

Dedication

To

My parents

Acknowledgments

I consider it my utmost obligation to express my gratitude to Allah Almighty, the omnipresent, kind, and merciful who gave me the health, thoughts and the opportunity to complete this task.

I offer my humble thanks from the core of my heart to the Holy Prophet **Muhammad** (Peace Be Upon Him) in the completion of this work.

I was fortunate in having the generous advice and encouragement of my learned supervisor professor **Abdelhamid Ahmed Mohamed Elfadil**.

It is my privilege to express deep sense of gratefulness to my co-adviser associate Dr. **Mohammed Rajab Bakhiet** in Veterinary Research Institute (VRI) Department of Bacteriology for his advice and teaching.

I also wish to add words of thanks to all staff of bacteriology, Veterinary Research Institute particularly Dr. **Yahia Ali Sabil**, the head department, for their constant help and necessary facilities.

I am highly obliged to express profound gratitude to my colleagues **El Amir Jafar Saad, Sarah Mohammed Al Hassan, Ammar Ebrahim, Husam Hafiz and Myadh Ebrahim Adam**.

Sincere thanks to my parents, sister **Marlin Levi Sebit** and to my close friend **Mokhtar Abdurahaman Ebrahim** for their support.

List of Contents

No	Title	Page No
I	Dedication	I
II	Acknowledgements	II
III	List of contents	III
VII	Abstract	VII
IX	ملخص البحث	IX
1	Introduction	1
	Chapter One	
	Literature Review	
1.1	Definition	4
1.2	Epidemiology of mastitis	4
1.3	Dynamics of infection	5
1.4	Infection Patterns	5
1.4.1	Contagious disease patterns	5
1.4.2	Opportunistic disease patterns	6
1.4.2.1	Microorganisms	6
1.4.2.2	Host factors	7
1.4.2.3	Environmental factors	7
1.5	Development of the disease	8
1.6	Types of Mastitis	8

1.6.1	Contagious mastitis	8
1.6.1.1	Types of contagious mastitis	9
1.6.1.1.1	Clinical mastitis	9
1.6.1.1.1.1	Types of clinical mastitis	10
No	Title	Page
1.6.1.1.1.1.1 1	Per-acute	10
1.6.1.1.1.1.1 2	Acute	10
1.6.1.1.1.1.1 3	Sub-acute	10
1.6.1.1.2	Sub Clinical mastitis	10
1.6.1.1.3	Chronic mastitis	10
1.6.2	Environmental Mastitis	11
1.6.3	Summer Mastitis	11
1.6.3.1	Clinical Signs of summer mastitis	12
1.7	Diagnosis	13
1.7.1	Clinical Inspection of Udder	13
1.7.2	California Mastitis Test	13
1.7.3	White Side Test (WST)	14
1.7.4	Surf Field Mastitis Test (SFMT)	15
1.8	Treatment	16
1.8.1	Intra-mammary or Systemic Administration	16
1.8.2	Treatment of Clinical Mastitis in Practice	17

1.8.3	Treatment of Subclinical Mastitis	18
1.9	Prevention and Control	20
1.10	Previous Studies	22
	Chapter Two	
	Materials and methods	
2.1	Study area	37
2.2	Study population	38
2.3	Study design	38
2.4	Sampling methods	39
2.4.1	Multistage random sampling	39
2.5	Sample size	40
2.6	Clinical inspection of udder	42
2.7	California mastitis test	42
2.8	Laboratory diagnosis	43
2.9	Sampling technique	43
2.10	Microbiological procedure	44
2.10.1	Catalase	45
2.10.2	Oxidase	45
2.10.3	OF (Oxidation fermentation)	46
2.10.4	Glucose Breakdown	47
2.11	Questionnaires survey	47
2.12	Statistical analysis	47
	Chapter Three	
	Results	

3	Descriptive statistical analysis frequency table, cross tabulation and association table between the disease and risk factors	49
3.4	Summary of results	51
3.8	Summary of multivariate analysis	71
3.10	Summery of bacteria isolated	74
	Chapter Four	
	Discussion	75
	Conclusion	86
	Recommendations	87
	References	88
	Appendix	103

List of tables

No	Chapter Three	Page
	Results	
1.8.4	Proportional of Susceptible Isolates	19
3.1	Prevalence of clinical and subclinical mastitis in 646 dairy cattle examined in Khartoum State	49
3.2	Herd prevalence of clinical and subclinical mastitis in 63 dairy farms in Khartoum State	50
3.3	Quarter prevalence of clinical and subclinical mastitis in 646 dairy cattle in Khartoum state	50
3.5	Frequency distribution of 646 dairy cows in Khartoum State examined for mastitis according to potential risk factors investigated	59

3.6	Cross tabulation of mastitis infection in 646 dairy cows from Khartoum State with potential risk factors investigated	63
3.7	Univeriable analysis of association of different potential risk factors with mastitis using the Chi-square (χ^2) test	67
3.9	Multivariable analysis of the association of different potential risk factors with mastitis using Logistic Regression	72
3.10	Bacteria primary test	73
3.11	Bacteria isolated from bovine clinical and subclinical mastitis from 50 positive mastitic milk samples selected	74

Abstract

A cross-sectional study was conducted in large and small dairy farms in Khartoum state from April to October 2012. The objectives were to estimate the overall prevalence of bovine mastitis (clinical and sub clinical), elucidate the association of potential risk factors and to isolate and identify t bacteria associate with mastitis from milk samples. A total of 646 lactating dairy cow comprising 51 local, 590 cross and 5 pure breed cows were randomly selected and screened using California Mastitis Test (CMT) for subclinical mastitis and clinically examined for clinical mastitis. The overall prevalence rate was found to 51% (6.3% clinical and 44.7% subclinical). The prevalence in different localities was 99 (67.7%) in Ombada, 104

(45.2%) in Omdorman, 308 (50%) in Eastnile and 153 (45.1%) in Khartoum. The overall herd prevalence was 66.2% (27% clinical and 63.5 subclinical). The percentage of mastitis within quarters was 24% (4% clinical and 20% subclinical, 50% hind quarters and 48.7% front quarters). Risk factors such as, locality (p-value = .003), health score (p-value = .000), stage of lactation (p-value = .004), parity (p-value = .009), previous exposure to mastitis (p-value = .000), teat injuries (p-value = .06), presence of ticks (p-value = .001), yielding milk (p-value = .000), herd size (p-value = .10), floor disinfectant (p-value = .21), water scarcity (p-value = .03), drainage system (p-value = .006), dung removing (p-value = .21), farm fencing (p-value = .05) and education level (p-value = .09) showed statistically significant association (p-value < 0.25) with the occurrence of mastitis in the univariate analysis.

The results of this study also showed that locality (p-value = .02), stage of lactation (p-value = .004), parity (p-value = .02), previous exposure to mastitis (p-value = .007) and yielding milk (p-value = .000) had statistical significant association of mastitis (p-value ≤ 0.05) in the multivariate analysis.

Twenty five subclinically positive milk samples and 25 milk samples from clinically affected cows were subjected to bacteriological examination. All samples were cultured positive. In addition, mixed infection was found. Among these cultured positive samples, the prevalent mastitis causing agents isolated were: 61.1% *Staphylococcus spp*, 15% *Streptococcus spp*, 6% *Corynebacterium spp*, 3% *Aerococcus spp*, 2% *Micrococcus spp* and 2% *Bacillus spp*.

ملخص البحث

أجريت هذه الدراسة الوبائية في 63 مزرعة لأبقار اللبن بولاية الخرطوم، في الفترة من ابريل إلى أكتوبر 2012. الدراسة تهدف إلى تقدير نسبة انتشار التهاب الضرع (العياني ودون العياني)، وتحديد عوامل الخطورة التي تساعد على حدوث المرض وتحديد المسببات البكتيرية. مجمل 646 بقرة حلوب تم اختيارها عشوائياً كالاتى: 51 محلى، 590 هجين و 5 ابقار نقى تم فحصها بواسطة CMT للأبقار دون العيانية وبواسطة العين المجردة للاصابات العيانية حيث سجلت النتائج التالية: نسبة انتشار المرض فى الولاية 51% (6.3% للفحص العياني و44.6% للفحص دون العياني). كما سجلت الدراسة نسبة تفشى المرض فى المحليات التي تم اختيارها عشوائياً كالاتى: 99 (67.7%) فى محلية امبده، 104 (45.2%) فى محلية امدرمان، 308 (50%) محلية شرق النيل 135 (45.1%) فى محلية الخرطوم. كما سجلت ايضاً نسبة انتشار المرض فى القطيع 66.2% (27% من المزارع مصابة بالتهاب الضرع العياني و44.7%

مصابة بالتهاب الضرع تحت العياني). كما رصدت الدراسة ايضاً نسبة تفشى المرض بين ارباع الضرع بنسبة 24% (20% للحالات تحت العيانية و4% للحالات العيانية) مع ازدياد حالات الاصابة فى الضرع الخلفى بالمقارنة بالضرع الامامى بنسبة 50% و 48.6% على التوالى. عند التحليل لكل عامل خطورة على حدة، حددت الدراسة بعض عوامل الخطورة التى تساهم بشكل وثيق فى حدوث المرض منها المحليات، الحالة الصحية، مراحل الحلابة، عدد الولادات، التعرض المسبق لالتهاب الضرع، الجروح والإصابات الموجودة على الحلمت والضرع، كمية الحليب، وجود القراد على الضرع، حجم القطيع، تطهير أرضية المزرعة، وفرة المياه فى المزرعة، إزالة روث الأبقار، نظام الصرف فى المزرعة، نوعية سور المزرعة و المستوى التعليمي للرعاة. واثبتت ان المحليات، مراحل الحلابة، عدد الولادات، التعرض المسبق للالتهاب و كمية الحليب هى اكثر عوامل الخطورة التى تساهم فى حدوث المرض وذلك فى تحليل عوامل الخطورة مجتمعة. تم اخذ خمسين عينة من العينات المصابة بالتهاب الضرع (25 عياني و25 تحت عياني) وفحصها معملياً لتحديد انواع البكتريا المسببة للالتهاب الضرع وقد افرزت الدراسة الاتى:

(61.1%) *Staphylococcus spp*, (15%) *Streptococcus spp*, 6% *Corynebacterium spp*, 3% *Aerococcus spp*, (2%) *Micrococcus spp* and (2%) *Bacillus spp*.