ACKNOWLEDGMENTS

First of all my thanks and praise are due to my Almighty Allah, the Beneficent, the Merciful for giving me the health and strength to accomplish this work.

My thanks are due to Professor Osman Saad Ali, Dean of the College of Technology and Human Development; former Dean of College of Veterinary Medicine and Animal Production for providing this specialization and help to establish it.

I wish to express my indebtedness and sincere thankfulness to my supervisor Dr Bushra Hussein Ahmed, College of Radiological Sciences and Nuclear Medicine. National Rabat University and my co- supervisor Dr Amel Omer Bakhiet, College of Veterinary Medicine and Animal Production, Sudan University of Science and Technology (SUST), for their keen guidance, valuable assistance, advice and encouragement. My special gratitude to the Sudan University of Science and Technology (SUST), who sponsored this work.

My grateful thanks are due to the Police Dog Administrator, Ministry of Interior for providing the ultrasound machine; especial thanks are due to Dr Ali Hassan Ali.

Especial thanks are due to the Ministry of Agriculture, Animal Resources and Irrigation, Khartoum State, for providing the experimental animals; Saanen goats. Especial thanks are due to Dr Tageldin Osman Saeed and Dr Haleema Salih Ahmed.

I am also indebted to Professor Ahmed Abdelrahim Gameel, Head of the Department of pathology, Faculty of Veterinary Medicine, University of Khartoum, and Dr Shadia Abdel Atti Omer, College of Veterinary Medicine and animal Production, Sudan University of Science and Technology for their endless help and guidance.

I am grateful to Dr. Alsafi Ahmed Abdallah College of Medical Radiological Sciences, Sudan University of Science and Technology

I am also indebted to Dr Salah Kargweel and Alsir Ali Saeed, Ribat University Teaching Hospital for their keen support and assistance.

I am also grateful to Prof Abdelgadir Musa Homeida, King Faisal University, Kingdom of Saudi Arabia for doing the Progesterone assay.

My grate thanks are due to Dr Mohamed Tageldin Ibrahim for doing the statistical analysis (SPSS).

I am also indebted to my sincere friends Rabab and Somaia for their endless help. I would like to thank Mohamed Abdulrahim for preparing the images. My thanks are due to the staff of Sudan University of Science and Technology web page, especial thanks to Bakri Mohamed. My thanks are also due to my student Makki and Yousif (Sudan Heart Center) for preparing the ultrasound images.

Thanks are due to all those whom I forgot to mention.

عن النبى صلى الله عليه وسلم قال:-
الغنم بركة والإبل عز لأهلها والخيل معقود بنواصيها الخير إلى يوم القيامه.

(اخرجه البزار)
حديث شريف

وعنه صلى الله عليه وسلم قال:-
الغنم من دواب الجنه فامسحوا رغامها وصلوا فى مرابضها.
(أخرجه الخطيب البغدادى)
حديث شريف

وعنه صلى الله عليه وسلم قال:-
الفخر والخيلاء فى أهل الإبل والسكينة والوقار فى أهل الغنم.
(اخرجه أحمد)
حديث شريف

وعنه صلى الله عليه وسلم قال:-
ما بعث الله من نبى إلا ورعى الغنم.
حديث شريف

LIST OF CONTENTS

Dedication		
Acknowledgements		I
List of Contents		iv
List of Figures		vii
List of Tables		viii
List of Abbreviations		ix
Abstract		xii
ملخص الاطروحة		xiv

CHAPTER ONE
INTRODUCTION 1-3

INTRODUCTION		1
The Objectives		3

CHAPTER TWO
LITERATURE REVIEW 4-19

2.1.	Goats in Sudan	4
2.1.1	Saanen goats	4
2.2.	Estrus cycle	4
2.3.	Gestational period and placentation	5
2.4.	Methods of pregnancy diagnosis	5
2.4.1.	Non-return to estrus	5
2.4.2.	Abdominal ballottement	6
2.4.3.	Laboratory methods	6
2.4.3.1.	Progesterone (P4) assay	6
2.4.3.2.	Early pregnancy factor (EPF)	7
2.4. 3.3.	Pregnancy specific protein B (PSPB)	8
2.4.4.	Radiography	8
2.4.5.	Ultrasound	8
2.4.5.1.	Sound waves definition	9
2.4.5.2.	Spectrum of sound waves	9
2.4.5.3.	Production and detection of sound waves	9
2.4.5.3.1.	Transducers	9
2.4.5.3.2.	Transducers arrays	9
2.4.5 .4.	Different ultrasonic methods for pregnancy diagnosis	10
2.4.5.4.1	Amplitude modulation (A- Mode)	10
2.4. 5.4.2.	Medata ultrasonic pregnancy detectors	10
2.4.5.4.3.	Brightness Modulation (B-Mode)	11
2.4.5.4.3.1.	Early detection of pregnancy, embryo proper	11

with its heart beats
2.4.5.4.3.2. Fetal number (multiplicity) 12
2.4.5.4.3.3. Fetal sexing 13
2.4.5.4.3.4. Estimation of gestational age 14
2.4. 5.4.3.4.1. Crown Rump length (CRL) 14
1. 5. 5.4. 3. 4. 2. Bi Parietal Diameter (BPD) 14
2.4.5.4.3.4.3. Abdominal circumference (AC) 16
2.4.5.4. 3.4.3. Femur length (FL) 16
2.4.3.3.3.4.5. Placentomes size and shape 16
2.4. 5.3. 3. 4.6. Fetal Heart Rate (FHR) 17
2.4.5.4.3.5. Fetal anomalies 17

CHAPTER THREE
MATERIALS AND METHODS 20-29

3.1. Experimental Animals and Housing 20
3.2. Experimental techniques 20
3.2.1. Abdominal ballottement 20
3.2.2. Hormonal assay 20
3.2.3. Ultrasound 21
3.2.3.1. Animal preparation 21
3.2.3. 2. Animal positioning 21
3.2.3.3. Area of scanning and scanning technique 22
3.2.3.4 Ultrasound machine 22
3.2.3.5. Hard copy imager printer 22
3.3. Experimental design 22
3.3.1. Experiment (1) 22
3.3.2. Experiment (2) 23
3.3.2.1. CRL 23
3.3.2.2. BPD 23
3.4. Statistical analysis 24
3.4.1. Experiment 1 24
3.4.2. Experiment 2 24

CHAPTER FOUR
RESULTS 30-59

4.1. Experiment 1 30
4.1.1 Abdominal ballottement 30
4.1.2 Progesterone (P4) assay 30
4.1.3 Ultrasound findings 30
4.2. Experiment 2 41
4.2.1 Ultrasound 41

4.2.1.1 Fetometry 41
4.2.1.1.1 Crown Rump Length (CRL) 41
4.2.1.1.2. Bi Parietal Diameter (BPD) 44
4.2.1.1.3 Placentomes size and shape 47
4.2.1.1.4 Other fetal parameters 51
4.2.1.1.5. Fetal sex 56
4.2.1.1.6. Fetal anomalies 56

CHAPTER FIVE
DISCUSSION 60-64

Conclusion and Recommendations 63

REFERENCES 65-71

LIST OF FIGURES

No.	Figure	Page
1	Animal Positioning (Dorsal Recumbency)	25
2	Ultrasound machine	26
3	CRL at day 53. Measuring 6.41cm	27
4	CRL at day 60. Measuring 9.76cm	28
5	BPD complete line.	29
6	Gestational Sac (GS) at day 26 of gestation	34
7	Two gestational sacs (GS) at day 28 of gestation.	35
8	Cotyledons (C) at day 87 of gestation	36
9	Fetal head (H) with spine	37
10	Fetal Rib Cage	38
11	Twins at day 38 of gestation	39
12	Twins at day 60 of gestation	40
13	The relationship between the CRL (cm) and gestational age (days)	43
14	The relationship between the BPD (cm) and gestational age (days)	46
15	Cotyledons(C) at day 46 of gestation	48

16 Cotyledons at day 60 of gestation 49
17 Cotyledons (C) at day 88 of gestation 50
18 Fetal heart rate (FHR) at day 97 of gestation measuring 195 beats/min 52
19 Femur length measuring 4.4 cm at Day 97 of gestation 53
20 Cross section of the UC 54
21 Longitudinal section of the umbilical cord (UC) 55
22 Male fetus (penis) 57
23 Male fetus (scrotum) 58
24 Female fetus 59

LIST OF TABLES

No.	Table Title	Page
Table 1.	Pregnancy diagnosis using progesterone concentration and ultrasound	32
Table 2	Fetal number using ultrasound compared with delivery	33
Table 3.	Measurements of (CRL) in Saanen goats	42
Table 4.	Measurements of (BPD) in Saanen goats	45

LIST OF ABBREVIATIONS

AC	Abdominal Circumference
AI	Artificial Insemination
BPD	Bi Parietal Diameter
Bpm	Beats per minute
CL	Corpus Luetium
CRL	Crown Rump Length
CSP	Cavum Septum Pellucidum
EGA	Estimated Gestational Age
EV	Embryonic Vesicle
FC	Falx Cerebri Midline
FHR	Fetal Heart Rate
FL	Femur Length
GS	Gestational Sac
HL	Humerus Length
MHz	Megahertz
OCF	Occipito-Frontal
OvPAG	Ovine Pregnancy Associated Glycoprotein
P4	progesterone
PAG	Pregnancy Associated Glycoprotein

PD	Pregnancy Diagnosis
PSPB	Pregnancy Specific Protein B
RIA	Radio Immune Assay
Se	Sensitivity
Sp	Specificity
TD	Trunk Diameter
UC	Umbilical Cord

ABSTRACT

Early pregnancy detection in goats was not practicable in the country until now. The present study evaluated the use of ultrasonography in detecting pregnancy as early as 24 days, determining fetal number, viability and establishing gestational equations in a flock of Saanen goats under Sudan conditions.

31dairy Saanen does aged between 7-31 months were used in the study. They were housed and managed at the main center of goat improvement project, (*Hilat Kuku*), Khartoum state. Estrus was carefully observed and each doe was naturally mated twice on the 1st and 2nd day of estrus, hence the first day of estrus was designated as day 0 of gestation.

Real–time B- mode ultrasonography was performed with 3.5MHz transabdominal curvilinear transducer. The accuracy of Ultrasound (US) in detecting pregnancy was 100% in both positive (29) cases and negative (2) cases. The accuracy of detecting single feti, twins and triplets was 88.2%, 77.7% and 50% respectively. Blood sample was taken from each animal at the time of Ultrasound scanning for progesterone assay. Contrary to the ultrasound scanning the progesterone assay detected all pregnant animals but failed to detect non pregnant ones, (accuracy 93.5%) or fetal number.

Four nillparous does of the same age, weight and date of natural mating were scanned at weekly intervals from day 46-67 and 46-95 for measuring (CRL) and (BPD) respectively and Gestational equations were established as follows:

CRL = 0.464 x- 17.767

BPD = 0.055 x-1.431

Where x is the Gestational Age (GA). The correlation coefficient between the (GA) and each of the two parameters was found to be highly significant ($P<0.0001$)

The (CRL) was some times difficult to measure because of the very fast movements of the fetus and the measurements should be taken when the fetus is fully extended which is very difficult to occur. The BPD became increasingly difficult as pregnancy advanced beyond day 95 of gestation. Out of four feti two were diagnosed as females and one as male which was confirmed at delivery.

ملخص الاطروحة

كشف الحمل المبكر فى الاغنام لا يمكن إجراؤه عمليا إلى الأن فى السودان, الدراسة الحالية أجرت تقييم لإستخدام الموجات الصوتية لكشف الحمل المبكر فى عمر 24 يوم, لتحديد عدد الاجنة, بقائها حية و من ثم تكوين معادلة للحمل فى قطيع من أغنام السعانين تحت ظروف السودان.

عدد 31 من أغنام اللبن سلالة السعانين تتراوح اعمارها بين 7-31 شهر إستخدمت فى إجراء التجربة, هذه الأغنام موجودة فى مشروع تحسين نسل الماعز المركز الرئيسى /حلة كوكو /ولاية الخرطوم.

تمت المراقبة الدقيقة للشبق وكل انثى تم تلقيحها طبيعيا مرتين فى اليوم الاول والثانى للشبق لذلك أعتبر اليوم الأول للشبق هو يوم صفر فى الحمل.

اجريت الموجات الصوتية الحية من نوع (ب) بإستخدام محول ذو تردد 3.5 ميجاهرتز ,كانت نسبة الدقة للموجات الصوتية لكشف الحمل 100% حيث كانت هنالك 29 حالة موجبة للحمل و 2 حالة سالبة . كانت نسبة الدقة لتحديد عدد الأجنة المفرد والمثنى والثلاثى 88.2 ,77.7 و 50% على التوالى . أخذت عينة دم من كل حيوان فى نفس الوقت الذى أجريت فيه الموجات الصوتية لفحص هلامون البروجسترون . أظهر فحص هرمون البروجسترون فى الدم وجود 31 حالة موجبة للحمل وذلك بوجود حالتين موجبة كاذبة أى ان نسبة الدقة كانت 93.5 % , لم يتمكن هرمون البروجسترون من تحديد عدد الاجنة.

عدد 4 اغنام بكر متساوية فى العمر, الوزن, وتاريخ التلقيح الطبيعى تم الكشف عليها بالموجات الصوتية اسبوعيا إبتداء من يوم 46-67 ومن يوم 46-95 من الحمل لقياس الطول الكلى للجنين والمسافة بين العظمين الجداريين على الترتيب لعمل معادلة للحمل و تم عمل معادلة للحمل كانت كالاتى

الطول الكلى للجنين= 464. س- 17.767

المسافة بين العظمين الجداريين =.0.055 س- 1.431

حيث أن س هى عمر الحمل وكان معامل الإرتباط بين عمر الحمل وأى من القياسين قوى جدا

كان قياس الطول الكلى للجنين صعبا فى بعض الاحيان وذلك لسرعة حركة الجنين حيث أن القياس يتم فى حالة الأستقامة التامة للجنين والتى يصعب تحقيقها وكان قياس المسافة بين العظميين الجداريين يذداد صعوبة مع تقدم الحمل بعد يوم 95

عدد أربعة اجنة تم تحديد الجنس لعدد 2 انثى واخر ذكر وتم تاكيد النتائج بعد الولادة.