UNIVERSITY OF NAIROBI

Bachelor of Veterinary Medicine

RETROSPECTIVE STUDY ON PREVALENCE OF MASTITIS IN MILK SAMPLES SUBMITTED TO THE MICROBIOLOGY LABORATORY, CLINICAL STUDIES DEPARTMENT-FACULTY OF VETERINARY MEDICINE, UNIVERSITY OF NAIROBI

PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR AWARD OF A DEGREE IN VETERINARY MEDICINE FROM THE UNIVERSITY OF NAIROBI.

SUBMITTED BY: RAGA ERIC NGURU

J30/2027/2010

DECLARATION

I hereby declare that this project is my original work and has never been submitted or presented, to the best of my knowledge, to any other institution for the award of any degree.

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J30/2027/2010

This project has been submitted with approval of a University of Nairobi Supervisor.

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Dedication

I dedicate this project to my family, classmates and friends for their support and encouragement as I was undertaking my work on the project.

Acknowledgement

I wish to sincerely thank Dr Mbai for working with me and supervising my project work. I also appreciate Mrs. Jane Kamau the technologist at the Clinical Studies microbiology lab, who was of great assistance in collection of data. I also thank my parents, classmates and friends for their support while working on the project

God bless you all.

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1.0 ABSTRACT

Mastitis is the inflammation of the mammary gland accompanied by chemical, physical and bacteriological changes in milk. It has a high morbidity rate in dairy cows making it the single most important disease in the dairy industry. Mastitis is commonly caused by bacteria, fungus and yeast. The source of infection is from the environment and the infected udder. Mastitis causes many economic losses to the farmer either directly or indirectly due to decreased milk production and expenditure associated with the disease. Mastitis is also of public health importance with regard to antibiotic residuals in milk. Treatment of mastitis is done with use of antibiotics and supportive therapy. The type of antibiotic to use and route of administration depends on the type of mastitis.

A retrospective study was carried out to determine the prevalence of mastitis and the most prevalent mastitis causing organism isolated in milk samples submitted to the laboratory for culture and sensitivity testing. A 5 year data were analyzed for the year 2009 – 2013.

The prevalence of mastitis over the 5 years was 75% of the samples presented. Staphylococcus was the organism commonly isolated with a prevalence of 58.269%. Other organisms isolated were *Streptococcus* (19.784%) , E. coli (5.719%), *Klebsiella* (2.628%) and *Pseudomonas* (2.318%). Methods of mastitis prevention and control recommended include maintenance of good hygiene in the sheds, proper milking techniques and hygiene to reduce transmission, use of teat dips, dry cow therapy, culling of chronic cases, early and proper treatment of new cases and regular screening of milk to detect subclinical mastitis using various methods like California mastitis test and other methods that detect rise in somatic cell counts like Coulter counter.

2.0 Introduction

Kenya's economy is driven by agriculture which contributes to income generation, employment creation, food security and industrial development (G.O.K 2004). 60% of rural employment is generated in agriculture sector. 80% of Kenyan population live in rural areas and derive their livelihoods from subsistence crop farming and livestock activities (G.O.K 2004). Livestock sector is an important sub sector in agriculture. It is an important socio-economic activity in the high rainfall areas where dairy production is the main economic activity (Mutugi, 2003).

2.1 Dairy industry in Kenya

Kenya's dairy industry is mainly comprised of smallholder dairy farming. Kenya has one of the largest and well developed dairy production and processing industries in the Sub-Saharan Africa (G.O.K, 1993). The white settlers introduced commercial dairy production in Kenya in the 20th century when they brought exotic dairy breeds from South Africa and Europe (Bebe *et al*, 2002). The smallholder dairy farmers produce 70% of the estimated 2.6 million metric tons of milk produced annually in Kenya (Staal *et al*., 1998). Dairy cattle population is estimated as over three million and about 660,000 smallholder farmers keep the dairy animals (Reynolds *et al*., 1996), with the main breeds been Fresian, Ayrshire, Guernsey, jersey and various crossbreeds. Due to increasing population pressure, little land is available for crop production and farmers have opted to dairy farming as a source of income. The level of income largely depends on the amount of milk produced and the cost of production. Mastitis has a direct relationship with the two. Mastitis reduces amount of milk produced directly or indirectly. Mastitis lowers the

amount of milk produce with subclinical mastitis having the highest implication. It also results in culling of chronic cases or even death of the animal. It also rises the cost of production through drugs used for treatment, discarded milk and cost of implementing a mastitis control program.

Mastitis is the single most disease in dairy farming implicated with the highest use of antibiotics. This has resulted in rising concerns in the public health sector due to antibiotic residues in milk and milk products. Indiscriminate use of antibiotics in treatment and control of mastitis has led to development of antibiotic resistance in many cases.

Some of the organisms isolated in cases of bovine mastitis have also been known to cause serious human infections. *Staphylococcus aureus* is the cause of serious infections in humans, including endocarditis deep-seated abscesses and osteomyelitis (Brakstad *et al*., (1992)

2.2 LITERATURE REVIEW

2.3 Definition

Mastitis is the inflammation of the mammary gland tissue and is accompanied by chemical, physical and bacteriological changes in milk together with pathological changes in the glandular tissue (Oliveira P. *et al* 2000). It is inflammation of the udder indicated by a rise in milk somatic cell count (International Dairy Federation, 1979). It is a multifactorial disease that results when management and environmental factors interact to increase exposure reduce udder resistance and aid deposition of organisms into the teat canal (Philpot, 1984). Mastitis is of great concern in milk hygiene and milk processing as it causes compositional changes in milk. Discriminate use of antibiotics in the treatment and control of the disease has also rendered it of public health

concern. Antibiotic residuals in milk pose the following hazards to the consumer: Allergic reactions, bacterial resistance to the antibiotics and alteration of the status quo of the normal gut flora leading to super infections. Antibiotics residuals are also of technical concern in milk l8processing as they lead to inhibition of starter cultures.

2.4 Epidemiology

Mastitis occurs worldwide with an incidence of 40% morbidity rate among dairy cows. The quarter infection rate is about 25%. The quarter infection rate as indicated by infection with specific pathogen maybe as low as 10% (Radostits 1994). The quarter infection rate in beef cattle varies from 1-18% (Radostits 1994). The infection of the mammary gland is via the teat canal. The source of infection is the environment and the infected udder.

The frequency of occurrence of each of the etiological types of mastitis depend on the ability of the bacteria or fungus to set up infection in the mammary tissue which is dependent on bacterial characteristics and transmission mechanism (Radostits 1989)

The bacterial characteristics include

- Ability of the organism to survive in the immediate environment
- Ability to colonize teat duct (Bramley, A. J. *et al* 1979)
- Ability to adhere to mammary tissue epithelium and set up a mastitis reaction (Brook, B. W. & Barnum, D.A 1984)
- Resistance to antibiotics

2.5 ETIOLOGY

Many infectious agents have been isolated. The major mastitides are *Staphylococcus aureus, Streptococcus agalactiae* and coliforms. It may also be associated with many other organisms including *Actinomyces pyogenes, Pseudaomonas aeruginosa, Nocardia asteroides, Clostridium perfringens* and others like *Mycobacterium, Mycoplasma*, *Pastuerella* and *Prototheca* species and *yeasts* (Rodostits et al., 2007). The majority of the cases are caused by only a few common bacterial pathogens, namely, *Staphylococcus species, Streptococcus* species, *Coliforms* and *Actinomyces pyogenes* (Du Preeze, 2000)

Exhaustive lab investigations for anaerobic bacteria has resulted in some isolations usually in association with other facultative bacteria e.g *Bacteroides melaninogenicus, Fusobacterium necrophorum* (Mc Gilivery, D.J *et al* 1984)

Fungus that cause mastitis includes *Trichosporon spp, Aspergillus spp, Pichia spp*. Yeast includes *candida spp, Cryptococcus neoformans, Torulopsis spp*.

2.6 CLASSIFICATION

Mastitis can be classified according to: the clinical symptoms, the mode of transmission, the causative agent, the duration of infection and the pathological changes in the mammary gland tissue.(McGillivery, D.J.*et al* 1984)

Clinical symptoms

Clinical and subclinical mastitis

Duration of infection

Acute and chronic mastitis

Causative agent

Bacterial, fungal and physical mastitis

Mode of transmission

Contagious and environmental mastitis

Pathological changes in the mammary gland

Gangrenous mastitis

Contagious mastitis occurs where the causative agent is transmitted from cow to a healthy one. *Streptococcus agalactiae* and *Staphylococcus aureus* are of main concern since they inhabit cow tissues. The prevalence of infection with *Staphylococcus aureus* in cows ranges from 7 to 40%, and in some herds is even higher (Fox, L.K. & Gay,J.M. 1993). A survey of Danish Dairy herds found that 21-70% of all cows and 6-35% of all quarters were infected (Aarestrup, F.M. *et al.* 1995). *Staphylococcus aureus* was isolated from 10.2% of quarter samples and was the most common species isolated (Fox, L.K. & Gay,J.M. 1993). The prevalence of *Streptococci,* including *Streptococcus agalctiae*, ranges from 1-8% of cows. A relative incidence of *Streptococcus agalactiae,* other *Streptococci* and *Staphylococcus aureus* of 1:1:2 is a common

finding (Radostits 2000). *Staphylococcus aureus* will persist for several months in teat lesions and other body locations (MacDonald, 1984). The source of infection of *Staphylococcus aureus* is injured teat ends or other skin surfaces including milkers hands and the subclinical chronically infected glands that are more common in older cows within each herd (McDonald, 1984)

Environmental mastitis mode of transmission is from the contaminated environment. The important pathogens are the coliforms and the environmental streptococci. The source of these pathogens is the environment. The prevalence of intramammary environmental streptococci is less than 5% in well managed herds but may exceed 10% in some problem herds (Smith, K.L. & Hogan, J.S. 1993). A characteristic of intramammary coliform infections is the short duration; 40-50% persists less than 7 days. The majority of environmental streptococci infections lasts less than 30 days (Radostits 2000)

Exposure of udder to mastitis pathogens is recognized to play an important role in determining the rate of infection (McDonald, 1984; Dodd, 1986)

2.7 LOSSES DUE TO MASTITIS

Mastitis is the single most common disease syndrome in adult dairy cows, accounting for 38% of all morbidity (Sischo WM et al 1990). Economic cost of diseases, mastitis included, is made of direct losses e.g decreased milk production and expenditures associated with disease. The cost factors of mastitis include decreased milk production, veterinary services, diagnostics, drugs, discarded milk, labour ,decreased product quality' increased risk of new cases of the same

disease or of other diseases, increased risk of culling and materials for prevention (Hogeveen and Osteras 2005)

In the US, direct losses to the produce have been estimated at $ 200 per cow annually (Philpot, 1984). Reduced milk production accounts for 70% of the total loss (Philpot, 1984)

On average an affected quarter suffers a 30% reduction in productivity and an affected cow estimated to lose 15% of its production (Morris, R.S. 1973). Experimental infection of quarters during the dry period causes 35% reduction in yield in these quarters during the next lactation. Quarters found to be infected in late lactation had a 48% reduction in yield, but if the infection occurred in the dry period the depression of yield after calving was only 11% (Smith, A. *et al* 1968)

Total milk loss in quarters affected with subclinical mastitis with subclinical mastitis is approximately 10 – 26% (De Graves & Fetrow 1993). Subclinical mastitis is hidden to farmers and has high losses. Clinical mastitis results in the greatest losses when the case occurs early in lactation (DeGraves & Fetrow 1993). Cows in later lactations show a greater decrease following clinical mastitis than first lactation cows (DeGraves & Fetrow 1993). A quarter that experiences clinical mastitis may never completely recover, creating a carryover loss.

2.8 CLINICAL FINDINGS

The clinical findings vary with each bacteriological type of mastitis. This includes abnormalities of secretion, abnormalities of size, consistency and temperature of the mammary gland. The abnormalities in milk include discoloration, clots and flakes.

Abnormalities of the udder include swelling, pain, redness, increased warmth, hard in consistency. The teats may also be swollen and painful

A systemic reaction may also occur with infections by *Coliforms, Klebsiella spp or Actinomyces pyogenes* resulting in toxemia, fever, tachycardia, ruminal stasis, recumbence.

Subclinical mastitis is difficult to diagnose and is only characterized by decreased milk production. It is only detected indirectly with California Mastitis Test (CMT), Whiteside Test, Milk Electrical Conductivity test (Milner *et a*l..1996).The sensitivity and specificity of CMT has been reported to be 95.4% and 30.4% respectively (Abduraham et al, 1995). Younan et al, 2001 reported a sensitivity and specificity of 60% and 95% respectively, showing a very wide discrepancy.

The difference in CMT sensitivity between intramammary infections caused by *Streptococcus agalactiae* and *Staphylococcus aureus* may result from a les intensive inflammatory response to *Staphylococcus aureus* as compared to *Streptococcus agalactiae*.

2.9 TREATMENT OF MASTITIS

Special bacterial types of mastitis require specific treatments. The main therapeutic agents for treating mastitis are sulfonamides and antibiotics among them penicillin, neomycin,

streptomycin and tetracycline. No one drug is effective against all types of pathogens causing mastitis. Combinations of antibiotics and sulfonamides are often used to increase spectrum. Treatment tends to remove infection from the udder and return milk to normal composition but milk production and yield is reduced until at least the next lactation year. The degree of response depends on type of causative agent, speed of treatment and route in which the drug is administered. Actual effectiveness of each drug in particular circumstances influence on the choice of drug (Ziv, G. 1980)

Parenteral treatment is advisable in all cases of mastitis in which there is a marked systemic reaction to control septicemia, bacteremia and also in treatment of infection in the gland. Sterilization of infected udder is seldom achieved due to poor diffusion of antibiotic from bloodstream into milk. Diffusion is greater in damaged than in normal quarter (Radostits 1994). Parenteral treatment is also advisable where the udder is badly swollen because intramammary antibiotics are unlikely to diffuse properly. Good diffusers include erythromycin, tylosin, chloramphenical & trimethoprim. Poor diffusers include streptomycin and neomycin. To produce therapeutic levels in mammary gland, higher than normal doses are used (Mc Diarmid, S.C. 1978)

Udder infusion is the most used route of drug administration in the treatment of mastitis due to its convenience and efficiency. Drugs in water soluble ointment base are used in individual cows but aqueous infusions are adequate, cheaper and indicated when large numbers of quarters are to be treated. Diffusion of infused drugs is limited by blockage of lactiferous ductsl8 and alveoli with inflammation debris. The udder should be emptied before infusing the

drug. Avoid emptying the udder after drug infusion to avoid loss of drug. Drugs that diffuse best through udder tissue after intramammary infusion include penicillins, chloramphenical, erythromycin and tylosin. Poor diffusers include streptomycin and neomycin (Ziv, G. 1980)

Chronic cases are well cured by treatment when the cow is not lactating. The dry period is also good for prophylactic treatment. The drug is infused at last milking or at beginning or end of dry period because the glandular tissue secretes a viscid substance for much of the dry period. The secretion interferes with drug diffusion.

Choice of drug

In vitro sensitivity tests are not basis of drug selection (Pearson, J.K.L & Mackie, D.P. 1979). Continuous surveillance must take a good deal of notice of the antibiotic susceptibility of the current infections (Hinckley, L.S*. et al* 1985). Choice depends on degree of binding of a drug to mammary tissue and secretion, ability to pass through the lipid phase of milk and degree of ionization. The withholding period of the drugs should be observed. This refers to the minimum period that must elapse after the last administration of a drug before an animal or its products are sold for human consumption (Rogers et al..1992)

Other methods of treatment include drying off all infected quarters, supportive therapy and continuous milking and backflushing the infected udder followed by milking.

2.10 ANTIBIOTIC RESISTANCE

Staphylococcus aureus produce enzyme penicillinase which breaks down the beta-lactum ring of the penicillin molecule. In Finland, an increase of 27% in the proportion of *Staphylococcus aureus* strains resistant to at least one antibiotic was reported (Myllys *et a*l…,1993)

Group B streptococcus are resistant to tetracycline due to ribosomal protection encoded by tet K or tet L (Culebras *et a*l, 2002; Speer *et al*, 1992)

2.11 CONTROL OF MASTITIS

Improving dairy management practices is recognized as the only practical approach to minimize intramammary infections (Dodd, 1983). However the interaction of management and environmental factors can increase the teats exposure to mastitis pathogens and aid the pathogens in traversing the teat canal and gaining access to the secretory epithelium of the udder (Philpot, 1984)

Control measures are based on practices that prevent cow to cow and quarter to quarter spread, prevent teat injuries and teat canal penetration, deal with residual contamination and colonization of teats and teat lesions, reduce the duration of infection and eliminate the source of infection (Anderson, 1982). The options in mastitis control are between;

- Eradication. However this is not achievable due to a myriad risk factors affecting occurrence
- Limitation of infection rate to achieve an infection rate <5%
- Voluntary program- this is basically a mastitis awareness program and is purely economic.

Strategies in limiting infection rates include;

- Reduction in duration of infection. This reduces the amount of losses suffered from the infection and includes **a)** Treating all cows with dry cow therapy at drying. The administration of long acting antibiotics to all quarters of all cows at the time of drying off is expected to cure existing infections and additionally to prevent new infections during the early part of the dry period (MC Donald, 1984; Dodd, 1986; Nickerson and Owens, 1990). Antibiotics administered to non-lactating cows have been designed to create a prolonged local concentration of the drug (Nickerson and Owens, 1990). The advantages of dry cow therapy are that there are no losses caused by discarded milk and possibility of antibiotic contaminated milk reaching the consumer is minimal (Nickerson and Owens, 1990). There is lower infection rates during dry period in cows that had all quarters infused than in cows in which only the infected quarters were infused (Browning *et al*, 1990) **b)**treat all cases as they occur. This removes the '2reservoirs of infection and reduces period of milk loss and udder injury **c)** cull all chronic cases
- Reduction in the new quarter infection rate which involves use of teat dips after all milkings, service all milking machines properly, flushing milking machine cups with quartenary ammonium compounds between milkings, use of a new towel for each cow, milk infected cows and quarters last
- Regular checking of all cows in all quarters for mastitis. This is done using California Mastitis Test kit or somatic cell count in a herd.
- Maintain a hygienic environment

3.0 Justification of the study

Milk is an important source of nutrition. It contains proteins, carbohydrates, vitamins and minerals. In Kenya, small scale dairy farming is widespread. It contributes immensively to the economic gains of the farmers and the country. Mastitis is the most common disease in dairy farming leading to both direct and indirect losses. Mastitis causing organisms in milk is of public health concern. Recognizing mastitis early combined with improved hygiene can reduce the milk loss resulting in high economic gain (Abdurahman, 2006). Better herd management of mastitis will increase milk production and hence increase income for the farmers

Staphylococcus aureus is the most common causative agent of intramammary infections in dairy cows, but *Streptococcus agalactiae* can cause greater production losses (Radostits *et al*. ,1997). Milk and milk products have been implicated in food borne bacterial outbreaks with *Staphylococcus aureus* been the most frequent pathogen associated with the outbreaks. Subclinical mastitis is not easily recognized and hence poses great health danger to the consumers.

The study will help in identifying the most prevalent organism causing mastitis and thus will be of assistance in enacting and implementation of a mastitis control program leading to increased revenue to farmers and a reduction in public health risks associated with mastitis.

3.1 Hypothesis

1. Staphylococcus sp is the most prevalent mastitis causative agent in bovine

4.0 OBJECTIVES OF THE STUDY

4.1 General Objective

Identification of mastitis causative agents will help improve milk production and reduce losses due to mastitis by enacting proper mastitis control measures in areas covered by the Department of Clinical Studies

4.2 Specific objectives

1. To determine the prevalence of mastitis in milk samples submitted to the microbiology lab, Clinical Studies Department.
2. To determine the most prevent mastitis causing agents in Ndumbuini, Uthiru, Kanyariri, Loresho and Lower Kabete in a 5 year period between 2009 & 2013.

5.0 MATERIALS AND METHODS

5.1 Area of study

The study was carried out in the microbiology laboratory Clinical Studies Department, faculty of veterinary medicine in The University of Nairobi. It is situated in Uthiru approximately 8 KM West of Nairobi. The majority of the milk samples submitted for culture and sensitivity come from the surrounding areas namely Uthiru, Ndumboini, Kanyariri, Loresho, Limuru, Dagorreti and Lower Kabete

5.2 Study samples

The total milk samples were 647. Milk samples brought to the lab are collected from cows with clinical signs of mastitis. The samples were submitted for culture and sensitivity. A 5 year period data between 2009 & 2013 was analyzed using tables and bar graphs according to whether there was growth and the organism isolated

6.0 RESULTS AND DISCUSSION

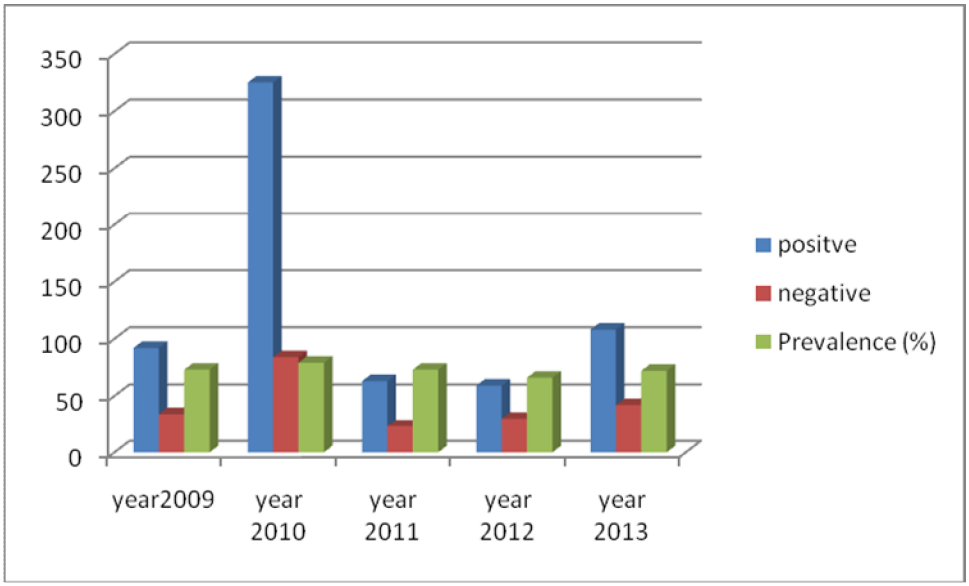
The data was analyzed in terms of prevalence per year, breed and the specific causative agents isolated

Table 1; number of milk samples which were positive or negative per year from 2009-2013 and the percentage prevalence of mastitis in the same years

	2009	2010	2011	2012	2013	Total
Positive	92	325	63	59	108	647
Negative	34	84	23	30	42	213
Total	126	409	86	89	150	860
% prevalence	73	79	73	66	72	75

of mastitis						

Figure 1;% Prevalence of Mastitis per year from 2009-2013

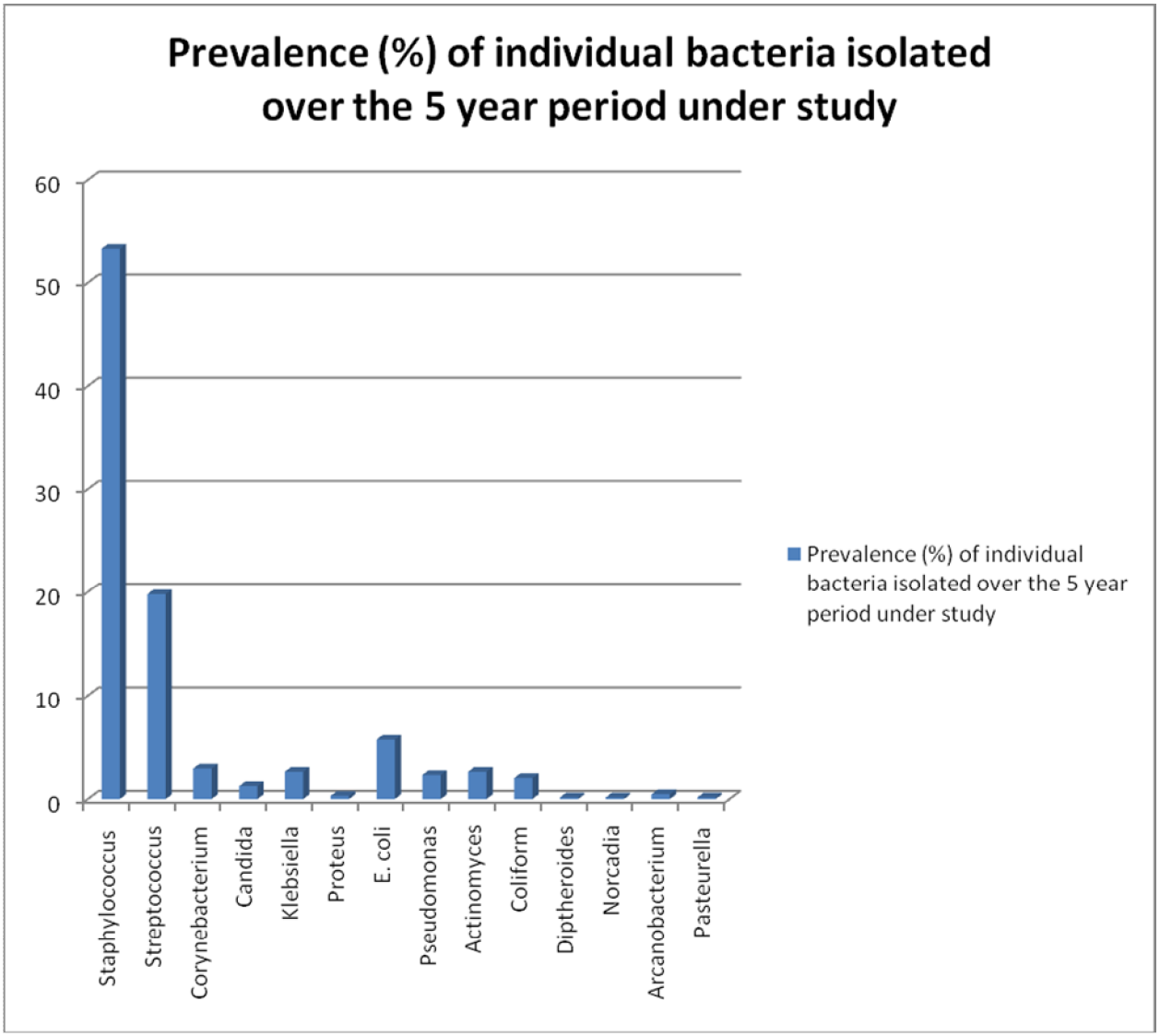


The prevalence of mastitis in the milk samples submitted to the lab for culture and sensitivity over a period of 5 years was 75%. This can be attributed to the fact that the samples submitted were from animals that had clinical signs of mastitis and California Mastitis Test had been done. The highest prevalence was seen in 2010 (79%) and the lowest prevalence was recorded in the year 2012 with 66%. The drop may be attributed to improvement of dairy management practices which help minimize udder infections. Improving shed hygiene, early treatment of new cases, culling chronic cases and good milking hygiene minimize spread of mastitis in a herd and thus reduction in new cases.

Table 2; Occurrence of individual bacteria isolated per year from 2009-2013 and the overall %prevalence of individual bacteria isolated

ORGANISM ISOLATED	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2012	YEAR 2013	TOTAL	PREVALENCE (%)
Staphylococcus	43	209	29	25	71	377	58.269
Streptococcus	17	76	9	12	14	128	19.784
E. coli	9	8	5	4	11	37	5.719
corynebacterium	5	11	1	9	1	27	2.937
Actinomyces	3	7	4	2	1	17	2.628
Klebsiella	2	4	6	3	2	17	2.628
pseudomonas	7	3	2	2	1	15	2.318
Coliform	3	2	4	-	4	13	2.009
Candida	2	2	2	-	2	8	1.236
Arcanobacterium	-	2	-	1	-	3	0.464
Proteus	-	1	1	-	-	2	0.309
Diptheroides	1	-	-	-	-	1	0.155
Norcadia	-	-	-	1	-	1	0.155
Pasteurella	-	-	-	-	1	1	0.155
TOTAL	92	325	63	59	108	647	

Figure 2



Staphylococcus spp were the single most isolated organisms with a prevalence of 58.269%..

Streptococci were second with 19.784% prevalence. Other organisms isolated were:

Corynebacterium (2.937%), Candida (1.236%), *Klebsiella* (2.628%), *Proteus* (0.309%), E. coli

(5.719%), *Pseudomonas* (2.318%), *Actinomyces* (2.628%), *Coliform* (2.009%), *Diptheroides* (0.155%), *Norcadia* (0.155%), *Arcanobacterium* (0.464%), *Pasteurella* (0.155%).

6.1 DISCUSSION

Staphylococcus species were the commonly isolated organisms with a prevalence of 58.269%. This is similar to other results which indicated *Staphylococcus* as the organism most isolated in Kenya (Omore And Arimi.S.(1996A). The results indicate the farmers in the area of study have poor mastitis control programmes indicated by high prevalence of *Staphylococcus* mastitis. *Staphylococcus* mastitis is easily controlled using basic methods like observing hygiene in the cow's environment and by use of teat dips containing chlorhexidine. The occurrence of particular bacteria changed over the time of study. Some bacteria e.g *Staphylococccus* and *Streptococcus* were isolated throughout all the years of study while some e.g *Diptheroides, Norcadia, Pasteurella* were isolated during some of the years of study. In the year 2010, *Staphylococcus* was isolated from 209 milk samples while the year 2012 had the least milk samples from which *Staphylococcus* was isolated (25). The same was recorded in Streptococci where the highest number was isolated in 2010 (76) and the least in 2011 (9). *Pasteurella* was only isolated in the year 2013 (1). Also only one case of *Norcadia* was isolated throughout the time of study.This can be attributed to the fact that samples came from different farms across the 5 years and thus the study was not controlled.

7.0 CONCLUSION

From the above results, the prevalence of mastitlis from the delivered samples was 75%.

The most prevalent mastitis causing organism was *Staphylococcus* (58.269%)

Hence the hypothesis was proved right and there was poor mastitis control in the study area.

8.0 RECOMMENDATIONS

Mastitis can be controlled by improving dairy management practices. The preventive measures include; good shed hygiene, proper milking techniques and milking hygiene, institute a dry cow therapy, early treatment of new cases, culling of chronic cases, use of teat dips and regular screening of milk for mastitis to detect subclinical mastitis and changes in somatic cell counts.

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