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Prevalence and risk factors of sub-clinical mastitis in dairy cows at some selected areas of Patuakhali

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ABSTRACT

The risk factors related to mastitis is necessary for prevention and control of mastitis, an economically important dairy disease. The purpose of the study is to determine the prevalence and identify the potential risk factors of sub-clinical mastitis in dairy cows at some selected areas of Patuakhali district, Bangladesh from March 2017 to February 2018. A total of 200 lactating cows were randomly collected from study area. California Mastitis Test (CMT), White Side Test (WST) and Surf Field Mastitis Test (SFMT) was performed on each quarter sample of lactating cows at field condition for the determination of subclinical mastitis in dairy cows. Overall prevalence of subclinical mastitis was 10% (20/200). The prevalence of subclinical mastitis was comparatively higher in cross breed (65%) as compared to local breed (35%). The highest prevalence of SCM in dairy cows was also found in mid lactation period (64.71%), Backyard rearing of cows (75%), a cow with post parturient disease (75%) and 3rd parity group (45%). Moreover, the cows grazing in free range areas; poor health conditions; season and feeding management increase the susceptibility of SCM. For early diagnosis of subclinical mastitis, CMT could be performed regularly as a control measures and emphasis should be provided on farm management practices, particularly on milking hygiene and udder sanitation.

INTRODUCTION

The term “Mastitis” is derived from Greek Word “masto” which means “breast” (Mammary gland) and “itis” means Inflammation i.e. inflammation of the mammary gland is called mastitis. Mastitis is a general term which refers to inflammation of the mammary gland, regardless of cause. It is characterized by physical, chemical, and usually bacteriological changes in the milk and by pathological changes in the udder. Early recognition and prompt treatment are important for limiting tissue damage and production losses. However, since treatment is often unrewarding, emphasis should be on mastitis control and prevention. There is swelling, heat, pain and in duration in the mammary gland in many clinical cases. However, a large proportion of mastitis, glands are not readily detectable by manual palpation or by visual examination of the milk using a strip cup. Development of the mammary gland in the sheep and goat is identical to that of the cow (Schalm et al. 1971**)**. The teat has a single opening leading into a teat sinus which is continuous with the gland sinus above which a number of large ducts empty.

There are a limited number of studies on the influence of heredity on resistance or susceptibility to mastitis in the cow, goat or sheep. Genes are known to influence the shape and structure of the teat (Hickman, 1964).Mastitis histories of two cow families in different geographical locations revealed significant difference which led to the conclusion that heredity played a part in the infection rate. Dam-daughter comparisons based on data derived from field surveys cite the influence of heredity on mastitis (Rangeland, 1962).The primary cause of mastitis in cattle, goats and sheep are well-recognized groups of

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microorganisms, *Streptococcus sp.*,*Staphylococcus sp, Pasteurella sp., and coliforms, Escherichia coli, Enterobacter sp., and Klebsiella sp.* Recent studies at the University of Missouri collected data on the incidence of subclinical mastitis in ewes and identified Staphylococcus, sp., Streptococcus sp. and Micrococcus sp., found in bacterial cultures (Andrews et al., 1985). Nineteen microorganisms have been identified as causative agents of mastitis in cattle. Yeast and fungus have also been found frequently infecting the udder, but usually go unnoticed because they produce a mild or subclinical mastitis.

Source of infection are contagious pathogens, environmental pathogens and other pathogens. Mastitis is caused by many different infectious agents, commonly divided into Contagious pathogens (*Streptococcus agalactiae, Staphylococcus aureus*, *Mycoplasma bovis*) causing contagious mastitis and Environmental pathogens (*Streptococcus uberis, Streptococcus dysgalactiae* are most prevalent and Gram negative bacteria *Escherichia coli, Klebsiella spp., Citrobacter* spp., *Enterobacter spp., Enterococcus foecalic* etc.) causing environmental mastitis.

Several studies on mastitis include morphology of udder and teats and milk yield (Ahmed et al., 2005), dry cow therapy (Hossain, 2004) and the Occurrence of sub-clinical mastitis (Quaderi, 2005). Prevalence and risk factors of mastitis in dairy cows (Rahman et al., 2009), Udder-related risk factors for clinical mastitis in dairy cows (Nakovet al., 2014), Risk Factors Associated with Mastitis Occurrence in Dairy Herds (Elbablyet al., 2013), prevalence, risk factors and isolation of *Staphylococcus aureus* in dairy herds (Abebe et al., 2016). No precise and comprehensive reports are available, and a study to identify the risk factors related to mastitis is necessary. Clinical mastitis can be diagnosed by signs and strip cup test. Therefore, this study utilized Strip cup test and cow and udder scoring protocols to determine the occurrence of mastitis and the possible risk factors in mastitis. Considering the above facts, the study has been conducted to determine the prevalence and risk factors of mastitis in cow at kolapara, Patuakhali.

MATERIALS AND METHODS

Study area

The study was carried out at Upazila Veterinary Hospital, Kolapara, Patuakhali from 09 March 2019 to 07 Jun 2019 (3 months). Cows from large, small scale and backyard farm are source of population. Pure, cross and local breeds are available.

Data collection

The data is collected by asking the owners about both herd and animal level including type of dairy husbandry system breed, age, parity, lactation stage, milk yield and herd size. Udder and milk abnormalities (injuries, tick infestation and indurations, swelling, milk clots, abnormal secretion, etc.) were recorded. The data was also collected from the hospital record book. Age of the animals was determined by asking the owner and dentition characteristics and categorized as young (>3 to 6 years), adults (>6 to 10 years), and old (>10). Stage of lactation was categorized as early (1st to 4th month), mid (4th to 8th month), and late (8th month to the beginning of dry period). Parity was categorized as few (with 2-3 calves), moderate (with 4–7 calves) and many (>7 calves).

Clinical inspection of udder

The udder was first examined visually and then through palpation to detect possible fibrosis, inflammatory swellings, visible injury, atrophy of the tissue, and swelling of supra mammary lymph nodes. The size and consistency of mammary quarters were inspected for the presence of any abnormalities, such as disproportional symmetry, swelling and firmness. Viscosity and appearance of milk secretion from each mammary quarter were examined for the presence of clots, flakes, blood, and watery secretions. Injuries caused by vigorous calf suckling were identified as circumscribed lesions around the teats. Clinical mastitis was detected based on results of clinical inspection of udder and signs of systemic involvement.

Collection and examination of sample

Milk was collected from the affected teat in a test tube. Immediately after collection, milk samples

were subjected to physical examination with naked eyes to detect any abnormalities in color, odor, consistency, presence of blood and clot, flakes and any other visible abnormalities.

Treatment of mastitis

Mastitis was treated with different antibiotics in the study area. Among them Gentamycin, Ceftriazone, Streptomycin and Penicillin, Procaine Penicillin and Neomycin of different companies were used (Table 1).

Table 1: Treatment of mastitis with different antibiotics in the study area

	Generic Name	Trade Name	Doses	Route
Inject able solution	Gentamycin	Genta- 10®	10 ml/100Kg	IM
	Ceftriazone	Eracef vet® Trizone Vet ®	1gm/100kg	IM or IV
	Streptomycin and Penicillin	SP vet ®	2.5gm/100kg	IM
	Gentamycin	Mastanil® ointment	One tube for each quarter	Intramammary
	Procaine Penicillin Neomycin	Neomast® Syringe	One tube for each quarter	Intramammary

RESULTS AND DISCUSSION

Prevalence of mastitis in cattle

A total of 200 diseased cows were handled at Upazila Veterinary Hospital, Kalapara, Patuakhali from 9 March 2019 to 7 Jun 2019. Among them 20 cows had clinical signs of mastitis indicating the prevalence of mastitis at10% in cows of study area.

Prevalence of mastitis in cows

This finding is less than the findings of Raman et al. (1997) who reported 13.33% prevalence of clinical mastitis in dairy cows. Rahman et al. (2009) found 19.9% mastitis in dry season (Nov. to Feb.) This finding is also varied with the observation of Chisty et al. (2007) who reported 16.72% prevalence of clinical mastitis in dairy cows in Pakistan. This result also varied from Molalegne Bitew et al. (2010) and Elbablyet al.,(2013). These variations in results might be due to the population size, rearing system and breed of the species.

Prevalence of mastitis in different types of breed

The frequency of mastitis was high in cross bred 65% (13) than local breed 35% (7) cows (Table 3).

Table 3: Prevalence of mastitis in case of breeds of cow

Types of breed	No. of cows	Prevalence (%)
Local breed	7	35
Cross breed	13	65
Total	20	100

This result is dissimilar to the observations made by Rahman et al. (1997) and Nooruddin et al. (1997) who recorded higher frequency of mastitis in cross breeds. The findings of Hossain et al. (2004), Slettbark et al. (1995) and Rodostits et al. (2000) also reported that high yielding cows are more prone to udder infection than low producing one. Because the production of large quantity of milk keep the glandular tissue more generative and thus become more susceptible to infections. Cross breed cows produce more milk than the local zebus. Bigger size, long, and pendulous udder in cross breed cow might have picked up more infection resulting higher rate of infection (Roy et al.1993). But the result is varied due to improper hygienic condition and ignorance of the farmer and also the limited stock of cross breed in this Upazilla. The prevalence of mastitis in different farm size is presented in the table4. In cows, the percentage of mastitis were higher in backyard farms 80% (12), compared to medium farm 20% (3) and no findings of large farm. In Amtoali dairy

sector, cross and high yielding dairy are reared in backyard and medium farm as there no large farm is develop. This statement is dissimilar with Nooruddin et al. (1997) and Rahman et al. (1997). They reported that percentage of mastitis is higher in large and medium farms.

Table 4: Prevalence of mastitis in relation to farm type

Type of farm	Cows	Prevalence (%)
Small scale farm	5	25
Backyard	15	75
Total	20	100

Prevalence of mastitis in different parity of dairy animals

Parity plays an important role in causing mastitis (Table 5). The occurrence of mastitis in cows at different parity were 1st parity 10% (02), 2nd parity 25% (05), 3rd parity 45% (09), 4th parity 10% (02), 5th parity 10% (02).

Table 5: Prevalence of mastitis in different parity of cow

Parity	No. of mastitis cows	Prevalence (%)
1st	02	10
2nd	05	25
3rd	09	45
4th	02	10
5th	02	10
Total	20	100

The high parity cows have less defense apparatus as their teat sphincter get loosen and cellular defense lowered, resulting the organism to get easy entrance through the teat canal on the contrary younger cows are less susceptible to mastitis because of their more effective defense mechanism. Polymorphonuclear leukocytes functions was reported better in primiparous cows than multiparous ones (Dulin et al., 1988 and Roy et al., 1998). This result is in agreement with the observation made by (Kapur and Sing, 1978) who reported highest incidence rate of mastitis in 2nd parity than 1st one. The finding of present study also support with the findings of Rasool et al. (1985) who observed an increased occurrence of mastitis in old animals. Schokklen et al. (1989) reported that cows had an increased trend of mastitis, as the parity increased which is also agreed with the result of present study.

Prevalence of number of quarter(s) affected in mastitis

It has been shown that one quarter is more (60%) affected than two or more number (40%) of quarters in cows (Table 6).

Table 6: Number of quarter(s) affected in mastitis

Quarter affected	No. of cows	Prevalence (%)
One quarter	12	60
More than one	8	40

For this study it was observed that in most cases mastitis starts with one teat infection. Then it gradually spread to other teats (quarters). When treatment is performed the probability of infection to other teat is reduced. About 12 (70%) cows were affected with one teat infection and 8 (40%) cows affected with more than one quarters. The statement is supported by (Mahbub-E-Elahi et al., 1996) who reported that about 51 (34%) cows affected with one quarter affected. Elbably et al., (2013) reported 29.08%prevalencein Egypt based on quarter of which clinical and subclinical forms were 5.81% and 23.47 %.

Prevalence of mastitis on reproductive state

The Prevalence of mastitis were higher in non-pregnant and lactating cows 85% (17) and lactating animal than pregnant and lactating cows 15% (3) (Table 7).

Table7: Prevalence of mastitis on reproductive stage

Reproductive state	No. of cows	Prevalence (%)
Pregnant and Lactating	3	15
Non pregnant and lactating	17	85
Total	20	100

In pregnant and lactating animal the amount of milk production is reduced due to lower amount of

prolactin release and lower nutritional level because fetus takes a great part on nutrition. Low milk production is less prone to mastitis (Nulin et al., 1989 and Roy et al., 1997).

Prevalence of mastitis in cows with periparturient diseases

A total of 8 cows were affected with periparturient diseases. Cows without a history of periparturient disease had occurrence of 5 (25%) mastitis; in contrast, 15 (75%) of cows with a history of periparturient disease had mastitis (Table 8).

Table 8: Prevalence of mastitis in cows with periparturient diseases

Condition	Affected animals (Cow)	Prevalence (%)
Cows without a history of periparturient disease	5	25
Cows with a history of periparturient disease	15	75
Total	20	100

The result is supported by Rahman et al. (2009). The lower immunity level of periparturient cows makes the cow more prone to infection in the udder (Rainard and Riollet, 2006). Once a cow gets infected or diseased during the periparturient period, it becomes more susceptible to udder infection due to lowered immunity (Nickerson, 1994; Peeler et al., 1994).

Calcium ions are necessary for muscle constriction. As a result, in milk fever, low level of calcium decreases the rigidity of the teat sphincter that perhaps allows the organism to pass into the udder (Paape and Guidry, 1993). In addition, cows having infected uterine discharge and retained placenta risk the udder and teats being contaminated (Peeler et al., 1994).

Prevalence of mastitis in relation to cleanliness of farm

Clean barn had shown lower occurrence of mastitis 25% (05) in cow. On the other hand dirty barn had shown occurrence of mastitis 75% (15) in cow (Table 10).

Table 10: Prevalence of mastitis in relation to cleanliness of farm

Category	Total cases (Cows)	Prevalence (%)
Clean	05	25
Dirty	15	75
Total	20	100

The result of present study is supported by the findings of Chishty et al. (2007) who reported that the occurrence of mastitis were found to be highest in cows managed with lower drainage system.

Rick factor of mastitis

Risk factors such as age difference, herd size, use of bedding material, breed, milk yield, udder and leg hygiene, udder position, and teat end morphology, stage of lactation, parity, previous history of clinical mastitis, and farm hygiene were highly significant in the mastitis prevalence. On the other hand, strong relationship was found between milk production and occurrence of bovine mastitis as, prevalence was higher in adult cows, hence the risk of developing mastitis significantly increase in lactating cow at ages (3-5 years) , at early lactation stage , with parity number (2-4) and during summer months, than those corresponding animals. In conclusion, the potential risk factors associated with mastitis prevalence and severity includes cow's itself and their surrounding environment particularly farm and milking hygiene procedure. Moreover, veterinary supervision, and tick infestation are among the potential risk factors predispose and increase severity of mastitis problem in dairy farm.

Mastitis is a difficult problem to comprehend because this disease caused by many factors, both in large and in small-scale herds. Micro-organisms are responsible for the infection, but for them to enter the mammary gland and establish themselves to the point that they cause an infection, a multitude of factors may be involved. There are many factors acting simultaneously, and the disease generally involves interplay between management practice and infectious agents, but with other factors, such as genetics, udder shape or

climate. (Awale et al., 2012; Sori et al.2005). Being aware that especially sub-clinical mastitis is highly spread through herds in developing countries, it is important to identify risk factors and to assess their contribution to the occurrence of the disease. Identification of area-specific and/or farm-specific risk factors is important for the design of control programming for mastitis in cows (Almaw et al., 2012).

The main factors identified as risk for the occurrence of mastitisare discussed by different authors. Occurrence of mastitis is generally higher in high yielding bovines. Holstein Friesian (HF), Jersey or HF and Jersey crossbred dairy cows are generally more susceptible to mastitis than indigenous breeds (Moges et al., 2012; Sudhan and Sharma, 2010; Joshi and Gokale, 2006; Dego and Tareke, 2003; Sori, Zerinhum and Abdicho, 2005; Lakew, Tolosa and Tigre, 2009), although Rahman and co-workers found no significant difference between HF crossbreds and zebu (Rahman et al., 2009).

Cows with the most pendulous quarters appear to be the most susceptible to mammary infections, the pendulous udder exposes the teat and udder to injury and pathogens easily adhere to the teat and gain access to the gland tissue (Almaw, 2004; Sori, Zerinhum and Abdicho, 2005). Long teats increase the risk of accidental trauma and such lesions constitute potential sources of micro-organisms, which increases the probability of quarter infection (Almaw, 2004).

The prevalence of mastitis was noticed to be higher in cows with lesions and/or tick infestation on the skin of the teat and/or udder than in cows without this factor (Dego and Tareke, 2003; Moges et al., 2012; Lakew, Tolosa and Tigre, 2009. Mulei, 1999), in Kiambu district, Kenya, also recorded a prevalence of 71% of SCM in quarters with teat lesions.The prevalence of Sub Clinical mastitis increases with age, increasing lactation number and parities (Dego and Tareke, 2003; Joshi and Gokale, 2006; Rahman et al., 2009; Awale et al., 2012; Hameed et al., 2012; Mungube et al., 2004; Girma et al., 2012; Moges et al., 2012; Lakew, Tolosa and Tigre, 2009; Jarassaeng et al., 2012; Islam et al., 2011).

It has been shown that the higher prevalence of mastitis in older animals is due to increased potency of teats and increased degree and frequency of previous exposure in multiparous old cows (Girma et al., 2012). In 2011 recorded the highest prevalence of the disease in the early stage of lactation, both in crossbreds and local breeds, in Bangladesh (Islam et al., 2011); the same was reported by Dego and Tareke in Southern Ethiopia (2003), and by (Lescourret and Coulon, 1994), in whose study the impact of mastitis appeared to be more marked in early lactation, both because mastitis cases inducing important or very important milk losses were more frequent, and because their impact was felt over a longer period.
Seasonality in the incidence of mastitis has been studied. The occurrence of mastitis varies from season to season, because growth and multiplication of organisms depends on specific temperature and humidity. Incorrect ventilation, with high temperature and relative humidity, encourages the multiplication of various bacteria Exposure of animals to high temperature can increase the stress of the animal and alter immune functions (Sudhan and Sharma, 2010). Joshi and Gokale reported that, in India, animals were more prone to SCM in the monsoon season compared with summer or winter (Joshi and Gokale, 2006). It was noticed by Dego and Tareke (2003) that the prevalence was higher in the rainy season than in the dry season.

Different types of milking methods (e.g. stripping, knuckling, full hand method, machine milking) are practiced by dairy farmers. Faulty milking practices, especially knuckling, cause great harm to tissue and they become prone to infection (Sudhan and Sharma, 2010).

Housing increases the risk of mastitis. Intensively managed cows present a higher risk for the development of mastitis, followed by semi-intensive, with least risk among extensively managed animals (Sori, Zerinhum and Abdicho, 2005). The present study supports the findings of Hameed and co-workers (2012) in Pakistan, who observed higher prevalence of mastitis in backyard housed animals than in animals kept on the street and open areas, possibly due to the highly contaminated environments in backyard areas.

CONCLUSION

The prevalence of mastitis in the study area is 10% and is associated with number of factors. In cross bred cows were more susceptible (65%) than the local breed (35%). The farming condition also affects the prevalence of mastitis. In this study the prevalence of mastitis on backyard rearing system was 75%. In the higher lactation (3rd lactation) shows the high occurrence (37.5%). Cleanliness of the farm also affects the occurrence. Risk factors such as age difference, herd size, use of bedding material, milking mastitis cows last, breed, milk yield, udder and leg hygiene, udder position, and teat end morphology, stage of lactation, parity, tick infestation, previous history of clinical mastitis, and farm hygiene were highly significant. Economic loss consideration of the disease is high which call upon the misfire of the commercial dairy farmer. Udder hygiene and proper milking management methods, Proper installation, function and maintenance of milking equipment, dry cow management and therapy, appropriate therapy of mastitis during lactation, culling chronically infected cows, good record keeping, periodic review of the udder health management is help to take the challenge of mastitis control program. A well-documented continued research and educational effort is required to increase producer awareness of cost due to mastitis to the dairy enterprise. Control of this economically important disease need a continuing program of elimination and prevention of infection.

REFERENCES

Abebe R, Hatiya H, Abera M, Megersa B and Asmare K (2016). Bovine mastitis: prevalence, risk factors andisolation of Staphylococcus aureus in dairyherds at Hawassa milk shed, South Ethiopia BMC Veterinary Research 12:270 DOI 10.1186/s12917-016-0905-3.

Ahmed JU, Sutradhar S, Rahman MM (2005). Morphological characteristics of udders and teats in relation to mastitis and milk yield in crossbred dairy cows. The Bangladesh Veterinarian 22 23–28.

Andrews ML, Mollett TA, Marshall RT and Keisler DH (1985). Incidence of subclinical mastitis in ewe and impact on lamb performance. Missouri Sheep Report, University of Missouri and Lincoln University. Nov/85.

Bitew M, Tafere A and Tolosa T (2010). Study on Bovine Mastitis in Dairy Farms of Bahir Dar and its Environs. Journal of Animal and Veterinary Advances, 9: 2912-2917.

Chishty MA, Arshad M, Avais M, Hameed S and Ijaz M (2007). Cross sectional epidemiological, studies on mastitis in cattle and buffaloes of Tehsil Gojga, Pakistan. Buffalo Bulletin, 26(2): 50-55.

Dulin AM, Paape MJ and Nickerson SC (1988). Comparison of phagocytosis and chemiluminescence by blood and mammary gland neutrophils from multiparous and nulliparous cows. American Journal of Veterinary Research, 9: 172–177.

Elbably MA, Emeash HH and Asmaa NM (2013). Risk factors associated with mastitis occurrence in dairy herds in Beni-Suef Governorate. Worlds Veterinary Journal, 3:05–10.

Hickman CG (1964). Teat shape and size in relation to production characteristics and mastitis in dairy cattle. Journal of Dairy Science,47:777.

Hossain SMA (2004). Efficacy of dry cow therapy in mastitis control strategy. MS Thesis. Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. .

Mahbub-E-Elahi ATM, Rahman MA, Rahman MM and Prodhan MAM (1996). Isolation and identification of bacteria from different quarters of mastitis affectd dairy cows in Bangladesh. Bangladesh Veterinary Journal, 30:63-65.

Nakov D, Hristov S, Andonov S, Trajchev M (2014). Udder-related risk factors for clinical mastitis in dairy cows. Veterinary Arhive, 84: 111-127.

Nickerson SC (1994). Bovine mammary gland - structure and function relationship to milk production and immunity to mastitis. Review of Agricultural Practice 15: 8-18.

Nooruddin M, Rahman MS and Rahman MM (1997). Occurrence and distribution of mastitis in crossbred and exotic dairy cows. Bangladesh Veterinary Journal,14:14-44.

Paape MJ and Guidry A (1993). The teat defenses of mammary gland. Advances in Experimental Medicine and Biology, 225 457–463.

Peeler EJ, Otte MJ and Esslemont RJ (1994). Interrelationship of periparturient diseases in dairy cows. The Veterinary Record, 5 129–132.

Quaderi MA (2005). Prevalence of sub-clinical mastitis in dairy farms. MS Thesis, Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Radostits OM, Gay CC, Blood DC and Hinchcliff KW (2000). Mastitis. In: Veterinary Medicine,

A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 9th Edn, W B Saunders Co. Philadelphia, USA pp. 603–612. Veterinary Journal, 26(2): 54-60.

Rahman MA, Bhuiyan MMU, Kamal MM and Shamsuddin M (2009). Prevalence and risk factors of mastitis in dairy cows. The Bangladesh Veterinarian, 26(2): 54 – 60

Rahman MS, Norruddin M and Rahman MM (1997). Prevalence and distribution of mastitis in crossbred and exotic dairy cows. The Bangladesh Veterinarian, 14 1–4.

Rahman MM, Munsi MN, Ekram MF, Kabir MH, Rahman MT and Saha S (2014). Prevalence of subclinical mastitis in cows at Anwara, a Coastal Upazila of Chittagong district in Bangladesh. Journal of Veterinary Advance, 4: 594-598.

Roy A, Rahman MM, Rahman A and Ali MR (1998). Occurrence of Staphylococci and Streptococci organisms on the udder skin and on the milk samples of apparently healthy cattle. Bangladesh Veterinary Journal of Microbiology, 3: 21-23.

Schalm OW, Carol EJ and Jain NC (1971). Bovine mastitis. Lea and Febiger, Philadelphia, USA, pp. 128-157.

Sharma N, TY Kang TY, Lee SJ, Kim JN, Hur CH, Ha JC, Vohra V and Jeong DK (2013). Status of bovine mastitis and associated risk factors in subtropical Jeju Island, South Korea. Trop. Anim. Health Prod. Published Online, 29 May 2013.

Sori H, Zerihum A and Abdicho S (2005). Dairy cattle mastitis in and around Sebeta, Ethiopía. International Journal of Applied Research in Veterinary Medicine, 3: 332- 338.