**UNIVERSITY OF MALAYA**

**ORIGINAL LITERARY WORK DECLARATION**

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## ABSTRACT

Until recently, early pregnancy detection in goats was not practical or unreliable. Ultrasonography diagnosis was reported to be an alternative and effective tool to detect pregnancy. The objectives were: 1) to determine the efficacy of ultrasonography in goat pregnancy detection, 2) to monitor the foetal development using transrectal (TR) and transabdominal (TA) probes, 3) to predict the specific and combination of structures observed for each stage of pregnancy, 4) to estimate age of foetus with specific and combination of structures observed and 5) to confirm the accuracy of specific and combination of structures in estimating the age of foetal. Pregnancy diagnosis was performed using a real-time B-mode scanner equipped with TR (7.5 MHz) and TA (5.0 MHz) transducers. Gestation period was categorized into five stages, i.e. initial, early, middle, late and final stages. In Experiments 1 and 2, a total of 9 and 13 naturally oestrus does were scanned using TR and TA probes, respectively. Foetal development and related structures were obtained as fact findings along gestation period. In Experiments 3 and 4, a total of 95 and 150 does were diagnosed along gestation period to obtain specific and combination of structures using TR and TA probes, respectively. In Experiment 5, confirmation on reliability of specific and combination of structures for each stage of gestation obtained from Experiments 3 and 4, were carried out in 75 does. The highest predictive values (100%) for specific and combination of structures during early stage of gestation were detection of sac, non-echogenic (NE) area and foetus-heartbeat-uterine wall-amniotic fluid. During middle stage of pregnancy, detection of combination on foetus-heartbeat, placentomes-foetus-heartbeat and foetus-heartbeat-spinal cord-ribs gave 100% predictive values each. Predictive accuracy for combinations of structures in late stage,

placentomes-foetus-heartbeat-spinal cord-ribs, placentomes-foetus-heartbeat-spinal cord-ribs-foetal organ; and foetus-heartbeat-spinal cord-ribs-foetal organ were 100, 80, and 100%, respectively. During final stage of gestation, only placentomes were detected and gave 100% predictive value. Accuracy on prediction of pregnancy status and age estimation for each stage of gestation i.e. early, middle, late, and final stages probes were 100, 100, 97 and 100%, respectively. Early detection of pregnancy is promising with TR probe. Images captured enable operators to determine stages of gestation in an effort to improve reproductive efficiency. TR probe is suitable for early pregnancy detection whereas TA probe is more practical to later stage of pregnancy. Both probes were needed to ensure the effectiveness in pregnancy diagnosis. Therefore, ultrasound scanning technology could be coupled with other reproductive technologies i.e. AI and cryopreservation to be used routinely and efficiently in the goat farm management. In conclusion, B-mode ultrasonography in caprine pregnancy diagnosis was efficient in detection of pregnancy as early as day 23 of gestation and gave high predictive value in estimating different stages of pregnancy using TR and TA probes.

## ABSTRAK

Sehingga kini, kaedah mengesan kebuntingan di peringkat awal dalam kambing adalah tidak menyakinkan. Diagnosis pengesan ultrabunyi telah dilaporkan sebagai pilihan alternatif dan kaedah yang efektif untuk mengesan kebuntingan. Tujuan kajian adalah: 1) untuk menentukan keberkesanan pengesan ultrabunyi dalam mengesan kebuntingan 2) untuk memerhati perkembangan fetus menggunakan prob *transrectal (TR)* dan *transabdominal (TA)*, 3) untuk memberi andaian struktur spesifik dan kombinasi struktur-struktur bagi setiap peringkat kebuntingan 4) untuk memberi andaian umur fetus dengan struktur spesifik dan kombinasi struktur-struktur dan 5) untuk mengesahkan ketepatan struktur spesifik dan kombinasi struktur-struktur dalam menentukan umur fetus. Diagnosis kebuntingan dijalankan menggunakan mesin pengesan *real-time B-mode* yang dilengkapi prob TR (7.5 MHz) dan TA (5.0 MHz). Tempoh kebuntingan telah dikategorikan kepada 5 peringkat, contohnya, peringkat permulaan, awal, pertengahan, lewat dan akhir. Dalam Eksperimen 1 dan 2, sejumlah 9 dan 13 ekor kambing betina yang estrus semulajadi didiagnosis menggunakan prob TR dan TA, masing-masing. Perkembangan fetus dan struktur berkaitan diperolehi sebagai penemuan asas sepanjang tempoh kebuntingan. Dalam Eksperimen 3 dan 4, sejumlah 95 dan 150 kambing betina didiagnosis sepanjang tempoh kehamilan bagi memperolehi struktur spesifik dan kombinasi struktur-struktur menggunakan prob TR dan TA, masing-masing. Dalam Eksperiman 5, pengesahan kebolehharapan struktur spesifik dan kombinasi struktur-struktur untuk setiap peringkat kehamilan yang didapati dari Eksperimen 3 dan 4 dijalankan ke atas 75 kambing betina. Nilai ketepatan andaian dengan peratusan tertinggi (100%) untuk struktur spesifik dan kombinasi struktur-struktur di peringkat awal kehamilan adalah karung, kawasan tidak

bergema dan fetus-degupan jantung-dinding uterin-cecair amniotik. Semasa peringkat pertengahan, kombinasi fetus-degupan jantung, placentum-fetus-degupan jantung dan fetus-degupan jantung-tulang belakang-tulang rusuk yang dikesan memberi 100%, masing-masing. Nilai ketepatan andaian bagi kombinasi struktur-struktur pada peringkat lewat adalah placentum-fetus-degupan jantung-tulang belakang-tulang rusuk, placentum-fetus-degupan jantung-tulang belakang-tulang rusuk-organ dalaman fetus dan fetus-degupan jantung-tulang belakang-tulang rusuk-organ dalaman fetus adalah 100, 80 dan 100%, masing-masing. Semasa peringkat akhir kehamilan, hanya placentum yang telah dikesan dan memberi 100% nilai ketepatan andaian. Ketepatan dalam mengandaikan status kebuntingan dan umur fetus bagi setiap peringkat adalah 100, 100, 97 dan 100%, masing-masing. Pengesanan awal untuk kebuntingan adalah menjanjikan dengan prob TR. Imej yang diambil membolehkan operator menentukan peringkat kebuntingan bagi meningkatkan keberkesanan pembiakbakaan. Prob TR lebih sesuai mengesan kebuntingan pada peringkat awal manakala prob TA lebih praktikal untuk kebuntingan peringkat akhir. Kedua-dua prob diperlukan bagi memastikan keberkesanan dalam diagnosis kehamilan ini. Oleh itu, teknologi pengesanan ultrabunyi boleh digandingkan dengan kaedah pembiakan teknologi yang lain e.g. permanian beradas dan penyejukbekuan untuk dijadikan rutin dan secara berkesan dalam pengurusan ladang kambing. Kesimpulannya, mesin ultrabunyi B-mode adalah berkesan dalam diagnosis kebuntingan kambing seawal 23 hari dan memberi nilai ketepatan andaian yang tinggi dalam menentukan peringkat-peringkat kebuntingan yang berbeza menggunakan kedua-dua prob.

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## LIST OF PUBLICATIONS, PRESENTATIONS AND AWARDS

### *Peer-reviewed Articles*

**R.K. Raja Ili Airina*,** W.E. Wan Khadijah and R.B. Abdullah. 2008. Ultrasound imaging of foetal development for goat pregnancy diagnosis. Submitted in Malaysian Journal of Animal Sciences.

### *Conferences (Oral Presentations)*

**R. K. Raja Ili Airina*,** W.E. Wan Khadijah and R.B. Abdullah. 2009. Estimation of foetal age in Boer does using B-mode real-time ultrasound scanner. Proceedings of the 30th Malaysian Society of Animal Production (MSAP) Annual Conference, June 2-5, Sabah, Malaysia (extended abstract).

**R. K. Raja Ili Airina*,** W.E. Wan Khadijah and R.B. Abdullah. 2008. Ultrasound Images for pregnancy diagnosis during goat's foetal development using transrectal and transabdominal probes. Proceedings of the13th Biological Sciences Graduate Congress, December 15-17, National University of Singapore, Singapore, p. 41 (abstract).

**R. K. Raja Ili Airina*,** W.E. Wan Khadijah and R.B. Abdullah. 2008. Ultrasound imaging of foetal development for goat pregnancy diagnosis. Proceedings of the 29th Malaysian Society of Animal Production (MSAP) Annual Conference, May 25-27, Penang, Malaysia, pp.46-47 (extended abstract).

### *Conferences (Poster Presentations)*

**R. K. Raja Ili Airina*,** W.E. Wan Khadijah and R.B. Abdullah. 2008. Ultrasound Imaging for Caprine Pregnancy Diagnosis. Proceedings of the 4th Life Sciences Postgraduate Conference (LSPC), June 18-20, Penang, Malaysia, p.578 (abstract).

### *Award Obtained*

Won the "Best Oral Presentation Award" in the 28th Malaysian Society of Animal Production (MSAP) Annual Conference, May 25-27th 2008, Penang, Malaysia.

## TABLE OF CONTENTS


| | Page |
|---|---|
| DECLARATION | i |
| ABSTRACT | ii |
| ABSTRAK | iv |
| ACKNOWLEDGEMENTS | vi |
| LIST OF PUBLICATIONS, PRESENTATIONS AND AWARDS | viii |
| TABLE OF CONTENTS | ix |
| LIST OF FIGURES | xiii |
| LIST OF TABLES | xxvi |
| LIST OF ABBREVIATIONS | xxviii |
| Chapter 1 | 1 |
| 1.1 INTRODUCTION | 1 |
| 1.2 BACKGROUND | 2 |
| 1.2.1 Application of Ultrasonography in Farm Animals | 2 |
| 1.2.2 Ultrasound scanning in goats | 4 |
| 1.2.3 The Principle of Ultrasound Scanning | 7 |
| 1.3 JUSTIFICATION | 8 |
| 1.4 STATEMENT OF PROBLEMS | 8 |
| 1.5 OBJECTIVES OF THE STUDY | 10 |
| Chapter 2 | 11 |
| 2.0 REVIEW OF LITERATURE | 11 |
| 2.1 TIMELINE OF SIGNIFICANT FINDINGS IN GOAT ULTRASOUND IMAGING | 11 |

2.2 HISTORICAL BACKGROUND OF ULTRASOUND SCANNING IN PREGNANCY DIAGNOSIS 16

2.3 DIFFERENT TYPES OF ULTRASOUND SCANNERS 18

2.4 FACTORS AFFECTING ACCURACY RATE OF PREGNANCY DIAGNOSIS USING ULTRASOUND SCANNING 22

2.5 RELATIONSHIP BETWEEN STRUCTURES DETECTED BY ULTRASOUND SCANNER DURING PREGNANCY 26

2.6 SUITABILITY OF SCANNERS FOR DIFFERENT STRUCTURES ALONG THE PREGNANCY PERIOD 30

2.7 IMPROVEMENT OF ULTRASOUND SCANNING 36

Chapter 3 38

3.0 MATERIALS AND METHODS 38

3.1 GENERAL INTRODUCTION 38

3.2 LOCATION OF STUDY 38

3.3 EXPERIMENTAL ANIMALS 38

3.4 MATERIALS 40

3.4.1 Equipment and Instruments 40

3.4.2 Disposables/Miscellaneous 40

3.5 METHODS 40

3.5.1: General Overview 40

3.5.2: Transrectal Scanner Procedure 43

3.5.3 Transabdominal Scanner Procedure 43

3.6 EXPERIMENTAL DESIGN 45

3.6.1 Observation on Foetal Structures and Related Images in Reproductive System of Does using Transrectal Probe (Experiment 1) 47

3.6.2 Observation on Foetal Development and Related Images in Reproductive System of Does using 48

Transabdominal Probe (Experiment 2)

3.6.3 Optimization of Pregnancy Diagnosis of Does with Transrectal Probe (Experiment 3) 48

3.6.4 Optimization of Pregnancy Diagnosis of Does with Transabdominal Probe (Experiment 4) 49

3.6.5 Pregnancy Diagnosis in Does Undergo Natural Mating and AI with Transrectal and Transabdominal Probes (Experiment 5) 50

3.7 STATISTICAL ANALYSIS 51

Chapter 4 55

4.0 RESULTS 55

4.1 OVERVIEW OBSERVATION ON FOETAL DEVELOPMENT AND RELATED IMAGES IN REPRODUCTIVE SYSTEM IN DOES USING TRANSRECTAL PROBE (EXPERIMENT 1) 55

4.2 OVERVIEW OBSERVATION ON FOETAL DEVELOPMENT AND RELATED IMAGES IN REPRODUCTIVE SYSTEM IN DOES USING TRANSABDOMINAL PROBE (EXPERIMENT 2) 64

4.3 OPTIMIZATION OF PREGNANCY DIAGNOSIS OF DOES USING TRANSRECTAL PROBE (EXPERIMENT 3) 76

4.4 OPTIMIZATION OF PREGNANCY DIAGNOSIS OF DOES WITH TRANSABDOMINAL PROBE (EXPERIMENT 4) 93

4.5 PREGNANCY DIAGNOSIS IN DOES UNDERGO NATURAL MATING AND AI WITH TRANSRECTAL AND TRANSABDOMINAL PROBES (EXPERIMENT 5) 126

Chapter 5 185

5.0 DISCUSSION 185

5.1 INTRODUCTION 185

5.2 OVERVIEW OBSERVATION ON FOETAL DEVELOPMENT AND RELATED IMAGES IN 185

REPRODUCTIVE SYSTEM IN DOES WITH TRANSRECTAL PROBE (EXPERIMENT 1)

5.3 OVERVIEW OBSERVATION ON FOETAL DEVELOPMENT AND RELATED IMAGES IN REPRODUCTIVE SYSTEM IN DOES USING TRANSABDOMINAL PROBE (EXPERIMENT 2) 188

5.4 OPTIMIZATION OF PREGNANCY DIAGNOSIS OF DOES USING TRANSRECTAL PROBE (EXPERIMENT 3) 190

5.5 OPTIMIZATION OF PREGNANCY DIAGNOSIS OF DOES USING TRANSABDOMINAL PROBE (EXPERIMENT 4) 195

5.6 PREGNANCY DIAGNOSIS IN DOES UNDERGO NATURAL MATING AND AI WITH TRANSRECTAL AND TRANSABDOMINAL PROBES (EXPERIMENT 5) 199

5.7 GENERAL DISCUSSION 204

6.0 CONCLUSIONS 208

REFERENCES 210

APPENDICES 218

## LIST OF FIGURES


| Figure | Title | Page |
|---|---|---|
| Figure 2.1 | The stages of development of a fertilized egg | 27 |
| Figure 2.2 | A foetus taking form | 29 |
| Figure 2.3 | The normal-position of the foetus in the doe's abdomen (cross-section) | 30 |
| Figure 3.1 | Institute of Biological Sciences (ISB) Mini Farm (Livestock), University of Malaya | 39 |
| Figure 3.2 | Kambing Bakabaik Kepala Batas Farm (KBKB), Kepala Batas, Penang | 39 |
| Figure 3.3 | Ultrasound monitor (ALOKA SSD500) | 41 |
| Figure 3.4 | Transabdominal probe (5.0 MHz) with 4.0 cm length | 41 |
| Figure 3.5 | Transrectal probe (7.5 MHz) (shaft length: 35 cm, shaft diameter: 1.4 cm) | 42 |
| Figure 3.6 | Thermal printer Sony UP-860 | 42 |
| Figure 3.7 | The tip of the transducer was lubricated with carboxymethylcellulose contact gel | 44 |
| Figure 3.8 | Probe was moved gently forwards and backwards and rotated 90 degrees clockwise and counter-clockwise | 44 |
| Figure 3.9 | Surface probe was covered with gel | 46 |
| Figure 3.10 | Probe was moved orientated perpendicularly towards the ventral abdominal wall | 46 |
| Figure 3.11 | Female underwent artificial insemination (AI) | 47 |
| Figure 3.12 | Summary of experimental design | 54 |
| Figure 4.1 | Image (A) is an original image. Sac was detected on day 13 of gestation (initial stage). Image (B) is a labeled image | 56 |
| Figure 4.2 | Image (A) is an original image. Non-echogenic (NE) area was detected on day 23 of gestation (early stage). Image (B) is a labeled image | 57 |

| | | |
|---|---|---|
| Figure 4.3 | Image (A) is original image. Sac was detected on day 25 of gestation (early stage). Image (B) is a labeled image | 58 |
| Figure 4.4 | Image (A) is an original image. Foetus-heartbeat-uterine wall-amniotic fluid of was detected on day 28 of gestation (early stage). Image (B) is a labeled images | 59 |
| Figure 4.5 | Image (A) is an original image. Placentome was detected on day 29 of gestation (early stage). Image (B) is a labeled image | 60 |
| Figure 4.6 | Image (A) is an original image. No significant structure was detected on day 51 of gestation (middle stage). Image (B) is a labeled image | 61 |
| Figure 4.7 | Image (A) is an original image. No significant structure was detected on day 66 of gestation (middle stage). Image (B) is a labeled image | 62 |
| Figure 4.8 | Image (A) is an original image. No significant structure was detected on day 70 of gestation (middle stage). Image (B) is a labeled image | 63 |
| Figure 4.9 | Image (A) is an original image. Placentomes were detected on day 51 of gestation (middle stage). Image (B) is a labeled image | 66 |
| Figure 4.10 | Image (A) is an original image. Foetus with heartbeat and amniotic fluid were detected on day 66 of gestation (middle stage). Image (B) is a labeled image | 67 |
| Figure 4.11 | Image (A) is an original image. Placentomes were detected on day 66 of gestation (middle stage). Image (B) is a labeled image | 68 |
| Figure 4.12 | Image (A) is an original image. Foetus, ribs, spinal cord and heartbeat were detected on day 86 of gestation (late stage). Image (B) is a labeled image | 69 |
| Figure 4.13 | Image (A) is an original image. Foetus, ribs, spinal cord, heartbeat and foetal organs were detected on day 108 of gestation (late stage). Image (B) is a labeled image | 70 |
| Figure 4.14 | Image (A) is an original image. Placentomes were detected on day 123 of gestation (final stage). Image (B) is a labeled image | 71 |
| Figure 4.15 | Image (A) is an original image. Placentomes were | 72 |

| | | |
|---|---|---|
| | detected on day 133 of gestation (final stage). Image (B) is a labeled image | |
| Figure 4.16 | Image (A) is an original image. No indicator was detected on day 13 of gestation (initial stage). Image (B) is a labeled image | 73 |
| Figure 4.17 | Image (A) is an original image. No indicator was detected on day 25 of gestation (early stage). Image (B) is a labeled image | 74 |
| Figure 4.18 | Image (A) is an original image. No indicator was detected on day 28 of gestation (early stage) Image (B) is a labeled image | 75 |
| Figure 4.19 | Image (A) is an original image. Sac was detected on day 21 of gestation (early stage). Image (B) is a labeled image | 81 |
| Figure 4.20 | Image (A) is an original image. Non-echogenic (NE) area was detected on day 20 of gestation (early stage). Image (B) is a labeled image | 82 |
| Figure 4.21 | Image (A) is an original image. Non-echogenic area was detected on day 21 of gestation (early stage). Image (B) is labeled image | 83 |
| Figure 4.22 | Image (A) is an original image. Placentomes were detected on day 30 of gestation (early stage). Image (B) is a labeled image | 84 |
| Figure 4.23 | Image (A) is an original image. Foetus with uterine wall, amniotic fluid and heartbeat were detected on day 26 of gestation (early stage). Image (B) is a labeled image | 85 |
| Figure 4.24 | Image (A) is an original image. Foetus with heartbeat and amniotic fluid were detected on day 28 of gestation (early stage). Image (B) is a labeled image | 86 |
| Figure 4.25 | Image (A) is an original image. No indicator was detected on day 54 of gestation (middle stage). Image (B) is a labeled image | 87 |
| Figure 4.26 | Pregnancy predictive value (percentage) for specific structural image detected at early stage of gestation using transrectal probe regardless of singular or combination of structures detected for each doe | 89 |

| | | |
|---|---|---|
| Figure 4.27 | Pregnancy predictive value (percentage) of each structural image or combination of structures detected using transrectal probe on early stage of gestation for each doe | 89 |
| Figure 4.28 | Distribution of specific structural images observed for each doe along stage of gestation using transrectal probe calculated based on designated range of days during pregnancy regardless of singular or combination of structures detected for each doe | 90 |
| Figure 4.29 | Frequency of selected structural images observed on three period of early pregnancy using transrectal probe | 91 |
| Figure 4.30 | Image (A) is an original image. Placentomes were detected on day 56 of gestation (middle stage). Image (B) is a labeled image | 98 |
| Figure 4.31 | Image (A) is an original image. Foetus with heartbeat and spinal cord were detected on day 56 of gestation (middle stage). Image (B) is a labeled image | 99 |
| Figure 4.32 | Image (A) is an original image. Foetus with heartbeat and spinal cord were detected on day 63 of gestation (middle stage). Image (B) is a labeled image | 100 |
| Figure 4.33 | Image (A) is an original image. Placentomes were detected on day 63 of gestation (middle stage). Image (B) is a labeled image | 101 |
| Figure 4.34 | Image (A) is an original image. Foetus with heartbeat was detected on day 67 of gestation (middle stage). Image (B) is a labeled image | 102 |
| Figure 4.35 | Image (A) is an original image. Placentomes, ribs, and spinal cord was detected on day 68 of gestation (middle stage). Image (B) is a labeled image | 103 |
| Figure 4.36 | Image (A) is an original image. Placentomes were detected on day 72 of gestation (middle stage). Image (B) is a labeled image | 104 |
| Figure 4.37 | Image (A) is an original image. Foetus with heartbeat surrounded by placentomes were detected on day 72 of gestation (middle stage). Image (B) is a labeled image | 105 |
| Figure 4.38 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs was detected on day 84 of gestation (late | 106 |

stage). Image (B) is a labeled image

Figure 4.39 Image (A) is an original image. Placentomes were detected on day 84 of gestation (late stage). Image (B) is a labeled image 107

Figure 4.40 Image (A) is an original image. Foetus with spinal cord, ribs and foetal organ were detected on day 87 of gestation (late stage). Image (B) is a labeled image 108

Figure 4.41 Image (A) is an original image. Foetus with heartbeat were detected on day 88 of gestation (late stage). Image (B) is a labeled image 109

Figure 4.42 Image (A) is an original image. Foetus with spinal cord, ribs and foetal organs were detected on day 103 of gestation (late stage). Image (B) is a labeled image 110

Figure 4.43 Image (A) is an original image. Placentomes were detected on day 105 of gestation (late stage). Image (B) is a labeled image 111

Figure 4.44 Image (A) is an original image. Foetus with heartbeat, spinal cord and foetal organs were detected on day 106 of gestation (late stage). Image (B) is a labeled image 112

Figure 4.45 Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs were detected on day 110 of gestation (late stage). Image (B) is a labeled image 113

Figure 4.46 Image (A) is an original image. Heart and spinal cord were detected on day 117 of gestation (late stage). Image (B) is a labeled image 114

Figure 4.47 Image (A) is an original image. Placentomes were detected on day 121 of gestation (final stage). Image (B) is a labeled image 115

Figure 4.48 Image (A) is an original image. No indicator was detected on day 35 of gestation (early stage). Image (B) is a labeled image 116

Figure 4.49 Pregnancy predictive value (percentage) of each structural image/combination of structures occurrence using transabdominal probe during middle stage of gestation 118

Figure 4.50 Pregnancy predictive value (percentage) of each structural image/combination of structures occurrence using transabdominal probe on late stage of gestation 120

| | | |
|---|---|---|
| Figure 4.51 | Pregnancy predictive value (percentage) of each structural image/combination of structures occurrence using transabdominal probe on final stage of gestation | 122 |
| Figure 4.52 | Summary of existence of structural images total images observed in middle, late and final stages of gestation using transabdominal probe | 123 |
| Figure 4.53 | Summary on frequency of singular and combinations of structural images observed along gestation period using transabdominal probe | 124 |
| Figure 4.54 | Distribution of significant indicators along gestation period with transrectal and transabdominal probes | 132 |
| Figure 4.55 | Image (A) is an original image. Sac was detected on day 23 of gestation (early stage). Image (B) is a labeled image | 134 |
| Figure 4.56 | Image (A) is an original image. Sac was detected on day 23 of gestation (early stage). Image (B) is a labeled image | 135 |
| Figure 4.57 | Image (A) is an original image. Sac was detected on day 25 of gestation (early stage). Image (B) is a labeled image | 136 |
| Figure 4.58 | Image (A) is an original image. Non-echogenic (NE) area was detected on day 23 of gestation (early stage). Image (B) is a labeled image | 137 |
| Figure 4.59 | Image (A) is an original image. Non-echogenic (NE) area was detected on day 23 of gestation (early stage). Image (B) is a labeled image | 138 |
| Figure 4.60 | Image (A) is an original image. Non-echogenic (NE) area was detected on day 26 of gestation (early stage). Image (B) is a labeled image | 139 |
| Figure 4.61 | Image (A) is an original image. Foetus with heartbeat and amniotic fluid were detected on day 28 of gestation (early stage). Image (B) is a labeled image | 140 |
| Figure 4.62 | Image (A) is an original image. Foetus with heartbeat were detected on day 31 of gestation (early stage). Image (B) is a labeled image | 141 |
| Figure 4.63 | Image (A) is an original image. Foetus with heartbeat and amniotic fluid were detected on day 33 of gestation (early stage). Image (B) is a labeled image | 142 |

| | | |
|---|---|---|
| Figure 4.64 | Image (A) is an original image. Foetus with heartbeat and amniotic fluid were detected on day 36 of gestation (early stage). Image (B) is a labeled image | 143 |
| Figure 4.65 | Image (A) is an original image. Foetus and heartbeat were detected on day 60 of gestation (middle stage). Image (B) is a labeled image | 144 |
| Figure 4.66 | Image (A) is an original image. Placentomes were detected on day 60 of gestation (middle stage). Image (B) is a labeled image | 145 |
| Figure 4.67 | Image (A) is an original image. Foetus and heartbeat were detected on day 60 of gestation (middle stage). Image (B) is a labeled image | 146 |
| Figure 4.68 | Image (A) is an original image. Placentomes were detected on day 60 of gestation (middle stage). Image (B) is a labeled image | 147 |
| Figure 4.69 | Image (A) is an original image. Foetus and heartbeat were detected on day 65 of gestation (middle stage). Image (B) is a labeled image | 148 |
| Figure 4.70 | Image (A) is an original image. Placentomes were detected on day 65 of gestation (middle stage). Image (B) is a labeled image | 149 |
| Figure 4.71 | Image (A) is an original image. Foetus and heartbeat were detected on day 75 of gestation (middle stage). Image (B) is a labeled image | 150 |
| Figure 4.72 | Image (A) is an original image. Placentomes was detected on day 75 of gestation (middle stage). Image (B) is a labeled image | 151 |
| Figure 4.73 | Image (A) is an original image. Foetus and heartbeat were detected on day 77 of gestation (middle stage). Image (B) is a labeled image | 152 |
| Figure 4.74 | Image (A) is an original image. Placentomes were detected on day 77 of gestation (middle stage). Image (B) is a labeled image | 153 |
| Figure 4.75 | Image (A) is an original image. Foetus and heartbeat were detected on day 82 of gestation (middle stage). Image (B) is a labeled image | 154 |
| Figure 4.76 | Image (A) is an original image. Foetus and heartbeat were detected on day 82 of gestation (middle stage). Image (B) | 155 |

is a labeled image

Figure 4.77 Image (A) is an original image. Foetus and heartbeat were detected on day 70 of gestation (middle stage). Image (B) is a labeled image 156

Figure 4.78 Image (A) is an original image. Placentomes were detected on day 70 of gestation (middle stage). Image (B) is a labeled image 157

Figure 4.79 Image (A) is an original image. Foetus with heartbeat, spinal cord and ribs were detected on day 90 of gestation (late stage). Image (B) is a labeled image 158

Figure 4.80 Image (A) is an original image. Placentomes were detected on day 90 of gestation (late stage).Image (B) is a labeled image 159

Figure 4.81 Image (A) is an original image. Placentomes were detected on day 91 of gestation (late stage). Image (B) is a labeled image 160

Figure 4.82 Image (A) is an original image. Foetus with heartbeat, spinal cord and ribs were detected on day 91 of gestation (late stage).Image (B) is a labeled image 161

Figure 4.83 Image (A) is an original image. Foetus with heartbeat, spinal cord and ribs were detected on day 93 of gestation (late stage). Image (B) is a labeled image 162

Figure 4.84 Image (A) is an original image. Placentomes were detected on day 93 of gestation (late stage).Image (B) is a labeled image 163

Figure 4.85 Image (A) is an original image. Placentomes, foetus with heartbeat and foetal organ were detected on day 95 of gestation (late stage).Image (B) is a labeled image 164

Figure 4.86 Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 98 of gestation (late stage).Image (B) is a labeled image 165

Figure 4.87 Image (A) is an original image. Placentomes were detected on day 98 of gestation (late stage).Image (B) is a labeled image 166

Figure 4.88 Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 109 of gestation (late stage).Image (B) is a labeled image 167

| | | |
|---|---|---|
| Figure 4.89 | Image (A) is an original image. Placentomes were detected on day 109 of gestation (late stage).Image (B) is a labeled image | 168 |
| Figure 4.90 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 98 of gestation (late stage). Image (B) is a labeled image | 169 |
| Figure 4.91 | Image (A) is an original image. Placentomes were detected on day 98 of gestation (late stage).Image (B) is a labeled image | 170 |
| Figure 4.92 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 106 of gestation (late stage).Image (B) is a labeled image | 171 |
| Figure 4.93 | Image (A) is an original image. Foetus with heartbeat, spinal cord and foetal organ were detected on day 106 of gestation (late stage).Image (B) is a labeled image | 172 |
| Figure 4.94 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 119 of gestation (late stage). Image (B) is a labeled image | 173 |
| Figure 4.95 | Image (A) is an original image. Placentomes were detected on day 119 of gestation (late stage).Image (B) is labeled a image | 174 |
| Figure 4.96 | Image (A) is an original image. Foetus with heartbeat were detected on day 111 of gestation (late stage). Image (B) is a labeled image | 175 |
| Figure 4.97 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 111 of gestation (late stage). Image (B) is a labeled image | 176 |
| Figure 4.98 | Image (A) is an original image. Foetus with heartbeat, spinal cord and ribs were detected on day 97 of gestation (late stage). Image (B) is a labeled image | 177 |
| Figure 4.99 | Image (A) is an original image. Foetus with heartbeat, spinal cord and ribs were detected on day 111 of gestation (late stage). Image (B) is a labeled image | 178 |
| Figure 4.100 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 111 of gestation (late stage). Image (B) is a labeled image | 179 |
| Figure 4.101 | Image (A) is an original image. Foetus with heartbeat, | 180 |

| | | |
|---|---|---|
| | spinal cord, ribs and foetal organ were detected on day 96 of gestation (late stage). Image (B) is a labeled image | |
| Figure 4.102 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 103 of gestation (late stage). Image (B) is a labeled image | 181 |
| Figure 4.103 | Image (A) is an original image. Foetus with heartbeat, spinal cord, ribs and foetal organ were detected on day 101 of gestation (late stage). Image (B) is a labeled image | 182 |
| Figure 4.104 | Image (A) is an original image. Placentomes were detected on day 137 of gestation (final stage). Image (B) is a labeled image | 183 |
| Figure 4.105 | Image (A) is an original image. Placentomes were detected on day 143 of gestation (final stage). Image (B) is a labeled image | 184 |


**Appendix Figure**


| | | |
|---|---|---|
| Appendix Figure 1.1 | Image (A) is an original image of transrectal ultrasonography images of the uterine horns on a non-pregnant goat day 18 after mating in Anglo-Nubian goats. Note the absence of discrete non-echogenic areas in the uterine lumen cranial to the urinary bladder (b). Image (A1) is a labeled image | 218 |
| Appendix Figure 1.2 | Image (B) is an original image transrectal ultrasonographic images of the uterine horns on day 18 after mating in Anglo-Nubian goats. Ultrasonography of the uterine horn in a pregnant goat showing a round non-echogenic area in the uterine lumen (arrow). Image (B1) is a labeled image | 219 |
| Appendix Figure 1.3 | Image (C) is an original image transrectal ultrasonography images of the uterine horns on day 18 after mating in Anglo-Nubian goats. Image of the uterine horn in a pregnant goat showing an elongated non-echogenic area in the uterine lumen arrows. Image (C1) is a labeled image | 220 |
| Appendix Figure 1.4 | Image (A) is an original image transrectal ultrasonography images of uterine horns in pregnant goats. Embryo (arrow) measuring 8 mm on day 23 after mating. Image (A1) is a labeled image | 221 |

| | | |
|---|---|---|
| Appendix Figure 1.5 | Image (B) is an original image transrectal ultrasonography images of uterine horns in pregnant goats. Embryo (arrow) on day 40 after mating. The embryo measures 36 mm from the crown to rump. Image (B1) is a labeled image | 222 |
| Appendix Figure 1.6 | Image (A) is an original image. Ultrasound image of the urinary bladder (black sphere; arrow) in goats obtained using a 7.5 MHz transrectal transducer. Image (A1) is a labeled image | 223 |
| Appendix Figure 1.7 | Image (A) is an original image. Ultrasound image of non-pregnant uterus in goats obtained using a 7.5 MHz transrectal transducer. The uterus appears as a spherical structure with a medium echogenic density. Image (A1) is a labeled image | 224 |
| Appendix Figure 1.8 | Image (A) is an original image. Ultrasound image of early pregnant uterus using a 7.5 MHz transrectal transducer on day 21 post-mating (arrow). The fluid-filled sacs were round or oblong in shape. Image (A1) is a labeled image | 225 |
| Appendix Figure 1.9 | Image (A) is an original image. Ultrasound images of a goat embryo on day 30 of gestation obtained using a 7.5 MHz transrectal transducer. The embryo (E, arrow) is observed as an area of high echoic density. Image (A1) is a labeled image | 226 |
| Appendix Figure 1.10 | Image (A) is an original image. Ultrasound images of a goat embryo on day 35 of gestation obtained using a 7.5 MHz transrectal transducer. Image B shows the umbilical cord (arrow). Image (A1) is a labeled image | 227 |
| Appendix Figure 1.11 | Image (A) is an original image. Typical images observed by transrectal real-time ultrasonography with a 7.5 MHz linear-array transducer. Uterus of a non-pregnant doe (visible as a fuzzy ellipsoid structure). Image (A1) is a labeled image | 228 |
| Appendix Figure 1.12 | Image (A) is an original image. Typical images observed by transrectal real-time ultrasonography with a 7.5 MHz linear-array transducer. Fluid-filled vesicle in the uterine lumen of a doe 22 days pregnant. Image (A1) is a labeled image | 229 |
| Appendix Figure 1.13 | Image (A) is an original image. Typical images observed by transrectal real-time ultrasonography with a 7.5 MHz linear-array transducer. Larger foetus (head to the left) and umbilical cord of a doe 34 days pregnant. Image (A1) | 230 |

| | | |
|---|---|---|
| | is a labeled image | |
| Appendix Figure 1.14 | Image (A) is an original image. Ultrasound images of twin pregnancy (arrows) on day 40 of gestation obtained using 5.0 MHz transabdominal transducer. Image (A1) is a labeled image | 231 |
| Appendix Figure 1.15 | Image (A) is an original image. Ultrasound images of placentomes in goats (arrows) obtained on day 35 (A) using 7.5 MHz transrectal transducer. Image (A1) is a labeled image | 232 |
| Appendix Figure 1.16 | Image (B) is an original image. Ultrasound images of placentomes in goats (arrows) obtained on day 60 (B) of gestation using 5.0 MHz transabdominal transducer (note that placentomes are visible as small nodules on day 35 and become C or O shape later and increased in size as in image (B). Image (B1) is a labeled image | 233 |
| Appendix Figure 1.17 | Image (A) is an original image. Ultrasound images of the thorax in a goat foetus at 2 months of gestation obtained using a 5 MHz transabdominal transducer (arrows). Image (A1) is a labeled image | 234 |
| Appendix Figure 1.18 | Image (A) is an original image. Ultrasound images of a long bone (radius; A) goat foetus on day 70 of gestation obtained using a 5 MHz transabdominal transducer. Image (A1) is labeled image | 235 |
| Appendix Figure 1.19 | Image (B) is an original image. Ultrasound images of a head (B) of a goat foetus on day 70 of gestation obtained using a 5 MHz transabdominal transducer. Image (B1) is a labeled image | 236 |
| Appendix Figure 1.20 | Image (A) is an original image showing a female foetus with 45 days of pregnancy showing tail (T) and genital tubercle (GT). The ultrasound frequency was 6.0 MHz for all the images | 237 |
| Appendix Figure 1.21 | Image (B) is an original image showing a female foetus with 48 days of pregnancy showing genital tubercle (GT) and umbilical cord (UC). The ultrasound frequency was 6.0 MHz for all the images | 237 |
| Appendix Figure 1.22 | Image (C) is an original image showing female foetus with 58 days of pregnancy showing vulva (V), umbilical cord (U) and the ultrasound frequency was 6.0 MHz for all the images | 238 |

| | | |
|---|---|---|
| Appendix Figure 1.23 | Image (D) is an original image showing male foetus with 60 days of pregnancy showing scrotal bag (SB). The ultrasound frequency was 6.0 MHz for all the images | 238 |
| Appendix Figure 1.24 | Image (A) is an original image. Linear-array echographic images of the caprine foetus during the last three weeks of gestation. In all four instances the cranial part of the foetus is to the left, the caudal part to the right. The abdominal wall and uterine wall must be thought of as the base of each figure. A: thorax and anterior abdomen showing the foetal ribs, the heart, abomasum and the upper part of a frontleg Image (A1) is a labeled image | 239 |
| Appendix Figure 1.25 | Image (A) is an original image. Linear-array echographic images of the caprine foetus during the last three weeks of gestation. In all four instances the cranial part of the foetus is to the left, the caudal part to the right. The abdominal wall and uterine wall must be thought of as the base of each figure. B: thorax and abdomen showing the heart, dorsal aorta, part of the foetal stomach and one of the kidneys. Image (A1) is a labeled image | 240 |
| Appendix Figure 1.26 | Image (A) is an original image. Linear-array echographic images of the caprine foetus during the last three weeks of gestation. In all four instances the cranial part of the foetus is to the left, the caudal part to the right. The abdominal wall and uterine wall must be thought of as the base of each figure. C**:** caudal part of the abdomen showing the dorsal aorta and the two kidneys. Image (A1) is a labeled image | 241 |
| Appendix Figure 1.27 | Image (A) is an original image. Linear-array echographic images of the caprine foetus during the last three weeks of gestation. In all four instances the cranial part of the foetus is to the left, the caudal part to the right. The abdominal wall and uterine wall must be thought of as the base of each figure. D: thorax and anterior abdomen showing the junction of the umbilical vein and the posterior vena cava (i.e. ductus venosus). Image (A1) is a labeled image | 242 |

## LIST OF TABLES


| Table | Title | Page |
|---|---|---|
| Table 2.1 | Timeline of significant findings in goat ultrasound imaging in goat reproduction | 11 |
| Table 2.2 | Development of foetal structures detected in goats using transrectal and transabdominal probes with accuracy rate along gestation period | 31 |
| Table 3.1 | Classification stages of gestation and probable probe suitability for pregnancy detection | 43 |
| Table 3.2 | Independent and dependant variables | 51 |
| Table 4.1 | Images of foetal and related structures during gestation period during 7.5 MHz transrectal probe | 55 |
| Table 4.2 | Images of foetal and related structures during gestation period using 5.0 MHz transabdominal probe | 65 |
| Table 4.3 | Images on indicators along pregnancy period (stage and day of pregnancy) using 7.5 MHz transrectal probe | 78 |
| Table 4.4 | Summary of image observation for each structure/combination of structures using transrectal probe during gestation period | 88 |
| Table 4.5 | Number of animals that tested positive and negative with different stage of gestation | 92 |
| Table 4.6 | Images on indicators along pregnancy gestation using 5.0 MHz using transabdominal probe | 95 |
| Table 4.7 | Image observation for each structure/combination of structures using transabdominal probe during early and middle stages of gestation | 117 |
| Table 4.8 | Image observation for each structure/combinations of structures using transabdominal probe structures during late stage of gestation | 119 |
| Table 4.9 | Image observation for each structure/combination of structures using transabdominal probe structures during final stage of gestation | 121 |
| Table 4.10 | Number of animals that tested positive and negative with different stage of gestation | 125 |

| | | |
|---|---|---|
| Table 4.11 | Pregnancy predictive value (%)on specific and combinations of structures along gestation period using both probes | 128 |
| Table 4.12 | Summary on percentage of predicted accuracy on pregnancy status and predicted day of foetus during early stages of gestation using 7.5 MHz transrectal probe | 129 |
| Table 4.13 | Summary prediction and actual days of foetus with percent of accuracy on pregnancy status and predicted day during middle, late and final stages of gestation using 5.0 MHz transabdominal probe | 130 |
| Table 4.14 | Accuracy value (%) on stages of pregnancy during early, middle, late and final stage of gestation | 133 |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ABEL | Animal Biotechnology-Embryo Laboratory |
| CW | Continuous wave |
| CL | Corpora lutea |
| Heartbeat | Detection of heart in foetus |
| KBKB | Kambing Bakabaik Kapala Batas |
| NE | Non-echogenic |
| PW | Pulsed wave |
| TA | Transabdominal probe |
| TR | Transrectal probe |