlstedt and Sheehan, 1989).

Two types of CM are recognized, namely, estrogenic and gestagenic (Vigil *et al.*, 2009) which constituted different subtypes. Biophysical and biochemical characteristics of CM change during estrus cycle in cows. During estrus of the cow, cervical mucus is secreted under the influence of estrogens (Marinov and Lovell, 1967; El-Banna and Hafez, 1978). It has been found that in the ovulation cycle of cows, certain physical properties of the cervical mucus could be used to determine the optimal time for artificial insemination (AI) (Tsiligianni *et al.*, 2000).

Cervical mucus discharge is a mechanical barrier against pathogen of the uterus. Normally, a cow in estrus discharges a viscous liquid from the vulva. The healthy liquid is clear, originates from the cervix and has no bad odor. Clear cervical mucus discharge during artificial insemination (AI) was positively associated with increased first service conception rate

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(Loeffler *et al.*, 1999). Farmers or artificial inseminators claimed that cervical mucus discharge of cows with abnormal appearance in estrus cycle suppressed its repoductive performance (Mahmoudzadeh *et al.*, 2001).

Cervical mucus is an important component of fertility and plays at least two critically physiologic roles in fertility. First, the cervical mucus is essential to sperm survival and transport. The duration of cow's fertility is six days particularly in normal fertile couples. Five day's duration show that the sperm survives in fertile-type mucus and a day for ovulation. Without the fertile mucus, the sperm would only last for hours in the vagina with minimal chance of mating and fertilization of the ovum (Dunson *et al.*, 1999). Immediately, the deposited semen comes in contact with estrus mucus, where the physico-chemical properties affect the spermatoza viability and conception rate of dairy cattle.

Secondly, the nature of cervical mucus has a great influence on spermatoza activity in the female reproductive tract (Sharma and Tripathi, 1987). Cervical mucus has been described as a "biological valve," which admits the sperm to the uterus at certain times of the cycle and inhibits the entrance in other times. During the pre-ovulatory phase of the cycle under the influence of estrogen, cervical mucus forms parallel channels that allow sperm to traverse the cervix and swim up to the fallopian tubes. At this stage, the biological valve-cervical mucus opens. In the post-ovulatory phase and under the influence of progesterone, cervical mucus is thick and blocks the passage of sperm into the uterus. This time, the biological valve of cervical mucus closes (Hilqers and Prebil, 1979).

The study was designed to evaluate the correlation of fertility (conception rates) with color and consistency of the estrus cervical mucus in dairy cattle.

MATERIALS AND METHODS

1. Selection of Animal

One-hundred eight dairy cattle were used in the study and cervical-vaginal mucus samples were obtained from these dairy cattle. Color and consistency of cervical-vaginal mucus were taken immediately. Samples of cervical-vaginal mucus were taken from the cervix of normal cows, which had showed at least one standing estrus. All cows were healthy and free of any abnormal genital tract infection.

2. Heat Detection

Estrus was detected twice daily, in the morning and evening. All cows were considered in estrus when they stood for mounting by another cow. The cows were also monitored both for behavioral symptoms (frequent urination, bellowing, raised tail, restless and licking of external genitalia by other cows) and physical changes (vulvar edema and mucus discharge) of the reproductive tract.

3. Breeding of Animal

Artificial insemination (AI) schedules were recorded by the inseminator. Cows showing signs of true estrus were bred for 12 hours after the onset of estrus by AI. In addition to signs of estrus, the stage of estrus cycle was confirmed by the presence of fluctuant Graafian follicles and the absence of Corpus luteum by rectal palpation in all cows prior to AI.

AI was performed using frozen-thawed semen containing at least 10 million of motile spermatozoa from a single bull with proven fertility. Pregnancy diagnosis was confirmed after 60 days post breeding based on the rectal palpation. When AI resulted in positive pregnancy check, the process was successful. If the cow became non-pregnant by rectal palpation or simply returned to heat, AI was unsuccessful.

4. Measurement of Vaginal Mucus

Cervical mucus sample were collected taking all possible sterile precautions. The vulvar and perineum region were cleaned and dried. The vulvar lips were spread by an assistant and a sterilized insemination gun along with an assembled factory sterilized sheath were passed through the vagina. Collected mucus samples were examined for color (clear or cloudy) and consistency (thin or thick). Mucus was then studied for transparency and consistency by visual examination. These properties were identified and classified Sukhdeo and Roy, 1971.

The transparency of cervical-vaginal mucus was classified into three main types as 1, transparent or like an eggwhite, 2, turbid or cloudy in appearance and 3, dirty, appears non homogeneous colored yellow, ash, grey, red etc., or mixed colors.

The consistency of cervical-vaginal mucus was classified either as 1, thin or flows easily on a glass slide when kept inclined at 450 angle, and 2, thick, sticky mucus samples on a glass slide or does not flow at 450 angle.

5. Statistical Analysis

Ratio (%) in animals of the experimental groups was com-

puted. In order to see magnitude of variation in ratio among animals of groups, the data were subjected to statistical analysis using Duncan's multiple range test.

RESULTS AND DISCUSSION

Physical characteristics including color and consistency of estrus mucus are considered effective laboratory tools in predicting fertility in cattle (Pandey *et al.*, 1983). Also, the cervical mucus has been reported to be a useful indication of potential fertility in dairy cattle (Jeong *et al.*, 2010).

In this study, physical characteristics, color and consistency of the estrus mucus were investigated in dairy cattle. It is well established that during estrus, ovarian steroids induce physico-chemical changes in the cervical mucus which facilitate the passage of spermatozoa. Results on color of the cervical mucus in relation to conception rates are presented in Table 1. Findings indicated that the mucus was transparent in 49.06%, turbid in 39.62% and dirty in 11.32% (non pregnant group). According to Enkhia and Kohli (1982), transparent mucus was found in 50% repeat breeder cows, translucent mucus in 30% and yellowish in remaining 20% cows. Generally, colored cervical mucus has been reported to be a factor in sperm penetration and conception while turbidity in estrus mucus arrests sperm motility (Lopez-Gatius *et al.*, 1993). For optimum fertility, the estrus mucus should be transparent.

Results on the consistency of the cervical mucus in relation to conception rate are presented in Table 2. In this study, the consistency of estrus mucus was found to be thin in 81.82% and thick in 18.18% (pregnant group). Results further revealed that higher conception rate was found in cows with thin consistency of cervical mucus than with thick consistency. This was found to be in agreement with the findings of Sukhdev and Roy (1971) and Vadodria and Prabhu (1990). One cause of low conception rate in thick cervical mucus could be due to intertwined muco-proteins which resist the penetration and progressive movement of the spermatozoa (Odebald, 1968). Gebhard and Schumacher (1970) also reported that profuse watery and clear cervical mucus were favorable for sperm penetration. The consistency of cervical mucus changes during estrus cycle. The average estrus cycle usually lasts for three to four dry days after a five-day menstrual flow. After the dry days, the mucus wetness increases daily, lasting approximately nine days until it becomes abundant, slippery, clear, and very sticky (egg-white-like). Ovulation occurs within two days when the mucus becomes most clear, slippery and sticky.

Estrogen also affects the reproductive tract itself resulting in a thick and clear mucus which is then released within the cervix. The mucus aids in the lubrication of the bull's penis during natural mating and sperm transport into the reproductive tract. The thin, clear and watery mucus discharge from the vulva is a signal that the cow is in estrus. The mucus (egg-white-like) is secreted by the cervix and vagina. The cow's mounting activity causes it to flow from the lips of the vulva, becomes deposited on the tail and pin bones and appeared wet. Sometimes, cows on stanchions of tie-stalls have a pool of clear mucus in the gutter behind them. The mucus discharge is most noticeable during mid-estrus while minimal or less-watery mucus flow during late estrus. The clear discharge should not be confused with white or pus-like discharge which may be an indication of vaginal or uterine infections. Often times, the mucus is observed hanging from the vulva and stays on the

Table 1. Color of cervical-vaginal mucus in pregnant and non pregnant dairy cattle

Particulars	Number of sample taken	Color			*p*-value
		Transparent	Turbid	Dirty	
Non pregnant	53	26 (49.06)	21 (39.62)	6 (11.32)	0.1453
Pregnant	55	37 (67.27)	13 (23.64)	5 (9.09)	

Table 2. Effects of thin and thick consistency of cervical mucus on the conception rates of dairy cattle

Particulars	Number of sample taken	Consistency		*p*-value
		Thin	Thick	
Non pregnant	53	35 (66.04)	18 (33.96)	0.0614
Pregnant	55	45 (81.82)	10 (18.18)	

tail (Fig. 1). As the cow moves its tail, the mucus may spread on its rear/side. Dried mucus leaves a very distinct mark for several hours. All cows in heat produce cervical mucus. However, the mucus may not be expelled by all cows in heat. Thick and clear mucus or those on the tail or hip of the cow is a strong indication of its standing heat. However, non-standing cows should also be inseminated.

CONCLUSION AND RECOMMENDATIONS

The dairy cattle were bred and the pregnancy diagnosis was performed at the 60th day post breeding. Findings showed that the estrus mucus of the dairy cattle was transparent in 58.3%, turbid in 31.5% and dirty in 10.2%. It was further observed that the mucus consistency of the dairy cattle was thin in 74.1% and thick in 25.9%. In the pregnant group, 67.3% mucus samples were found transparent, turbid in 23.6% and dirty in 9.1%. However, non-pregnant group had 49.1%, 39.6% and 11.3%, respectively. The conception rates of dairy cattle with thin and thick consistency of cervical mucus were 81.8% and 18.1%, respectively.

Findings indicated that dairy cattle with thin mucus consistency and had clear discharge were pregnant cows.

Results showed that further studies are needed to clearly define the associations of the mucus characteristics, endocrine status and status of the reproductive system in dairy cattle. Quantitative analyses on protein and steroid hormones, confirmation of ovarian and reproductive tract activity by laparotomy or possibly slaughter and study of additional mucus characteristics such as electrical resistance could be a potential area of study. The value of measuring mucus characteristics depends on the reflection of hormonal levels and balances and the reproductive status of the dairy cattle.

Fig. 1. Mucus stringing from the vulva.

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