MORPHOMETRIC, HISTOLOGIC AND PATHOLOGIC STUDIES OF THE GENITALIA OF ONE-HUMPED FEMALE CAMELS (*Camelus dromedarius*) IN NORTHERN NIGERIA

BY

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A

Thesis

Submitted to

The Postgraduate School

Ahmadu Bello University

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

(THERIOGENOLOGY)

DEPARTMENT OF VETERINARY SURGERY & MEDICINE

FACULTY OF VETERINARY MEDICINE

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.

DECEMBER, 1988.

DECLARATION

This is to certify that I carried out the work reported in this thesis in the Department of Veterinary Surgery and Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, under the supervision of Drs. D. Ogwu, L.O. Eduvie and Prof. C.O. Njoku.

The work of other investigators in the areas covered in this thesis is duly acknowledged and referred to appropriately. No part of this thesis has been submitted elsewhere for a degree or diploma.

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CERTIFICATION

This thesis entitled "Morphometric, histologic and pathologic studies of the genitalia of one-humped female camels (Camelus dromedarius) in Northern Nigeria" by Abdullahi Yusufu Ribadu meets the regulations governing the award of Master of Science of Ahmadu Bello University and is approved for its contribution to scientific knowledge and literary presentation.

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"Inna lillahi wa inna illaihi rajiun"

This thesis is dedicated to the memory of my late father, ALKALI YUSUFU RIBADU (1919 - 1988). May Almighty Allah grant him eternal rest, Amin.

"Do they not look at the camel, how they are made?"

- Q. LXXXVIII:17

ACKNOWLEDGEMENTS

I wish to express my profound appreciation and gratitude to my supervisors Drs. D. Ogwu, L.O. Eduvie and Prof. C.O. Njoku for their guidance and encouragement throughout the course of this study. I deeply appreciate their individual and collective suggestions in the planning, execution and documentation of this work.

I would also like to thank Drs. J.D. Amin, J. Kumi-Diaka and Prof. M.R. Shalash for their assistance in retrieving and sending useful literature on my area of research from England, Canada and Egypt, respectively. I wish also to thank Drs. A. Sannusi, S.U. Abdullahi, U.S. Abdullahi, A. Ghaji and K.A.N. Esievo for the keen interest they have shown in my work. The co-operation and assistance received from the Head, Veterinary Surgery and Medicine, Dr. E.O. Gyang is also acknowledged.

I wish to register my sincere gratitude and indebtedness to all members of my family for their support and encouragement especially Alhaji Ahmadu Ribadu, Hamma Gidado, Usman Yusuf, Abubakar Yusuf, Alhaji Bappanyo, Arabo, Dr. Amin Sa'ad, Modibbo, Dahiru, Dr. Musa, Saidu and Hajiya Hauwau. My special thanks go to Dr. and Mrs. A.A. Ahmad, Dr. Hamman Tukur Sa'ad, late Dr. Mahmud M. Tukur (may Allah grant him Aljannah) and Mallam Isa Halilu for their assistance in various ways.

My gratitude goes to all my friends, colleagues and well wishers for their moral support.. My special thanks go to

Drs. G.I. Diggol, M.B. Arabo, K. Garba, S.U. Hassan, S.M. Ladan, F. Mohammed, B. Bappa, M. Mamman, M. Ahmed, A. Ajanusi, D. Adawa and A. Tukur. Others include Junaidu Kabir, Bashiru Mahmood, Yakubu G. Tilde, Abubakar El-Mahmood, Babangida Abbas, Umar Hamman tukur, Bello Aminu, Nasiru Mai, Tijjani Aminu, Ja'afaru Ibrahim, Dahiru Mohammed, Labaran Ahmed, Mohammed Sa'ad, Hamidu Sa'ad, Kabiru Shehu, Yusuf Ubale, Adamu Thnimu and Alkassum Abubakar.

The technical assistance and co-operation received from the staff of the departments of Veterinary Surgery and Medicine, Veterinary Pathology and Microbiology, and the authority of the Kano abattoir is also acknowledged. In this regard, my special thanks go to Mallam Yusufu Mohammed and Mrs. Molara Ogun tona.

I wish also to thank the University of Maiduguri for giving me the opportunity to undertake this programme.

Above all, thanks be to almighty Allah, the fountain of all knowledge, for the ability to undertake this study despite the limitations.

ABSTRACT OF THESIS

The genital dimensions, weights and histologic features of the different parts of 50 non-pregnant camels (Camelus dromedarius) were studied. The length, width and thickness of the left ovary was found to be 3.61 ± 0.54cm, 2.76 ± 0.44cm, and 0.73 ± 0.14cm respectively and weighed 4.76 ± 2.11gm while the right ovary measured 3.47 ± 0.54cm, 2.63 ± 0.42cm and 0.71 ± 0.14cm respectively and weighed 4.40 ± 2.04gm. Dimensions and weights of the oviducts, uterine horns and bodies, cervices and vaginas were also obtained. There were significant differences between the left and right uterine horns ($P < 0.05$). Histologically the ovary, oviduct, uterus, cervix and vagina were similar to those of most domestic animals.

A survey of the incidence of female genital disorders of one-humped camels showed 38 (4.47%) abnormalities from a total of 850 tracts examined. The conditions encountered included follicular cystic degeneration 0.83%, ovarian hemorrhagic cysts 0.47%, pyometra 0.35%, early embryonic mortality 0.12%, endometrial hemorrhages 0.47%, fetal maceration 0.12%, abscess 0.24%, vulvar tick infestation 1.77%, and cervical hypoplasia and aplasia 0.12%.

Pregnancy rate from 850 one-humped camels slaughtered for meat at the Kano abattoir, was found to be 49.64%. Embryos and fetuses in the first trimester were 206 (48.82%), 151 (35.78%) in the second trimester and 65 (15.40%) fetuses in the third trimester. The economic

significance of pregnancy wastage was highlighted and suggestions made on the ways of preventing or minimising the fetal losses.

Uterine swabs from 50 grossly normal non-pregnant uteri of one-humped female camels were cultured for bacteria on blood and MacConkey agar plates. Staphylococcus aureus was isolated in 4 cases (8%) while Escherichia coli was isolated in 1 case (2%). It is concluded that the normal healthy camel uterus should be bacteriologically negative and that any organisms found there may be regarded as potential pathogens.

TABLE OF CONTENTS

	Page
TITLE PAGE	i
DECLARATION	ii
CERTIFICATION	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
ABSTRACT	vii
TABLE OF CONTENTS	ix
LIST OF TABLES	xii
LIST OF FIGURES	xii
LIST OF PLATES	xiii
LIST OF APPENDICES	xv
CHAPTER ONE: LITERATURE REVIEW	1
Introduction	2
Ovaries	5
Histology of the ovary	10
Oviduct	11
Uterus	14
Cervix	17
Vagina	18
Seasonal variation in ovarian activity ...	18
Estrous cycle and estrus in camels	19
Pregnancy and pregnancy diagnosis	22
Pregnancy wastage and sex ratio	25
Reproductive disorders	27
Causes of low fertility	27
Congenital and nutritional causes of infertility..	34

TABLE OF CONTENTS CONT'D. Page

CHAPTER TWO: GENITAL DIMENSIONS AND WEIGHTS OF THE ONE-HUMPED FEMALE CAMEL (Camelus dromedarius) IN NIGERIA 35

INTRODUCTION 36

MATERIALS AND METHODS 38

RESULTS 39

DISCUSSION 40

TABLES 43

PLATES 45

CHAPTER THREE: HISTOLOGIC AND BACTERIOLOGIC STUDIES OF THE FEMALE GENITALIA OF THE ONE-HUMPED CAMEL (Camelus dromedarius) IN NIGERIA ... 46

INTRODUCTION 47

MATERIALS AND METHODS 49

RESULTS 50

DISCUSSION 55

PLATES 59

CHAPTER FOUR: INCIDENCE OF FEMALE GENITAL ABNORMALITIES OF THE ONE-HUMPED CAMEL (Camelus dromedarius) IN NIGERIA ... 66

INTRODUCTION 67

MATERIALS AND METHODS 68

RESULTS 69

DISCUSSION 70

TABLES 74

PLATES 77

TABLE OF CONTENTS CONT'D.

	Page
CHAPTER FIVE: PREGNANCY WASTAGE IN SLAUGHTERED CAMELS IN KANO, NIGERIA	84
INTRODUCTION	85
MATERIALS AND METHODS	86
RESULTS	86
DISCUSSION	87
FIGURE	90
PLATES	90
CHAPTER SIX: GENERAL DISCUSSION AND CONCLUSIONS ...	91
REFERENCES	97
APPENDICES	105

LIST OF TABLES

Table 1: Mean dimensions and weights of left and right ovaries.

Table 2: Mean dimension and weights of left and right oviducts.

Table 3: Mean dimension and weights of uterine horns and body.

Table 4: Mean dimensions and weights of the cervix and vagina.

Table 5: Incidence of different genital abnormalities of the female camel.

Table 6: Histopathologic lesions of the female genitalia of the one-humped camel (*Camelus dromedarius*) in Kano, Nigeria.

LIST OF FIGURE(S)

Fig. 1: Trimester distribution of embryos/fetuses.

LIST OF PLATES

PLATE I: Photograph of a herd of camels at the Kano abattoir.

Plate II: Photomicrograph through the cortex of ovary.

Plate III: Photomicrograph of the medulla of ovary.

Plate IV: Photomicrograph of a mature Graafian follicle.

Plate V: Photomicrograph of an ovum.

Plate VI: Photomicrograph of the mucosa and muscularis of the isthmus.

Plate VII: Photomicrograph of the muscularis and serosa of the isthmus.

Plate VIII: Photomicrograph of the ampulla of oviduct.

Plate IX: Photomicrograph of the mucosa and submucosa of the uterine horn.

Plate X: Photomicrograph of the muscularis and serosa of the uterine horn.

Plate IX: Photomicrograph of the mucosa and submucosa of the cervix.

Plate XII: Photomicrograph of the lower portion of the cervix.

Plate XIII: Photomicrograph of the mucosa and submucosa of the vagina.

Plate XIV: Photomicrograph of the muscularis and serosa of the vagina.

Plate XV: Photograph of pyometra.

Plate XVI: Photograph of a camel female genitalia with follicular cyst.

Plate XVII: Photograph of vulvar tick infestation.

Plate XVIII: Photomicrograph of hemorrhagic endometritis.

Plate XIX: Photomicrograph of a cystic uterine gland within the submucosa of the uterus.

LIST OF PLATES CONT'D.

Plate XX: Photomicrograph of chronic endometritis.

Plate XXI: Photomicrograph of uterine hemosiderosis.

Plate XXII: Photomicrograph of endometritis in pyometra.

Plate XXIII: Photomicrograph of acute endometritis.

Plate XXIV: Photomicrograph of hemorrhagic endometritis.

Plate XXV: Photomicrograph of follicular cystic degeneration.

Plate XXVI: Photomicrograph of hemorrhagic cyst in the ovary.

Plate XXVII: Photograph of single day fetal waste of near term camel fetuses.

Plate XXVIII: Photograph of fetuses of different ages removed from pregnant uteri from a single day's slaughter.

LIST OF APPENDICES

Appendix I: Dimensions and weights of camel genitalia.

Appendix II: Sex and estimated ages of fetuses recovered from slaughtered camels in Kano abattoir.

Appendix III: Economic losses as a result of the slaughtering of pregnant camels at Kano abattoir.

Appendix IV: Bacteria isolated from uterine horns of camels.

LIST OF ABBREVIATIONS

cm	=	Centimetres
CPL	=	Crown-rump-length
FSH	=	Follicle stimulating hormone.
LH	=	Loutinizing hormone.
mm	=	Millimetres.
ml	=	Millilitres.
h	=	hours.
%	=	Percent.
Pg	=	Picograms.
F	=	Female
M	=	Male

CHAPTER ONE

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INTRODUCTION

The Arabian one-humped camel (Camelus dromedarius), is a primary inhabitant of the northern half of Africa, the Middle East, Pakistan, India and some parts of West Africa including Nigeria. The two-humped camel (Camelus bacterianus) is found primarily in Central Asia. The dromedary is a multipurpose animal used for transportation, milk production and meat as well as by-products (wool, hair and hides). Camels are extremely well adapted to the hot arid environment. Consequently, the Arabian camels are of considerable economic importance.

According to the FAO (1978) estimate, there are about 18,000 camels in Nigeria, although this number has increased considerably in present times. Most of them are owned by pastoral groups in Sokoto, Katsina, Kano and Borno states where their importance as the traditional means of transport and agriculture cannot be overlooked despite the advent of modern transportation system and farm machineries. Camel meat is extensively consumed in some parts of Nigeria. At the Kano abattoir alone, 19,762 and 16,099 camels were slaughtered in 1986 and 1987 respectively. Most of the camels slaughtered were trade animals imported into Nigeria from neighbouring Niger and Chad Republics. Traditional camel owners in Nigeria rarely sell their stock.

Reproduction is the basis of any livestock economy. Sexual activity in the camelidae appears to be acyclic and ovulation is induced by copulation. The duration of sexual activity is variable. The pattern of the reproductive cycle appears to be related to the harsh environment from which the camel evolved. Selection has, thus been towards a type of animal with a breeding season coinciding with the most favorable time of the year. However, in areas with good environmental conditions, sexual activity does not follow such a restricted pattern (Novoa, 1970).

Little attention has been paid to camels from scientific viewpoints compared to other domestic animals. The negligence of camels could be attributed to double set of prejudices. It is not only considered of low economic value compared with other exotic livestock but is also believed to belong to old fashioned civilization. Economic and biological evaluation of camels in terms of productive and reproductive potentials have not been attempted, although substantial research has been conducted in the field of physiology and disease control (Shalash, 1983). Despite this report by Shalash (1983), work on the morphometry, histology and pathology of the genitalia of one-humped female camels in Nigeria is scanty. So also is the information on fetal losses as a result of slaughter of pregnant camels.

The specific objectives of this project are to:

1. determine the gross genital dimensions and weights of the different parts of the female genitalia of camels;

2. study the histology of normal female genital tracts;
3. undertake an abattoir survey of female genital diseases / abnormalities of camels;
4. determine the level of pregnancy wastage as a result of slaughter of pregnant camels and
5. conduct a bacteriologic study of grossly normal camel uteri.

LITERATURE REVIEW

OVARIES

Joshi et al. (1973) noted that although the camel is a ruminant, the reproductive tract of the female has some resemblance with that of the horse.

Lesbre (1903) cited by Novoa (1970) described the ovary in the camel as having the gross shape of a pea or nut with many ovisacs on its surface. Leese (1927) described the ovary as a flattened organ measuring 1 inch (2.5cm) in length. Asdell (1946) noted the length of the Graafian follicle as 1 to 1.5cm which attained a size of 2.5 to 3cm at maturity.

Shalash (1965) stated that the ovary of the female camel presents itself as a reddish flattened organ with a circular outline. The presence of numerous ovisacs on the surface of the ovary gives it the appearance of a bunch of grapes. The lateral and medial surfaces are slightly convex. The free ventral border is convex and presents no ovulation fossa. The corresponding attached border is somewhat straight. The ovary is enclosed in a large conical pocket-like fold of mesosalpinx, known as the bursa ovarii. The apex of this bursa is blind and laterally situated. The corresponding medial end of the bursa forms a large circular orifice beyond which the fimbriae of the uterine tube are situated. The ovarian ligament has been found in the form of a cord-like structure extending from

the superior surface of the broad ligament to the well defined hilus of the ovary of its own side.

The ovaries of the Iranian dromedary were found to have an average size of 13 x 19 x 33mm and an average weight of 10gm (Chahrasbi et al., 1975). Shalash (1965) however gave the weights as 3.65 ± 1.49gm and 3.89 ± 1.63gm for non functioning right and left ovaries respectively, and 5.51 ± 2.69gm and 5.47 ± 2.62gm for right and left ovaries with Graafian follicles. Ovaries with active corpora lutea of pregnancy weighed 7.94 ± 2.5[illegible] for right and 8.5 ± 2.66gm for left ovaries. Abdo et al. (1968) reported the size of the ovaries as 3 - 6cm for lenght x 2.5 - 4cm for thickness. According to Tayes (1948), the ovary of a mature camel weighed 2 - 4gm and measured 2 - 4cm long, 1.5 - 2cm wide and 0.8 - 1cm thick.

Abdallah (1965) reported that the ovaries in the non-pregnant camel are oval, situated in a cranio-caudal direction and are flattened laterally. They are bean-shaped in the resting period (anestrum) but vary much in shape during the breeding season and pregnancy. The average weight of each ovary was 5gm. From a study of 40 pregnant and non-pregnant genitalia of Camelus dromedarius collected from various slaughter houses in Egypt and Sudan, Abdallah (1965) concluded that the ovary is about 3cm long, 2cm wide and 0.8cm thick.

From a study of 30 female camels slaughtered at Hofuf abattoir, Saudi Arabia, Arthur et al. (1985) concluded that

the size and shape of the ovaries vary with their content of follicles and corpora lutea. The anestrus ovaries (roughly oval and thin) measured 4 x 2.5 x 0.5cm. They stated that the ovarian surface was uneven and showed many small follicles and, in mature animals, projections of old corpora lutea. Corpora albicantia were cream-colored and measured up to 0.6cm in diameter.

Ovaries of mature, non-pregnant camels contain numerous Graafian follicles in various stages of development. All Graafian follicles, especially the largest ones protrude from the surface of the ovary. They are turgid, transparent and almost spherical structures that are easily enucleated, since they are enveloped by a thick wall. Graafian follicles may grow to a diameter of 10cm but a common ovulatory size is 1.5 to 3.0cm (El-wishy and Hameida, 1984, Arthur et al., 1981). Ghoneim (1985) cited by Ismail (1987) reported that follicles also develop, but do not ovulate in the ovary of pregnant camels, particularly during the first 120 days (36.4%) and less so during the remainder (17.7%) of gestation.

Musa and Abusineina (1978a) estimated that follicles take about 6 days to grow to maximum size (range 2 - 14 days) and range from 1.5 to 3cm in diameter, although sizes of 8 - 9cm were also recorded. The grown follicle remain constant for 5 - 19 days (av. 13 days) before regressing over a 7 to 10 days period. The growth of follicles to maturity alternated

between the 2 gonads, but smaller follicles were always palpated alongside them. According to Arthur et al. (1985) mature follicles and current corpora lutea of the breeding season projected from the main contour of the ovary and gave the latter an exaggerated form.

Abdallah (1965) and Abdo et al. (1968) reported the presence of corpus luteum during the luteal phase of the estrous cycle in Iraqi and Sudanese camels. However, in a recent study by Musa and Abusineina (1978a) involving 35 estrous cycles over a 15-month period, no luteal phase was demonstrated, ovarian activity being mainly follicular. There is no cyclic luteal phase in camels (Nawito et al., 1967; Musa and Abusineina, 1978b; Shalash, 1980; Elias et al., 1984a). The follicular wave covers the period of time between the acceptance of the male by the female, with the associated changes in the ovaries, and her re-acceptance of the male indicating the start of a new wave (Nawito et al., 1967, Shalash, 1980). Nawito et al., (1967) divided the follicular wave into (a) mature follicular stage (b) atretic follicular stage (c) non-follicular stage, and (d) growing follicular stage.

The corpus luteum is thus normally observed only during pregnancy and in few cases with patent os uteri (Shalash, 1965). Its shape varied between spherical elongated and oval, and in early gestation it had a flabby consistency becoming larger and firmer as pregnancy advanced. A neck-like constriction was observed at the point where it attaches to the main ovarian body.

The corpus luteum of pregnancy was light brown with a grayish central cavity and variable numbers (1 to 5) may be found on the same ovary, their size varying from 1.85 to 1.88cm and their weight from 4.15 to 4.68gm (Shalash, 1965).

Ovulation in the camel does not occur spontaneously as in the cow, ewe or goat. Copulatory stimulus for its induction is indespensable (Shalash, 1965; Nawito et al., 1967; Novoa, 1970; Shalash, 1980; Elias et al., 1984a). Musa and Abusineina (1978b) also confirmed the above finding among Sudanese dromedaries. However, even 15 minutes of experimental cervical stimulation by palpation failed to induce ovulation, although luteinization of the Graafian follicle was produced. The camel is thus an induced ovulator like the cat and rabbit. Copulation apparently triggers the release of the gonadotropins essential for ovulation to occur approximatoly 36h later (Williamson and Payne, 1978).

Both Shalash (1965) and Musa and Abusineina (1976) who examined 787 and 416 female reproductive tracts respectively, agreed that there was more (12.98%) ovulation from the left than the right ovary and that pregnancy in the camel is almost exclusively left sided (99%). Cross pregnancy, where the pregnancy is maintained by a corpus luteum from the opposite side is very common (37.77%), early embryonic migration being probably frequent among dromedaries (Shalash, 1965).

Histology of the Camel Ovary

Abdallah (1965) stated that the camel ovary is covered by a layer of germinal epithelium except at the hilus. The cells of the germinal epithelium are of low cuboidal type with spherical nuclei. In some cases, the cells tend to be flattened Below the epithelium is a well defined layer of dense connective tissue known as tunica albuginea. The ovarian stroma which is cellular is next to the tunica albuginea. The cells are arranged in parallel lines around and between the growing follicles. The stromal cells are characterised by their densely staining nuclei. The area vasculosa is fibrous and contains many blood vessels. No interstitial tissue was observed in the ovary of the camel. He noted that follicles of different sizes were found in the stroma. The structure of the growing follicle is similar to that found in follicles of other domestic animals. The theca interna and theca externa could only be distinguished from each other in fairly large follicles approaching maturity.

Abdallah (1965) described the corpus luteum of ovulation and that of pregnancy to be similar structurally. It has however been shown that the camel has no cyclic luteal phase like other domestic animals (Nawito et al., 1967; Musa and Abusineina, 1978b; Shalash, 1980; Elias et al., 1984a). What Abdallah (1965) and Abdo et al. (1968) described as cyclic corpus luteum may have been corpus luteum developed as a result of infertile mating or corpus luteum associated with very early embryonic death (Musa and Abusineina, 1978b).

The corpus luteun according to Abdallah (1965) was covered by a vascular connective tissue capsule which sends septa towards the center. The luteal cells were very large and supported by a network of reticular tissue. They appeared triangular or polygonal in shape, with large spherical lightly stained nuclei. Active corpus luteum appeared very vascular with thin capillaries between the luteal cells. Corpora albicantia consisted of irregular dense connective tissue with fibrosing blood vessels in certain areas of the ovaries.

Hayes (1948) stated that the microscopic picture of the corpus luteum of pregnancy in the camel revealed a gradual decrease of lipoids and fat in the luteal cells and an increase in connective tissue elements as pregnancy advanced.

Shehata (1964) found medullary tubes in the ovary of the adult camel and thought the ovary of the camel possibly secretes a substance which causes persistence of both mesonephric structures. The medullary tubes appeared as intercommunication structures within the medulla of the ovary resembling glandular anini. The lining epithelium was cuboidal with or without secretion.

OVIDUCT

The general morphology of the oviducts of the one-humped camel is similar to that of other domestic animals. The oviducts of the camel are small in diameter (1 - 2mm), but become larger at the ovarian and where fimbriae are located (Mukasa-Mugerwa, 1981).

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According to Abdallah (1967), the oviducts of the one-humped camel are relatively long (17 - 22cm) in length and follow a tortous course to the corresponding horns but they tend to become straight at the isthmus region. The oviduct at the ampullary region is rather soft and flabby and has a wider diameter than in the isthmus region where it is hard in consistency. The abdominal end of the tube, infundibulum, has fimbrae which lie close to the medial opening of the bursa ovarii. The uterine end of the tube penetrates through the wall of the corresponding horn and protrudes for a few millimetres into the uterine lumen. The oviduct is covered by a fold of peritoneum, mesosalpinx, which is continuous with that of the broad ligament. Within the mesosalpinx is the uterovarian artery which runs parallel to the long axis of the oviduct.

Arthur et al. (1985) reported that the fallopian tubes are 22 to 24cm long. Their width increases towards the ovarian end where the tubes are obviously funnel shaped. The mesosalpinx and mesovarium together form a very well developed bursa which closely invests the ovary.

Novoa (1970) has stated that the oviduct of the camel is 25 to 28cm long. The isthmus is less coiled than the ampulla and the ovarian part of the fallopian tube. The lumen of the ampulla is 4 to 5cm in diameter at its ovarian opening in the depths of the fimbrae, while that of the isthmus is 1 to 2mm in diameter. Each oviduct opens into the uterine horns by a narrow orifice at a summit of papilla 3 to 4mm in height.

The uterine tubes are 22 to 28cm long. Their width increases towards the ovarian end where the tubes are funnel-shaped (Ismail, 1987).

Abdallah (1967) studied in detail the microscopic features of the camel oviduct. He noted that the mucous membrane of the oviduct is thrown into folds filling most of the lumen. In the ampullary region the mucosal folds were taller than in the isthmus region and showed primary and secondary folds. The lining epithelium consisted of 2 cell types, ciliated columnar and non-ciliated columnar with oval or elongated nuclei. The proportion of ciliated to the non-ciliated varied in the different phases of the estrous cycle and pregnancy. He observed that during the growth of the follicle more ciliated cells become apparent and towards the end of the follicular phase all the tubal epithelial cells were tall columnar with some non-ciliated secreting cells.

According to Trautmann and Feibiger (1957) the mucosal folds of the oviduct in most domestic animals are negligible in the isthmus but increases greatly in the ampulla. Mucosal folds are most pronounced in the sow, mare, less so in ruminants and subject to individual variation in carnivora. Abdallah (1967) observed the mucosal folds of the camel oviduct to be pronounced and compared it to that of ruminants.

The subepithelial layer which also fills the folds consists of loose connective tissue, blood vessels, lymphatics

and nerves. The tissue at the base of the folds is fairly cellular and sometimes infiltrated with lymphocytes. Smooth muscle fibres are noted. The lamina propria lies directly on the muscle layer as no muscularis mucosa is present. The inner smooth muscle layer is circular and outer longitudinal, the 2 muscle layers are interspersed by a zone of loose connective tissue. The circular smooth muscle layer is very thin in the ampullary region and thick in the isthmic region. The oviduct is covered by a serosal coat (Abdallah, 1967).

Scanning electron microscopy studies of the camel oviducts by Nayek (1977) showed that the epithelium of the camel uterine infundibulum consists primarily of 2 types of cells, ciliated and secretory. It was suggested that ciliated cells were concerned with the transport of ova and sperm while the secretory cells are involved with the secretory processes.

UTERUS

The uterus of the camel is of bicornual type and is large enough to occupy a position which is mostly abdominal and partly pelvic. It is reddish white, smooth and not dense in texture. Its upper and lower surfaces are convex and plain respectively. The body is relatively short. Both cornua are intimately united in their caudal portions. The divergence of the anterior portions is characterised by forming a T-shape with the uterine body rather than Y-shape (Leese, 1927; Tayes, 1948; Shalash, 1965; Novoa, 1970). Arthur et al. (1985) however

stated that the uterus is bicornuate with substantial uterine body from which 2 cornua diverge and taper anteriorly to form a combined uterine shape which is intermediate between that of the letter Y and T. The left horn is distinctly longer than the right one. The mucous membrane of the uterine body and of both cornua is smooth and presents no carunucles (Shalash, 1965; Abdallah, 1968; Novoa, 1970).

Shalash (1965) gave the length and diameter of the uterine body as 2.11 ± 0.29cm and 5.39 ± 0.90cm respectively during follicular growth and 1.85 ± 0.40cm and 5.84 ± 0.94cm for the length and diameter during the period of ovarian inactivity. The length of the right horn was 13.42 ± 1.76cm and 13.37 ± 2.5cm during the follicular (growth) phase and ovarian inactivity phases respectively. The length of the left horn was found to be 17.45 ± 2.86cm and 17.53 ± 3.29cm during the periods of ovarian activity and inactivity respectively. The diameter at the base of the uterine horns for right and left cornua during follicular phase was 3.73 ± 0.63cm and 4.29 ± 0.90cm respectively. During the ovarian inactivity phase, the diameter was found to be 3.73 ± 0.69cm for the right horn and 4.99 ± 0.91cm for the left horn.

The average uterine weight was found to be 278.22 ± 84.56gm but during the follicular activity it was found to be heavier than during the ovarian inactivity, being 284.06gm ± 92.29 and 272.38 ± 76.82gm respectively (Shalash, 1965).

Abdallah (1968) described in details the microscopic changes occurring in the camel uterus during the estrous cycle. There was proliferation and hypertrophy of the endometrial structures during follicular growth with evidence of secretory activity. Vascularization edema of the endometrium, hypertrophy and distention of the uterine glands were the most pronounced changes during pregnancy. Glycogen was present in the endometrial stroma throughout the estrous cycle and pregnancy.

Savi (1843) cited by Novoa (1970) was the first to note that the fetal placenta in the dromedary was diffuse in nature, as in the mare and not cotyledonary as in other ruminants. He described the thick chorionic membrane in the dromedary as being covered with short, shrublike tendrils or villi in which arteriovenous connections sometimes occurred. Similar observations on the epitheliochorial nature of the camel placenta was also made by several workers (Abdallah, 1968; Wilson, 1982).

Inspite of the nearly equal frequency of ovulation from the right and left ovaries, studies performed on the camel have shown that nearly all conceptuses (98.2 to 100%) are located in the left uterine horn (Tayes, 1948; Shalash and Nawito, 1964; Shalash, 1965; El-Wishy and El-Sawaf, 1971; Musa and Abusineina, 1976). This high incidence of left horn pregnancy is attributed to embryo migration which ranged from 30.0 to 48.8% (El-wishy and El-Sawaf, 1971; Arthur and Al-Rahim, 1982). It has also been observed by Arthur and Al-Rahim (1982) that the right horn does not support a conceptus after about day 50 postcoitum

and that adequate placental development is impossible in the right horn. When a normal single fetus develops in the left horn, its allantochorion grows out into the right horn and establishes normal placental relationships there as well as its own left horn.

CERVIX

The camel cervix, like that of the cow has a number of mucosal folds arranged in 3 to 4 rows (Ismail, 1987). The cervical canal is short (3.5cm), with a diameter of about 5.5cm. Like the cervix of the Zebu cow, that of the dromedary tends to hypertrophy and protrude about 1cm into the vagina resulting in the formation of 2 blind sacs, one situated dorsally and the other ventrally. Anteriorly, the mucosal folds of the cervical canal form a prominent crest which marks the cranial opening of the cervix (Mukasa-Mugerwa, 1981).

According to Arthur et al. (1985) the camel cervix resembles that of the cow but has 5 annular mucosal folds. A few centimeters behind the cervix is a concentric fringelike fold of the anterior vaginal mucosa which tends to obscure the uteri externum, and behind it are several progressively less prominent circular folds.

Shalash (1965) has reported the average length and diameter of the cervical canal during the follicular activity as 5.37 ± 0.98cm and 5.96 ± 0.2cm, respectively, while during ovarian

inactivity the length and diameter was found to be 4.96 ± 1.25cm and 5.79 ± 0.99cm respectively.

VAGINA

The vagina of the dromedary is an elastic organ of reddish color measuring 30 - 35cm and lined with mucosal folds posterior to the external cervical opening. Both longitudinal and circular folds have been demonstrated, althouth the later is more pronounced. With advanced pregnancy there is a tendency for the uterine weight to stretch out these folds (Mukasa-Mugerwa, 1981).

Leese (1927) described the canals of Gartner and the glands of Bartholini in the camel. Tyeb (1953) indicated that these canals are located in the vaginal wall; originating in the region of the external cervical opening.

REPRODUCTIVE PATTERNS OF THE FEMALE CAMEL

Seasonal variation in ovarian activity

Information about the breeding season in the dromedary is rather conflicting. The breeding season in Sudan was reported to be from March to August (Musa and Abusineina, 1978a). In Pakistan, Yasin and Wahid (1957) stated that the breeding season occurred between December and March. Matturu (1966) reported the breeding season of dromedaries in India as between November and March, while the breeding season in Somaliland was reported to be between April and May (Mares, 1954). Shalash (1965) studied the changes in ovarian functions in the camel during

different months and season in Egypt and found a highly significant difference in the ovarian activity between months as well as between seasons. This would illustrate that the female camel shows a stronger tendency to be a seasonal breeder as most of the ovarian activity occurs from December to May with a sudden drop during February. Optimum ovarian activity was found to occur in March. Nawito et al. (1967), however stated that although the female camel in Egypt shows a strong tendency to be regarded as a seasonal breeder, pregnancy can occur in any season of the year as indicated by the percentages of early pregnancy although it tends to be higher in winter and spring than in summer and autumn. El-wishy and Ghoneim (1986) also reported that conceptions occurred all the year round in Egypt but with a steep increase from 6.2% during April to 22.6% during July (spring and early summer). A dramatic decrease then occurred with the lowest level (3.5%) recorded during October and November. Arthur et al. (1985) has shown that conception occurred in all months except May, August and October in Saudi Arabia and concluded that in the tropics, the dromedary is a potentially polyestrous animal but that natural conditions of food shortage may decrease breeding activity.

Estrous cycle and estrus in camels

Studies on the ovarian cycle of the camel are scanty. Most reports in the literature are results of clinical observations from breeding records.

There are differences of opinion among investigators concerning the pattern and nature of estrous cycle of the camel. The lack of precise information about the cycle has contributed to the inefficient breeding of this animal (Barmentser, 1951 cited by Musa and Abusineina, 1978a).

Musa and Abusineina (1978b) studied 35 complete estrous cycles in 5 non-pregnant camels (Camelus dromedarius) over a period of 15 months and reported that estrous cycle lasted for 28 days and the ovarian activity was strictly follicular, with no luteal phase noted. On the other hand Shalash (1965) reported a length of 24 ± 4 days including 4 days of estrus.

Estrus tends to be longer in parous females than in virgin ones (Novoa, 1970). The female in estrus tends to be restless, bleats and has swollen vulva and a clear mucous discharge. She moves her tail up and down rapidly at the approach of the male or when hearing the gurgling vocalization of the rutting male. Experienced female responds rapidly to the attempts of a male camel to force her to the ground for copulation while inexperienced females may fight the male or run away (Yasin and Wahid 1957; Novoa, 1970; Arthur et al., 1985). External signs of heat in the camel are far less evident than in the cow and the mare (Musa and Abusineina, 1978b).

Joshi et al. (1978) studied the estrous cycle of Bikaneri camels of India in detail. They observed that the vagina appeared moist and light pink during proestrus. It became moist and red

during estrus itself, though the moistness decreased as estrus drew to an end. Similar changes were observed in the vestibular mucosa. Superficial flat cells with eosinophilic cytoplasm and pyknotic nuclei were found to be characteristic of vaginal smears during estrus, while intermediate cells were predominant in smears from pregnant animals. Vaginal examination showed that the cervix was moist and relaxed during estrus. On rectal examination the uterine horns were turgid at the beginning of estrus, but turgidity was not as marked as in cattle. Numerous Graafian follicles were palpable on both ovaries but no corpus luteum could be felt during any part of the estrous cycle.

Since ovulation is induced by coitus, the length of the estrus depends on whether mating occurs. In the absence of a male, estrus may last about 2 weeks, whereas if copulation occurred on the first day of estrus receptivity disappeared after 3 days (Arthur et al., 1985). Nawito et al. (1967) described follicular waves rather than estrous cycles which lasted an average of 24 ;21 days. He gave the duration of estrus as 0 - 15 days with a mean of 4 - 6 days.

Hafez (1974) stated that in the non-spontaneous ovulating species, the stimulus of copulation is carried by the nervous system to the ventral portion of the hypothalamus, while in the spontaneous ovulating species the stimulators are unknown. However, the mechanics and exact time of ovulation in the camel remain to be investigated.

Pregnancy and pregnancy diagnosis

The duration of gestation extends from conception to parturition. Estimating gestation length in the camel is difficult because the time of fertilization is inexact due to the large number of copulations that occur during estrus (Shalash, 1980; Ismail, 1987).

In 787 uteri examined by Shalash and Nawito (1964) for the site of pregnancy, it was found that 99% showed pregnancy in the left cornu and 0.76% in the right. Cross pregnancy, twin and triple pregnancy were also observed in 37.73%, 0.13% and 0.13% respectively.

The gestation period in the camel was reported to be 12 months (Islamy, 1950), 12 to 13 months (Yasin and Wahid, 1957), 389.87 ± 2.1 days (Mehta et al., 1962) and 370 - 375 days (Arthur et al., 1985). Male calves are carried 1.24 days longer than female calves. Sharma and Vyas (1971) in an investigation of 296 one-humped camels in India found an overall average gestation period of 391.1 ± 16.7 days and that male calves are carried 1.2 days longer than female calves. Mehta et al. (1962) however, stated that female calves were carried 1.3 days longer than male calves, but this difference was not statistically significant. The gestation period of the Bactrian camel is slightly longer averaging 13.5 months (Dahl and Hjort, 1976) cited by Mukasa-Mugerwa (1981).

Various methods have been developed for determining pregnancy and estimating its duration in the camel. Musa and Abusineina (1978a) studied the clinical features of pregnancy for each month of gestation in 6 pregnant camels over a period of 13 months. They reported the successful use of rectal palpation to diagnose pregnancy in the camel and compared their findings with those of the cow. It should be noted that larger corpora lutea are present only during pregnancy, 99% of the pregnancies are in the left horn, the right horn is congenitally shorter than the left and the amount of fetal fluid at all stages of pregnancy is less in the camel than in the cow (Arthur et al., 1985). External observation of the pregnant camels right flank reveals a spontaneous fetal movement from the ninth month and the fetus can be balloted externally from the tenth month.

El-Ghannam et al. (1974) have found that the Cuboni test for the demonstration of estrogens in urine can be successfully applied in camels as in the mare when the fetus was between 60 and 120cm corresponding to the second half of gestation. Similar results were reported in the mare between 150 and 300 days of gestation (Arthur et al., 1982). In the mare however, the source of pregnancy estrogens is believed to be the fetal gonads (Raeside et al., 1973) while in the camel the extremely high levels of estradiol in the allantoic fluid on the day of parturition (2411 ± 390 pg/ml) might imply a placental origin (Elias et al., 1984b).

Other possible methods of pregnancy diagnosis in the camel include the ultrasonic fetal pulse detector which could be successfully used from midpregnancy by applying the probe either to the right flank or per rectum above the uterus. Using a rectal probe to detect fetal movements, fetal pulse or thrilling of the urogenital artery, Schels and Mostafawi (1978) were able to diagnose pregnancy in 12 out of 15 camels beyond the fifth month of gestation. Since corpora lutea are present only during pregnancy a progestrone assay of blood or milk should be effective in distinguishing pregnancy fron non-pregnancy but this remains to be demonstrated (Arthur et al., 1985).

Serum estrogen and progesterone were measured in pregnant and non-pregnant camels by El-wishy et al. (1983). In non-pregnant camels, serum estrogen concentrations were found to be higher in multiparous (154.1 ± 63.3 pg/ml) when both groups had follicles of 3 to 5mm in diameter. Unexpectedly, low serum estrogen concentrations were found in some camels with follicles of 10 to 35mm in diameter; this was thought to be due to non palpable atretic changes in the follicles. Follicular atresia occurs in the non-mated camel. In pregnant camels, serum estrogen concentrations were higher during the last trimester (after the seventh month) of gestation. There was a clear increase in serum estrogen concentration at 15 to 21 days postpartum. This increase could be a signal to stimulate pituitary luteinizing hormone synthesis and subsequent resumption of ovarian activity after calving. Serum progesterone concentrations in the pregnant

camel (0.19 to 1.43 ng/ml) were 4 to 16 times higher than in non-mated camels (0.05 to 0.09 ng/ml). After calving, a decrease of serum progesterone occurred during the first 6 days and was accompanied by a dramatic decrease in the weight of the corpus luteum. During the subsequent 2 weeks, serum progesterone concentrations dropped close to the values reported for non-pregnant camels. A progesterone level of more than 1ng/ml is said to be reached only after fertile mating (Elias et al., 1984a). However, misinterpretation due to early embryonic death, presence of large corpus luteum in some congenital defects of the genital tract or ovarian cysts producing high levels of progesterone (El-wishy, 1988) must be borne in mind.

From studies on the vaginal smears and vaginal temperature of 6 camels, Nawito et al. (1967) concluded that in the camel vaginal smears cannot be used either as an indicator of ovarian activity or for pregnancy. Changes in vaginal temperature are influenced by the season and are not correlated with ovarian activity and that pregnancy does not have any influence on the vaginal temperature.

Pregnancy wastage and sex ratio

There is no report of pregnancy wastage as a result of slaughtering of pregnant camels in Nigeria. In Egypt, El-wishy (1988) encountered 416 pregnant genital tracts from a total of 1264 genitalis examined at post-mortem. This represents a pregnancy wastage of 32.91%.

The slaughtering of pregnant cows in Nigeria averages 17,000 per year resulting in an estimated financial loss of at least US $14 million over 10 years (ECA technical paper, 1988).

Ojo et al. (1977) found a pregnancy rate of 50.0% from 7,941 Zebu cows slaughtered at 3 slaughter slabs in Zaria. They highlighted in their study the magnitude of the problem of pregnancy wastage in Nigeria and estimated an annual wastage of 4,000 fetuses from the Zaria slaughter slabs alone.

Zwandor (1981) found a pregnancy rate of 11% from 1,003 cows slaughtered at the abattoirs of Jos, Kano and Kaduna.

Over the period July 1985 to June 1986, it was reported in the slaughter house of Yaounde that 1,043 fetuses were destroyed despite the existence of a decree forbidding the slaughtering of pregnant cows and animals less than 4 years. The resulting financial loss was well over US $0.9 million or US $825 per slaughtered cow (ECA, 1988).

Ladds et al. (1975) found a pregnancy rate of 62.9% from 7,495 cows examined at the time of slaughter in North-eastern Australia.

In 516 pregnant camel uteri examined for the detection of sex ratio, Shalash (1965) found 47.48% and 52.52% for male and female sexes respectively.

REPRODUCTIVE DISORDERS OF FEMALE CAMEL

Fertility rate: Novoa (1970) has stated that the fertility rate in camels is extremely low when compared to other domestic animals. In contrast, Arthur et al. (1985) reported that according to the Bedouins, fertility rate is high with sterility occurring in only 1% of camels. The disagreement between the authors quoted could be due to the differences in the management systems. Novoa (1970) described a confinement system of management while the Bedouins have an open, free ranging system.

Causes of low fertility:- The factors contributing to low fertility in the camel according to Mukasa-Mugerwa (1981) are many and complex. These include:

(a) Late age at first calving:- Puberty occurs late in the camel and animals may be 3 - 5 years or more at sexual maturity. Inadequate weight resulting from low plane of nutrition may also be a cause of delay. Gestation accounts for a further one year with the result that calving frequently occurs for the first time at 5 - 7 years considerably later than in cows.

(b) Limited rutting potential:- Full male rut may in some cases occur only at 8 years, and animals are often not put to full service before 6 - 8 years. In addition it is reported that only one male in the herd develops the rut, while the others supress their sexual desire. This situation together with a loss of appetite and increased

activity noted in males during the breeding season may lead to a loss of condition and subsequent drop in libido.

(c) Limited breeding opportunities:- Although animals near the equator are reported to breed all year round, the breeding season elsewhere appears limited (November - March in Northern hemisphere). Length of breeding season is probably affected by nutrition level and day light length and possibly by other factors such as altitude and air humidity. Since gestation usually lasts a year, the breeding season tends to occur at the same time as calving, thus limiting the number of females able to conceive. When prenatal deaths occur rebreeding is usually delayed until the following year.

(d) Prolonged calving interval:- The result is a low annual calving rate of 50 - 80%. The calving interval is prolonged by (i) lengthy gestation period, (ii) limited breeding season (iii) late post-partum estrus (frequently 1 year).

(e) Inadequate nutrition:- Low feed availability especially in times of drought may affect overall fertility in a variety of ways ranging from delayed sexual maturity and a curtailed breeding season to threatened calf viability. When feed is scarce, growth and lactation take priority over reproduction which then becomes a physiological luxury.

Other causes of low fertility in camels include management practices and disease factors.

Reproductive diseases

Spencer (1973) reported a low growth rate in some herds of camels in Northern Kenya and attributed it partly to the high incidence of diseases affecting reproductive performance. El-Wishy and El-sawaf (1971) have found the incidence of ovum and embryo loss as 11% from 234 one-humped camels examined at different stages of gestation.

The causes of concention failures include various pathological conditions such as metritis and pyometra as well as genetic abnormalities resulting from inbreeding, hormonal disturbances etc. One of the detrimental effects of inbreeding is the depression of heritable characters such as fertility reflected in increased abnormal germ cells and early degeneration of zygotes and embryos. This abnormality is well known in bulls and other domestic animals and so might occur in camels also (Mukasa-Mugerwa, 1981).

Prenatal losses seem to occur more frequently in camels than in other domestic animals. Embryonic mortality, often associated with genetic causes has been cited as a significant factor. Musa and Abusieneina (1976) and Musa (1979) found 2 to 3 corpora lutea in 13.65% and 1.22% of 491 single births, whereas twinning rate is 0.4%. These observations, together with the histological evidence of Shalash (1965) clearly indicate the early occurrence of embryonic mortality, although conclusive evidence of mortality were found in only a few of the genital tracts examined.

Early embryonic deaths in many species are frequently followed by resorption and a return to estrus. The death of larger fetuses may be followed by the invasion of suppurative bacteria leading to maceration. Alternatively, bacterial invasion may fail to occur, the dead fetus being retained in a sterile state as mummified fetus (Mukasa-Mugerwa, 1981).

Abortion and stillbirth both occur in the dromedary, Curasson (1947). Richards (1976) and Fazil (1977) attributed abortions in the dromedary to trypanosomiasis. Other causes include febrile conditions such as pneumonia, camelpox or nervous excitement (Leese, 1927). Pasteurellosis and salmonellosis have also been cited as possible causes of camel abortion.

Schwartz et al. (1983) stated that calf mortality in camels is high, 20 - 30% being considered normal. Abortions and calf mortalities are important sources of reproductive wastage in camels. A major problem on the ranches in Kenya relates to the high level of abortion and early deaths (Wilson, 1986). Data from four ranches revealed that abortions amounted to 11.6% of all births (3.5 - 25.3%) while preweaning deaths constituted 14% (10.1 - 19.3%). In a study involving 227 pregnancies in India, 22 fetuses (9.6%) were aborted while 33 calves died (16.1%) within the first 6 months (Bhargava et al., 1963 cited by El-wishy, 1988). These losses not only reduce the effectiveness of reproduction but also have long term effects on herd dynamics. There is no report on camel abortions in Nigeria.

Infection of the genital tract usually follows dystocia, retention of fetal membranes or trauma (Roberts, 1971).

Endometritis associated with partially involuted uterus and a regressing corpus luteum together with several cases of vaginal prolapse were recorded by Arthur and Al-Rahim (1982) and Arthur et al. (1985) from abattoir genital tracts in Saudi Arabia. El-wishy (1987) also reported cases of endometritis in Egytian camels. No case of ovarian or ovariobursal adhesions was noted in the abattoir or clinic.

In a study of uterine infections in 2,075 one-humped camels (Camelus dromedarius) in Cairo abattoir, Egypt, Nawito (1973) reported 7 cases of abscess, 31 of catarrhal endometritis, 5 of hemorrhagic endometritis, 26 of pyometra and 15 of pyometra associated with macerated fetuses. Bacteria isolated included Streptococcus pyogenes, S. albus, Escherichia coli, B-hemolytic streptococci, and Pseudomonas aeruginosa.

In Egypt, Hegazy et al. (1979) documented the bacteriological and histopathological findings in cases of endometritis in camels. From 24 uteri showing gross lesions of endometritis, a range of bacteria including the following were cultured: Proteus spp; Serratia spp; E. coli, Enterococci, Bacillus spp., C. renale, C. pyogenes, Staphylococcus aureus, Micrococci spp, and Streptococcus pyogenes. It was observed that the most severe purulent endometritis was associated with the presence

of C. pyogenes. Histologic and bacteriologic examination revealed subclinical endometritis in 8 uteri.

Abdo et al. (1968) noted that ovaries with cysts had more follicles larger than normal. It was attributed to low thyroid function which promotes release of FSH by the anterior pituitary resulting in the development of Graafian follicles which fail to ovulate because the luteinizing hormone is lacking. Abdo et al. (1969) in a study on the thyroid function of camels with ovarian cysts concluded that such thyroid was inactive. Mukasa-Mugerwa (1981) has stated that cystic ovarian degeneration is often associated with hormonal disturbances.

Shalash (1965) studied the incidence of abnormalities from 1701 female genitalia of Camelus dromedarius and found defects in 331 (19.40%). The conditions found included amongst others, ovarian hypoplasia (0.71%) cystic ovaries (0.82%) ovarian tumors (0.06%), ovarian dermoid cysts (0.59%), ovarian hemorrhagic cysts (1.22%), cystic corpus luteum (0.12%), hydrobursitis (0.29%), pyometra (1.76%), pyometra with macerated fetuses (2.33%), mummified fetus (0.65%) and persistent hymen (0.12%).

Musa (1979) attributed the occurrence of luteinized cysts and smaller corpora lutea in some non-pregnant genital tracts to either a reduced copulatory stimulation or due to early embryonic death and fetal resorption.

Shalash (1965) noted that pyometra and pyometra associated with macorated feti were quite common and concluded that the reproductive tract is susceptible to infection by many of the bacteria and other infective agents that attack camels. These infections may be chronic, lowgrade in nature or may impair the efficiency of the tract, impede the passage of spermatozoa and of eggs or render the condition of the endometrium unfavorable for implantation to occur. Pathological changes in the fallopian tubes and ovarian bursae were common but did not necessarily cause reduced fertility as adhesions were noted in some pregnant animals (Shalash, 1965).

The occurrence of brucellosis in the camel has been reported by several authors. Burgemeister et al. (1975) cited by Mukasa-Mugerwa (1981) tested 135 milk samples from Tunisian camels and found all were negative for Brucella, although 3/52 (5.8%) camels had serum antibodies to B. abortus and 2/52 (2.8%) to B. melitensis. Hameida et al. (1963) had 10 - 20% reactors in Egytian camels while Waghela et al. (1978) found a 14% reactor rate in Kenyan camels. Okoh (1979) reported a rate of 1% in camels presented for slaughter at the Kano abattoir. Nawito et al. (1967) isolated B. abortus from one camel with bilateral hydrobursitis.

Nawito et al. (1967) examined 2,075 genital organs of female camels and the results revealed the presence of various disorders in 347 representing 16.72% of the total material examined.

Multiple defects were recorded in 52 of the abnormal cases. El-wishy (1988) noted abnormalities in 35 (2.76%) genital tracts from a total of 1,264 genitalia of camels examined over a four-year period in Egypt.

Zayed (1964) studied the histopathological changes of 48 uteri and found that in cases with moderate endometritis 3 or more foci of cellular infiltration were demonstrated either within the stroma of the endometrium or around the glands and blood vessels. In animals affected with serious endometritis, there were focal cellular accumulations, severe changes of the uterine glands and an increased number of diffuse cellular infiltration in the stratum compactum and spongiosum.

Congenital and nutritional causes of infertility in camels

According to Shalash (1965) the occurrence of cystic ovaries, ovarian hypoplasia and infantile uterus is due to congenital factors. Lagerlof and Eviksson (1948) cited by Mukasa-Mugerwa (1981) found hypoplasia of the sexual glands in cows to be completely genetic while cystic ovarian degeneration seems to have a genetic basis, but environmental factors of different kinds influence its manifestations. Nawito et al. (1967) attributed cases of occluded horns and os uteri or persistent hymen to genetical factors as in the case of white heifers disease in cattle.

The high percentage of subfunctioning ovaries were attributed to malnutrition (Shalash, 1965). Nutritional anestrus occurs in the female camel because of poor grazing resulting from low rainfall (Arthur et al., 1985).

Chapter II

GENITAL DIMENSIONS AND WEIGHTS OF FEMALE CAMELS (*Camelus dromedarius*) IN NIGERIA

INTRODUCTION

The Arabian one-humped camel (Camelus dromedarius) is a primary inhabitant of the Northern half of Africa, the Middle East, Pakistan and India. In Nigeria dromedaries are found in the Northern part of the country. The dromedary is a multipurpose animal used for transportation, the production of milk and meat as well as the production of by-products such as wool, hair and hides. Dromedaries are extremely well adapted anatomically and physiologically to the hot arid environment.

The ovaries of the camel are oval, flattened and lobulated. The lateral and medial surfaces are slightly convex. The free border is also convex but the attached border is straight. The presence of numerous follicles gives the ovary the appearance of a bunch of grapes (Tayes, 1948; Shalash, 1965; Novoa, 1970). The oviducts of the camel are small in diameter but become larger at the ovarian end where the fimbriae are located. The uterus is a bicornuate, reddish white, shiny organ with a relatively short body and horns in the form of Y or T. The right horn is shorter than the left (Shalash, 1965; Novoa, 1970). The camel cervix like that of the cow has a number of mucosal folds arranged in 3 to 4 rows. The vagina is an elastic organ of reddish color and lined with mucosal folds posterior to the external cervical opening (Mukasa-Mugerwa, 1981).

Some investigation on the dimensions and weights of the genital organs of some breeds of camel have been undertaken.

According to Tayes, (1948), the ovary of a mature camel weighed 2 - 4gm and measured 2 - 4cm long, 1.5 - 2cm wide and 0.8 - 1cm thick. Arthur et al. (1985) stated that the ovary of an anestrus camel is roughly oval and thin and measured 4 x 2.5 x 0.5cm. The ovaries of Iranian dromedary were found to have an average weight of 10gm (Chahrasbi et al. 1975). Shalash (1965) however gave the weight as3.63±1.49gm and 5.47 ± 2.62gm for right and left ovaries with Graafian follicles. Abdo et al. (1968) reported the length and bredth of the camel ovary to be 3 - 6cm and 2.5 - 4cm respectively. The length of the oviduct was given as 17 - 22cm (Abdallah, 1967), 22 to 24cm (Arthur et al., 1985) and 22 to 28cm (Ismail, 1987). Shalash (1965) reported the length of the left and right horns as 17.45 ± 2.86cm and 13.42 ± 1.76cm respectively during the follicular phase. The cervical canal measured 3.5cm in length with a diameter of 5.5cm while the vagina was reported to be 30 - 35cm in length (Mukasa-Mugerwa, 1981).

Despite the economic importance of camels, little research has been conducted on their reproduction (Degen and Lea, 1982) There has been no study of the camel female genitalia in Nigeria.

The objective of this study was to determine the genital dimensions and weights of the different parts of the one-humped female camels slaughtered for meat at the Kano abattoir in Nigeria.

MATERIALS AND METHODS

Fifty grossly normal non-pregnant genitalia from physically normal camels were obtained from the Kano abattoir between October and December, 1987. As specimens were obtained at random, only rough estimate of the ages could be made using their dentition (Mukasa-Mugerwa, 1981). The specimens were immediately transported to the laboratory for the study on collection. Each whole genital was weighed using a spring balance after dissecting out the broad ligament, fat and other tissues. The length, diameter and thickness of the ovaries were determined using a measuring tape, thread and vernier callipers. The length of the ovary was taken by measuring the distance between the 2 poles. The width (diameter) is the distance between the hilus and the free border. The thickness is the distance between the 2 sides of the ovary. The weights of the ovaries were determined using a Mettler(R) analytical balance. Using thread and tape, the lengths of the oviducts were measured. The external diameter of the isthmus was determined using vernier callipers. The oviducts were also weighed. The lengths, diameters and weights of the uterine horns, uterine bodies, cervices and vaginas of all the 50 specimens were obtained using plastic tape, vernier callipers and Mettler(R) analytical balance, respectively.

The data obtained were subjected to statistical analysis using the student 't' test (Loveday, 1980).

R E S U L T S

The ovaries of the camel were found to be oval, flattened and lobulated organs with numerous follicles. The free border was convex while the attached border was straight. The ovaries were enclosed in a pocket like fold of mesosalpinx and mesovarium (bursa ovarii). The oviducts were observed as coily tubes which extended from the apex of bursa ovarii to the uterine horns. The isthmus was less coiled than the ampulla and the ovarian part of the fallopian tube. The uterus was bicornuate and reddish in color. It had a convex upper surface and a flattened lower surface with a short uterine body. The right cornua was shorter than the left one. The mucus membrane of the uterine body and both horns were smooth and had no caruncles. The cervix had ridges that were arranged in 4 - 5 rows. The cervical canal protruded into the vagina forming 2 blind cavities. The vagina was an elastic reddish organ which extended from the cervix to the vulva.

The mean dimensions and weights of the different parts of the 50 non-pregnant female genital organs are shown on Tables 1 - 4. The left ovary was slightly longer, wider, thicker and heavier than the right. A similar trend was observed for the left and right oviducts and uterine horns with respect to the length and weight. However, while the diameter of the left and right uterine horns were slightly different, it was the same at the isthmus of the oviducts.

DISCUSSION

The gross appearance of the camel female genitalia agree with those of Tayes (1948), Shalash (1965), Novoa (1970), and Arthur et al. (1982)

The dimensions obtained for the ovaries of camels in this study are similar to those obtained by other workers for different breeds of camel (Tayes, 1948; Abdallah, 1965; Musa, 1979; Arthur et al. 1985). While the mean ovarian weight obtained in this study is close to those reported by Tayes (1948) (2 - 4gm), Abdallah (1965) (5gm), and Shalash (1965) (3.66 ± 1.40 - 8.5 ± 2.66gm), it is different from those reported by Abdo et al. (1968) and Chahrasbi et al. (1975) (10 - 15gm). The discrepancy between the findings in this study and those by Abdo et al. (1968) and Chahrasbi et al. (1975) may be attributed to the differences in the breed/types of animals used in these studies. Although the left ovary appeared more active than the right in follicular development and weighed slightly higher than the right (4.76 ± 2.11gm compared to 4.40 ± 2.04gm), statistically there was no significant difference.

The dimensions of both the left and right (21.30 ± 3.30cm and 19.88 ± 3.86cm) oviducts obtained in this study agrees with the results obtained by Abdallah (1967), Arthur et al. (1985) and Ismail (1987) who obtained 17 - 22cm, 22 - 24cm and 22 - 28cm respectively for the length of the oviduct. It is however slightly different from the result obtained

by Abdo et al. (1968) who gave the length of the fallopian tube as 25 to 28cm. Mukasa-Mugerwa (1981) reported that the diameter of the isthmus was 1 - 2mm. This is slightly less than the 0.31 ± 0.05cm obtained in this study for both left and right oviducts.

Shalash (1965) reported the length of the left and right uterine horns as 17.45 ± 2.86 and 13.42 ± 1.76cm during the follicular phase, 17.73 ± 3.29 and 13.37 ± 2.15cm during the period of ovarian inactivity. These figures are slightly higher than those obtained in this study (13.17 ± 3.07cm for left uterine horn and 9.41 ± 2.12cm for the right uterine horn irrespective of the stage of follicular development). The uterine diameter at the base of the horn in this study (4.64 ± 1.23cm for the left horn and 3.79 ± 0.98cm for the right) agrees with the result obtained by Shalash (1965) who gave the left and right uterine diameters during the follicular phase as 4.29 ± 0.90 and 3.73 ± 0.63cm, respectively. During the period of ovarian inactivity the uterine diameter was found to be 4.99 ± 0.01 and 3.73 ± 0.69cm for the left and right horns respectively. The length and diameter of the uterine body in this study (3.45 ± 0.58 and 4.94 ± 1.23cm respectively) is slightly higher than the range given by Shalash (1965). The uterine weight of 199.06 ± 87.46gm in this study is also close to the 193.76 to 376.40gm reported by Shalash (1965). The finding of a consistently bigger left than right horn agrees with those by earlier workers (Shalash, 1965; Abdallah, 1968; Novoa, 1970; El-wishy and El-sawaf, 1971; Arthur and Al-Rahim, 1982,

Table 1: Mean dimensions and weights of left and right ovaries

ORGAN			MEAN	S.D
LEFT OVARY	Length	(cm)	3.61	± 0.54
	Diameter	"	2.76	± 0.44
	Thickness	"	0.73	± 0.14
	Weight	(gm)	4.76	± 2.11
RIGHT OVARY	Length	(cm)	3.47	± 0.54
	Diameter	""	2.63	± 0.42
	Thickness	"	0.71	± 0.14
	Weight	(gm)	4.40	± 2.04

Table 2: Mean dimensions and weights of left and right oviducts

ORGAN			MEAN	S.D
LEFT OVIDUCT	Length	(cm)	21.30	± 3.23
	Isthmus(d)	"	0.31	± 0.05
	Weight	(gm)	4.40	± 1.67
RIGHT OVIDUCT	Length	(cm)	19.88	± 3.86
	Isthmus(d)	"	0.31	± 0.05
	Weight	(gm)	4.00	± 1.40

(d) = diameter.

Arthur et al. 1982; Tsmail, 1987; El-wishy, 1988).

The cervix of the dromedary is 5.5cm in diameter according to Mukasa-Mugerwa (1981). Shalash (1965) reported the average length and diameter of the cervical canal during follicular activity as 5.32 ± 0.98cm and 5.96 ± 0.92cm respectively. The result obtained in this study is in conformity with the result obtained by the latter..

The length (22.51cm) and diameter (4.15cm) of the vagina from this study is less than the 30 - 35cm obtained by Shalash (1965).

In conclusion, it can be stated that the genital dimensions of dromedaries in Nigeria is similar to those obtained by other workers elsewhere.

Table 1: Mean dimensions and weights of left and right ovaries

ORGAN			MEAN	S.D
LEFT OVARY	Length	(cm)	3.61	± 0.54
	Diameter	"	2.76	± 0.44
	Thickness	"	0.73	± 0.14
	Weight	(gm)	4.76	± 2.11
RIGHT OVARY	Length	(cm)	3.47	± 0.54
	Diameter	""	2.63	± 0.42
	Thickness	"	0.71	± 0.14
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	Weight	(gm)	4.40	± 1.67
RIGHT OVIDUCT	Length	(cm)	19.88	± 3.86
	Isthmus(d)	"	0.31	± 0.05
	Weight	(gm)	4.00	± 1.40

(d) = diameter.

Table 3: Mean dimensions and weights of the Uterine horns and body

ORGAN			MEAN	S.D
LEFT UTERINE HORN	Length	(cm)	13.17[a#]	± 3.07
	Diameter	"	4.64	± 1.23
RIGHT UTERINE HORN	Length	(cm)	9.41[b#]	± 2.12
	Diameter	"	3.79	± 0.98
BODY OF UTERUS	Length	(cm)	3.45	± 0.58
	Diameter	"	5.00	± 1.24
WEIGHT OF BODY + LEFT & RIGHT HORNS	B+L+R	(gm)	199.06	±87.46

Table 4: Mean dimensions and weights of the Cervix and Vagina

ORGAN			MEAN	S.D
CERVIX	Length	(cm)	5.65	± 1.32
	Diameter	"	4.87	± 1.79
	Weight	(gm)	77.05	±42.60
VAGINA	Length	(cm)	22.51	± 3.48
	Diameter	"	4.41	± 0.80
	Weight	(gm)	179.16	±66.52

*Significant (P/ 0.05)



CHAPTER III

HISTOLOGIC AND BACTERIOLOGIC STUDIES OF THE FEMALE GENITALIA OF THE ONE-HUMPED CAMEL (*Camelus dromedarius*) IN NIGERIA

INTRODUCTION

The one-humped camel (Camelus dromedarius) is a hardy animal that has adapted both physiologically and anatomically to the hot arid conditions of the desert. The dromedary has enabled the people of the deserts of northern Africa and western Asia to live in difficult environments and has been a strong supporting factor in the historic development of these areas (Knoess, 1977). The primary uses of camels are for transport of goods and passengers in desert and semi-desert areas. Meat, milk, wool and skin are by-products of this animal. A large number of camels is slaughtered yearly at the major abattoirs in the northern states of Nigeria.

Knowledge of the anatomy of the reproductive tract is an essential aspect of the study of reproduction. Extensive studies have been conducted on the genitalia of most domestic animals like the cow (Asdell, 1960; Hafez, 1974), ewe (Hutchison and Robertson 1966) and mare (Hafez, 1974). There is scanty information on the histology of female genitalia of camels.

Studies conducted on the histology of the camel genitalia include those of the ovary and corpus luteum (Abdallah, 1965; Tayes, 1948; Musa, 1979), the oviduct (Abdallah, 1967), and the uterus (Abdullah, 1968). There has been no previous report on the histology of the female genitalia of camels in Nigeria.

The uterus of the camel is bicornuate with a substantial uterine body from which 2 cornua diverge and taper anteriorly to form a combined uterine shape which is intermediate between the letter Y and T (Arthur et al., 1985). The right horn is shorter than the left and the mucous membrane of the uterine body and both cornua are smooth and present no caruncles (Shalash, 1965; Novoa, 1970; Arthur et al., 1985).

The uterus serves several other functions besides being an incubator of zygote. It is also a passageway for the movement of sperm to the oviduct. The uterine glands secrete "uterine milk" which serves as a nutrient medium for the free living zygote for several weeks preceding implantation. The uterus is also actively involved in the parturition process and postpartum involution (MacDonald, 1977). To be able to perform these functions efficiently, the uterus must be free from infection. The cervix acts as a physiological barrier separating the external environment from the internal environment of the animal. A significant proportion of failures of conception can be ascribed to varying degrees of chronic metritis or endometritis (Roberts, 1971).

Kampelmacher (1954) cited by Roberts (1971) reported that the normal non-gravid uterus of a cow or virgin heifer is free of organisms. Bacteriologic study of the camel uterus is scanty.

The present investigation was aimed at studying the normal histologic features of the female genitalia and the bacteria

commonly found in grossly normal, non-gravid uteri of one-humped camels slaughtered for meat at the Kano abattoir in northern Nigeria.

MATERIALS AND METHODS

Histologic study

Fifty grossly normal, non-pregnant genitalia of one-humped camels were collected from Kano abattoir between October and December, 1987. Estimate of the camel's ages was made using the dentition according to Mukasa-Mugerwa (1981). Specimens were immediately transported to the laboratory for histology.

Sections (about 0.5 to 1cm thick and 1cm wide) were cut from the ovary, oviduct, uterine horns, uterine body, cervix and vagina for processing. Sections from the ovaries were fixed in Bouin's solution while the remaining sections were fixed in 10% buffered formalin. Sections were trimmed and processed in a Tissuematon (Scientific, Fischer Co.), embedded in paraffin, cut at 5 microns, mounted and stained with hematoxylin and eosin (H & E) according to Humason (1972).

For histological examination, slides were initially screened under low power magnification and detailed examination were done under high dry power and oil immersion lenses.

Bacteriologic study

The genitalia of 50 adult one-humped female camels of unknown history were obtained from Kano abattoir between October and December, 1987. Each genital tract was examined for any evidence of gross pathology. Only grossly normal genital tracts were used for this study. The dorsal surfaces of the uteri were disinfected using 70% alcohol. The uteri were then excised using sterile blades and uterine swabs taken under strict aseptic conditions. The swabs were streaked on blood and MacConkey agar plates and incubated at 37^{o}C for 24 to 48h. Gram stain and biochemical tests were used to study the type of micro-organism(s) present. Specific colonies were selected isolated and identified according to Bergey's manual (1974).

R E S U L T S

Ovary

The ovary consisted of a peripheral cortex and central medulla (plates II and III). Follicles in various phases of development were found in the cortex. The surface of the ovary was covered with germinal epithelial cells (low cuboidal) whose nuclei were spherical or flattened. Immediately below the epithelium was a well defined layer of dense connective tissue. Next to this layer was an area of cells with dark staining nuclei.

Numerous primordial follicles were located immediately beneath the tunica albuginea. Each of these follicles consisted

of an oocyte surrounded by a single layer of squamous follicular cells.

Growing follicles consisting of many layers of stratified follicular granulosa cells surrounding an oocyte were also noted in the cortical layer of some of the sections examined.

The structure of the mature Graafian follicle (plates IV and V) was similar to that found in other domestic animals. The granulosa cells were supported by a theca interna layer containing congested small blood vessels and larger thecal cells with spherical nuclei. The outer fibrous theca externa was continuous with the ovarian stroma. The large antrum was filled with follicular fluid (liquor folliculi). The cumulus oophorus cells surrounded the primary oocyte. The cells immediately surrounding the oocyte were columnar and radially disposed.

Irregular dense connective tissue with fibrosing blood vessels were noted in the cortical areas of some sections. This might represent the corpora albicantia.

Oviduct

The mucous membrane of the oviduct appeared thrown into numerous folds filling most of the lumen from which secondary and tertiary folds originated. The mucosal folds were taller in the ampullary region than in the isthmic region. The lining epithelium consisted of 2 types of cells, ciliated and

non-ciliated columnar with oval or elongated nuclei. The subepithelial layer which also filled the folds consisted of loose connective tissue, blood vessels, lymphatics and nerves.

The lamina propria consisted of loose connective tissue with reticular fibers and lay directly on the muscle layer as no muscularis mucosae was present.

The tunica submucosa essentially had the same structure as the lamina propria blended with it.

The tunica muscularis consisted of an inner circular smooth muscle layer and an outer longitudinal layer (plates VI, VII & VIII). The 2 muscle layers were interspersed by a zone of loose connective tissue which contained some blood vessels. The circular muscle layer was thin in the ampullary but thick in the isthmus region.

The tunica serosa forms the external coat of the oviduct.

Uterus

The uterine horns and body had essentially the same histology. Plate IX shows the mucosa and submucosa of the uterus while plate X shows the myometrium and the perimetrium.

The mucousal epithelium consisted of simple columnar cells. The lamina propria was rich in cells with loose

connective tissue. There was no muscularis mucosa.

The tunica submucosa contained fewer cells than the lamina propria. It contained secretory end pieces of simple branched tubular glands.

The tunica muscularis consisted of an inner thick circular smooth muscle layer and an outer longitudinal layer. The 2 muscle layers were separated by a stratum vasculare which contained blood vessels.

The serosa contained loose connective tissue and smooth muscle fibres which fused with the myometrium in some cases.

Cervix

Plates XI and XII show the mucosa and submucosa of the cervix. The mucosa of the cervix was lined by secretory columnar cells, some of which were ciliated. Goblet cells were present. Primary, secondary and tertiary folds of the mucosa and submucosa projected into the lumen. At the lower part of the cervix (external os of the cervix) or opening of the cervical canal into the vagina, the epithelium changed abruptly from columnar to stratified squamous.

The lamina propria consisted of loose connective tissue with many fibers intermingled with dense irregular connective tissue. No muscularis mucosa was present. Lymphatic nodules

were noted within the lamina propria in some of the sections examined (plate XII).

The submucosa was similar to the lamina propria. In some slides the propria and submucosa contained simple coiled mucous glands.

The tunica muscularis consisted of several circular smooth muscle layers separated by connective tissue. The outermost muscle layer was longitudinal. The muscle layers were not easily discernible.

The serosa had few smooth muscle fibers and connective tissue.

Vagina

Plate XIII shows the mucosa of the vagina which was lined by stratified squamous epithelium. Goblet cells were seen in sections from the cranial portion of the vagina. The lamina propria was continuous with the tunica submucosa and consisted of loose or dense irregular connective tissue. Lamina muscularis mucosa was absent. A lot of elastic fibers were observed. Lymphatic nodules were also noted within the submucosa.

The tunica muscularis had inner circular and outer longitudinal smooth muscle layers while the tunica serosa consisted of loose connective tissue (plate XIV).

Bacteriology

From 50 uterine swabs cultured for bacteria, there was growth from only 5 samples after 48 hours incubation.

Swabs taken from 4 camels showed white to yellowish-white non-hemolytic medium sized colonies on blood agar. The organisms were Gram, catalase and coagulase positive. They were identified as Staphylococcus aureus.

Uterine swab from another camel showed discrete flat colonies on blood agar and pinkish red colonies on MacConkey agar after 24 hours incubation. The organism was a lactose fermenter and a Gram negative rod. On Eosine-mythylene-blue (EMB) agar, it grew with shiny surface "metallic sheen". Biochemically, the organism was indole positive, methylred (M.R.) positive, citrate negative, and voges proscar (V.P.) negative. The organism was identified as Escherichia coli.

DISCUSSION

Microscopic examination of the ovaries of the non-pregnant female camels revealed the same findings as those of most domesticated animals. This finding is in accord with the result of Tayes (1948) who studied the histologic features of the ovaries of 150 pregnant and non-pregnant camels. Abdullah (1968) also did not notice any striking difference in the histologic appearance of camel ovaries compared to those of other domestic animals except that the camel ovary

KASHIM

lacked interstitial tissue. Abdo et al. (1968) also studied the microscopic anatomy of the camel ovary. He described primary, secondary and mature Graafian follicles which were similar to those of most domestic animals.

As all the 50 genital tracts used for this study were from non-pregnant camels, histologic features of the corpus luteum could not be described since the corpus luteum in the camel occurs only in pregnancy (Shalash, 1965; Musa and Abusineina, 1978a; Musa, 1979; El-wishy, 1988). In contrast however, a cyclic corpus luteum was reported by Abdallah (1965) and Abdo et al., 1968). It was stated by Musa and Abusineina (1978b) that the cyclic corpus luteum described by these authors could have been corpus luteum formed as a result of sterile mating or early embryonic mortality.

Shehata (1964) found medullary tubes in the ovary of the adult camel and concluded that the ovary of the camel possibly secretes a substance which causes persistence of both mesonephric structures. Medullary tubes were not observed in the present investigation.

Certain areas in some of the slides showed irregular dense connective tissue with fibrosing blood vessels. These areas may represent corpus albicans (remnants of old corpora lutea). This observation was also made by Abdallah (1965). The histologic feature of the oviduct was similar to that of other domestic animals (Abdullah, 1967). The observation of taller mucosal

folds in the ampulla than the isthmus as well as ciliated and non-ciliated columnar mucosal epithelia agree with the report by Abdallah (1967).

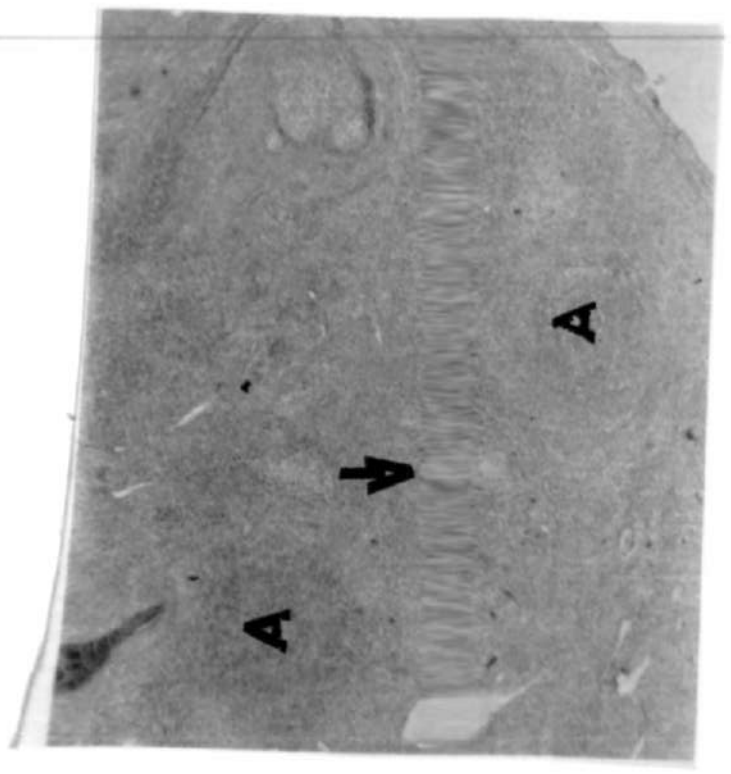
The microscopic anatomy of the uterine horn and body were similar. The epithelial lining consisted of columnar cells with uterine glands in the submucosa. This is consistent with the finding of Abdallah (1968). The histologic appearance of the cervix and vagina were also similar to those of other domestic animals.

Although the shape, size and weight of different parts of the camel female genitalia may differ from that of other domestic species, the histologic features show no clear differences.

The bacteriologic study has shown that S. aureus was isolated in 4 cases (8%) while E. coli was isolated in 1 case (2%). There was no previous report of isolation of these bacteria from normal uterine horns of camels in Nigeria. Hegazy et al. (1979) reported isolation of S. aureus and E. coli amongst others from 24 uteri of camels showing gross lesions of endometritis. It would appear that the normal healthy camel uterus should be bacteriologically negative and that any organisms found there could be potential pathogens. The bacteria isolated might be associated with a subclinical infection. The normal non-gravid uterus is endowed with a high degree of resistance to infection, but

virtually nothing is known of the mechanism of its resistance (Jubb and Kennedy, 1970).

It may be of interest to note that histologic examination of these genitalia did not reveal any evidence of endometritis.


A
A

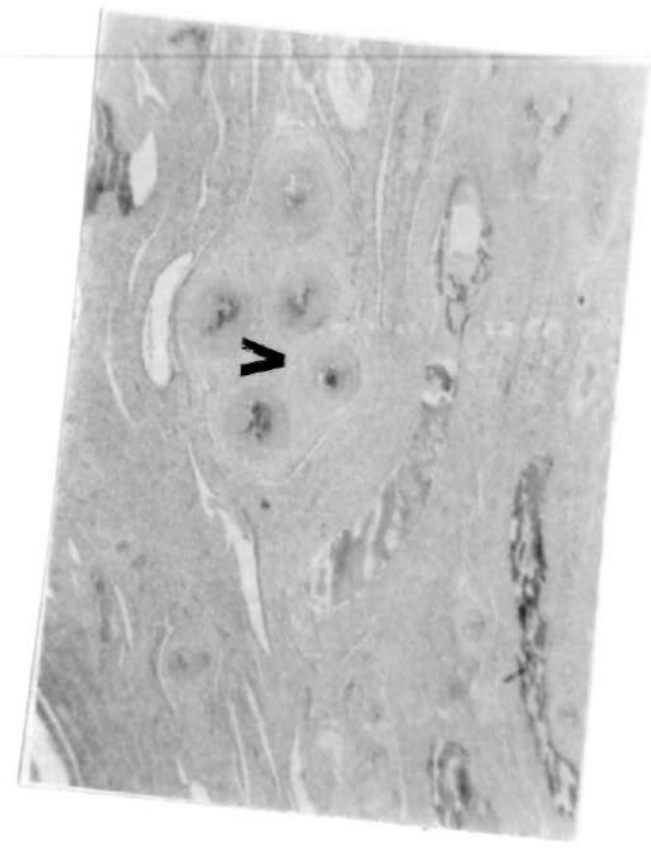
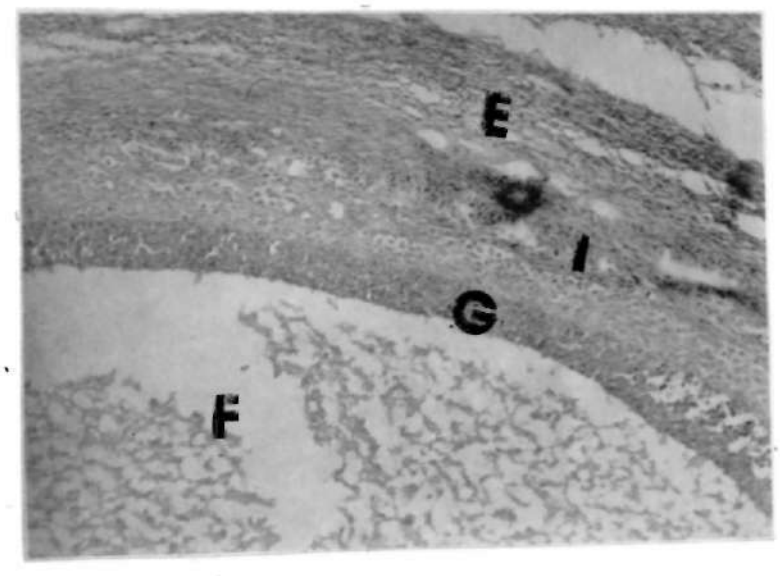

V

PLATE IV: Photomicrograph of a mature Graafian follicle. Note the theca externa (E), theca interna (I), membrana granulosa cells (G) and the liquor folliculi (F) in the antrum. H & E X160.

PLATE V: Photomicrograph of an ovum. Note the cumulus oophorus cells (C) surrounding the ovum. H & E X160.


E
I
G
F

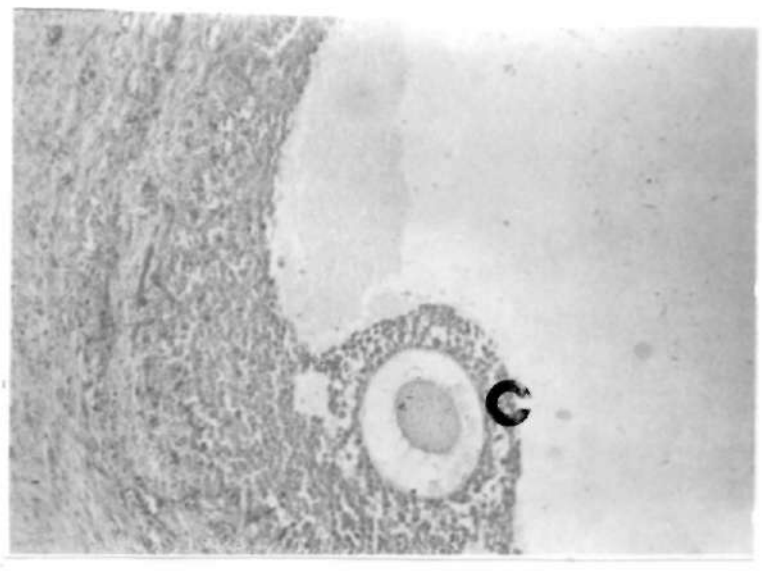
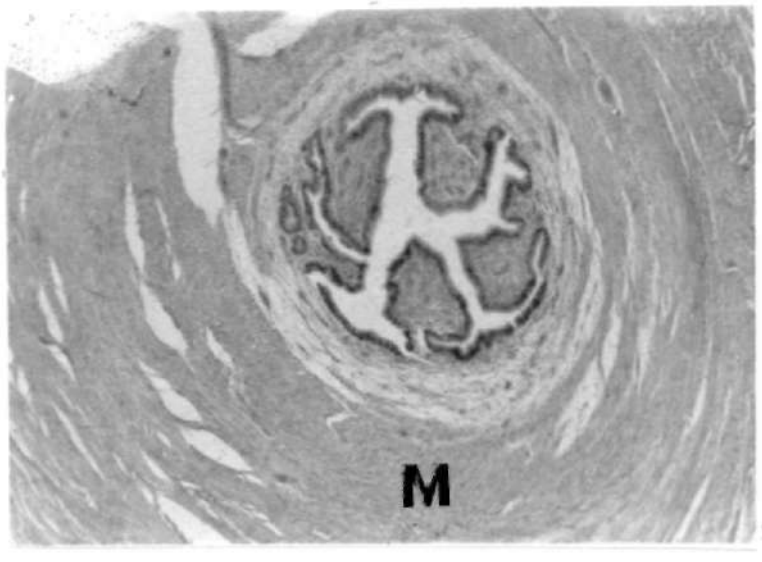

C

PLATE VI: Photomicrograph of the mucosa and muscularis of the isthmus. Note the thick inner circular muscle layer (M). H & E X63.

PLATE VII: Photomicrograph of the muscularis and serosa of the isthmus. Note the thick inner circular muscle layer (Y) and thin outer longitudinal muscle layer (O) H & E X63.


M

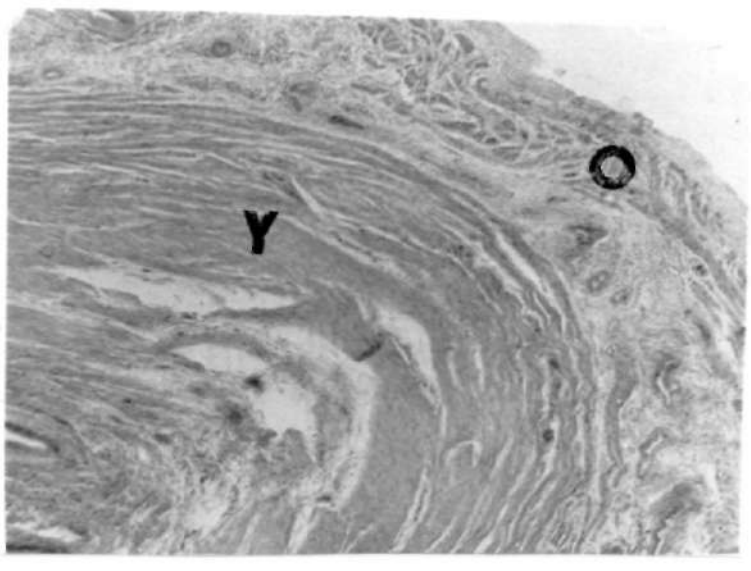

Y
O

PLATE VIII: Photomicrograph of the ampulla of the oviduct. Note the thin muscle layers (T). H & E X160.

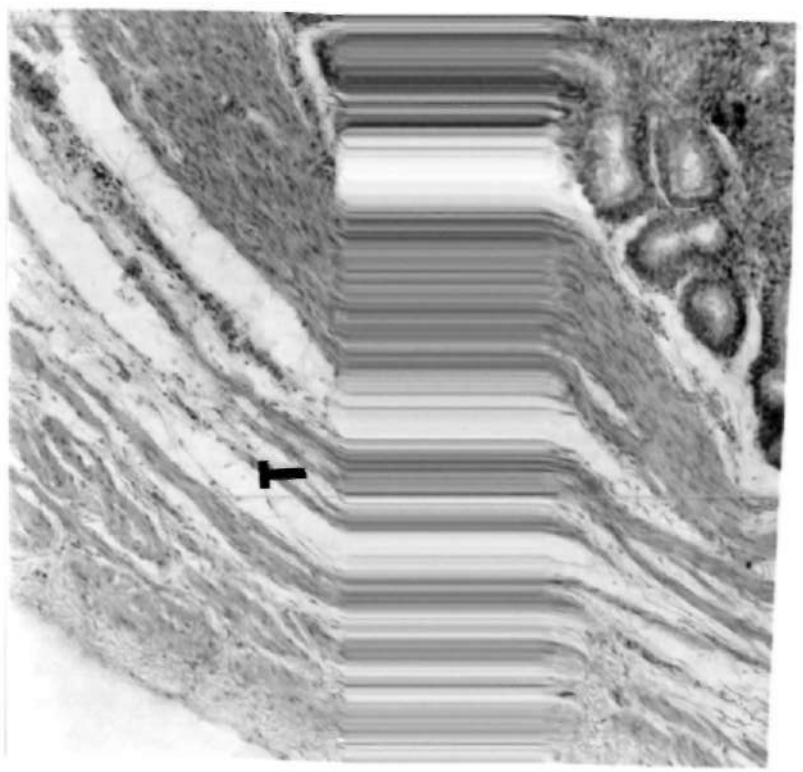
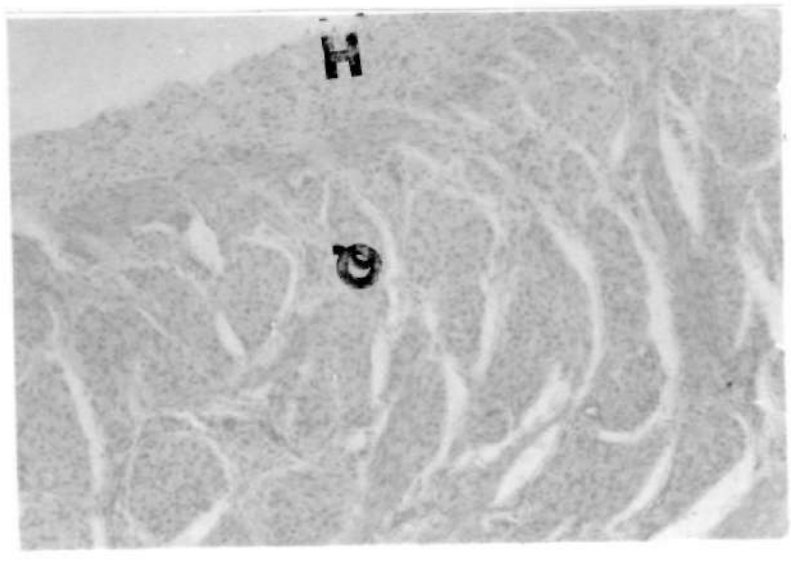


PLATE IX: Photomicrograph of the mucosa and submucosa of the uterine horn. Note the uterine glands (U) within the submucosa. H & E X63.

PLATE X: Photomicrograph of the muscularis and serosa of the uterine horn. Note the outer longitudinal muscle layer (Q) and the serosa (H). H & E X63.


H
g

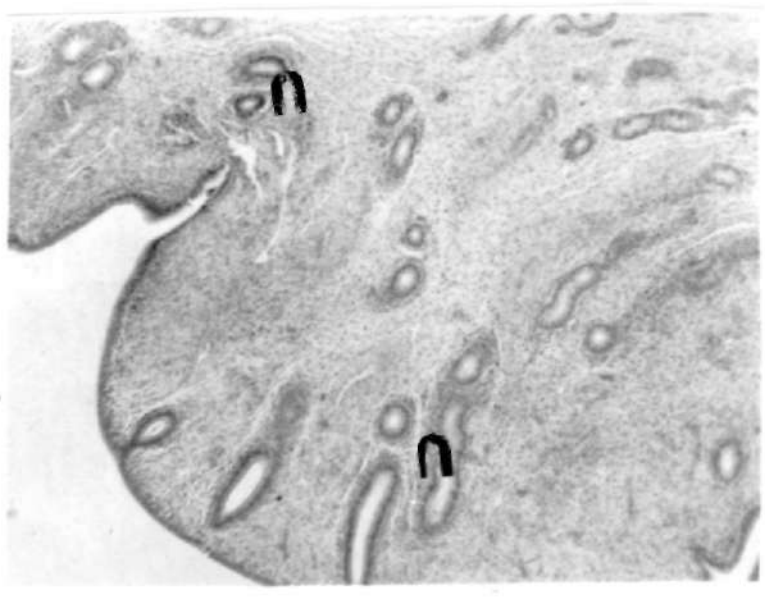
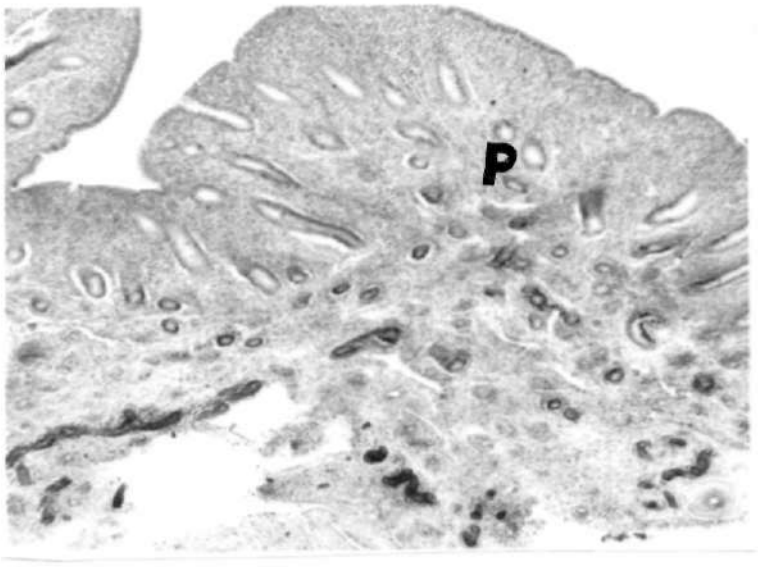

n
n

PLATE XI: Photomicrograph of the mucosa and submucosa of the cervix. Note the presence of cervical glands (P). H & E X63.

PLATE XII: Photomicrograph of the lower part of the cervix where the mucosa changes abruptly from simple columnar to stratified squamous. Note the presence of lymphoid nodule (N). H & E X63.


P

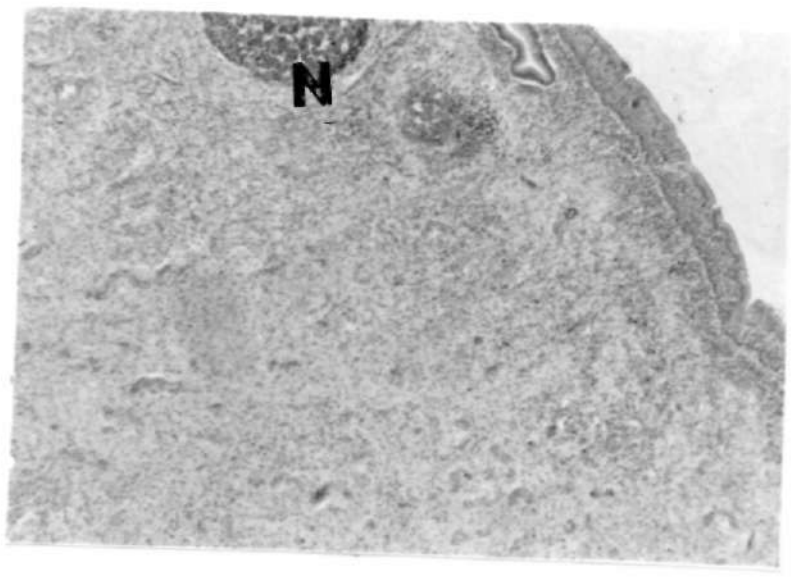
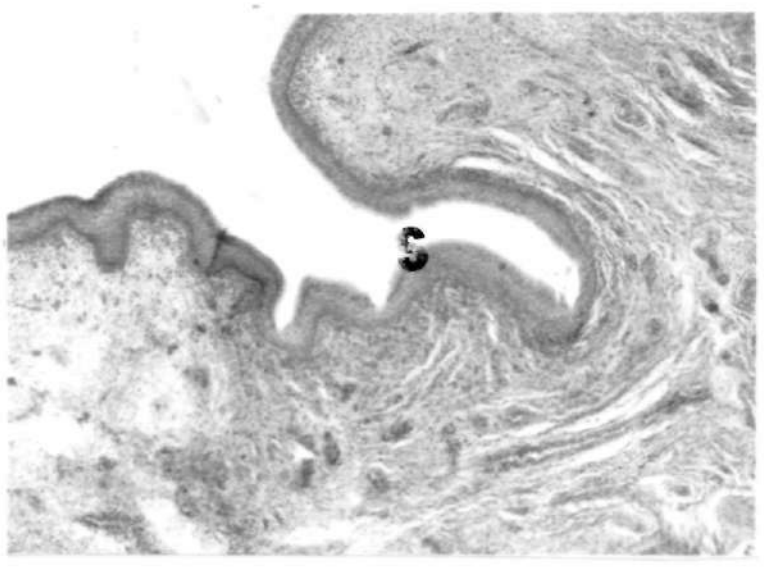
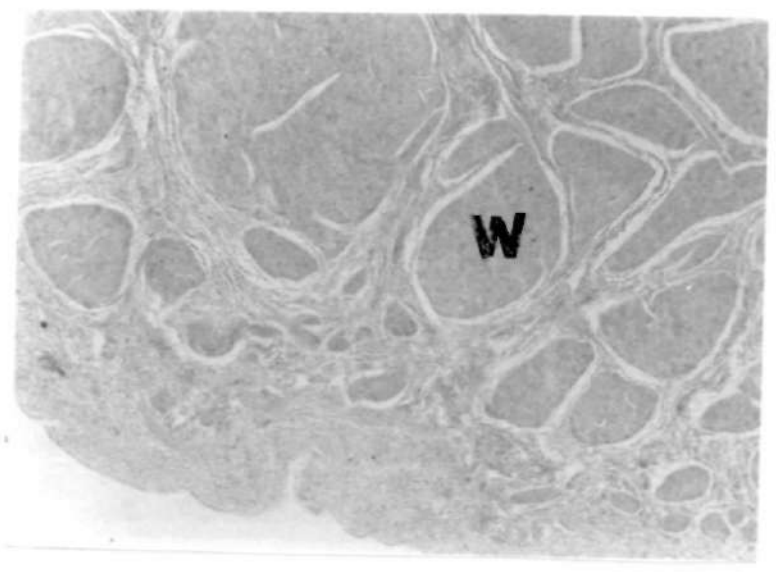

N

PLATE XIII: Photomicrograph of the mucosa and submucosa of the vagina. Note the stratified squamous epithelium (S) of the vaginal mucosa. H & E X160.

PLATE XIV: Photomicrograph of the muscularis and serosa of the vagina. Note the outer longitudinal muscle layer (W). H & E X63.


S


W

CHAPTER IV

INCIDENCE OF FEMALE GENITAL DISORDERS OF THE ONE-HUMPED CAMEL (Camelus dromedarius) IN NIGERIA

INTRODUCTION

Disease factors and management problems are the most important causes of infertility in camels (Shalash, 1965; Shalash, 1980; Mukasa-Mugerwa, 1981). These factors may take the form of specific diseases affecting reproductive organs directly or non-specific diseases that affect reproduction by reducing the efficiency of the animals as a whole (Shalash, 1980; Mukasa-Mugerwa, 1981). Disease may interfere with reproduction at any stage of the reproductive process.

Recent rinderpest epidemic and drought with resultant drastic reduction in livestock population in Nigeria has led to renewed emphasis for alternative and complementary sources of animal protein. Attention has therefore been focused on the camels and small ruminants. This has led to the establishment of another role for the camel in addition to its traditional one as the beast of burden, transportation, traction and power (Yusufu et al., 1987).

Infertility in the camel has not been extensively studied. Shalash (1965) studied the incidence of various reproductive disorders of female camels (Camelus dromedarius) in Egypt and noted an incidence of 19.46% from 1701 genital tracts examined. Nawito et al. (1967) however reported the incidence of sexual disorders of female camels in Egypt as 16.72%. Gahlot et al. (1983) reported a clinical case of fetal maceration in the one-humped camel. There is a dearth of information on the

reproductive disorders of camels in Nigeria. It was the need to investigate the various reproductive disorders which affect the fertility of female camels in Nigeria that prompted this study.

MATERIALS AND METHODS

A total of 850 female genital tracts of the one-humped camel were collected from the Kano abattoir between October, 1987 and April, 1988 and examined for abnormalities. The tracts consisted of 422 pregnant and 428 non-pregnant uteri.

All tracts were incised from vagina to oviduct and the lumen examined. Where a tract was found to be grossly abnormal tissues from the affected portions of the genitalia were taken for histopathological examination. The ovaries were examined for any evidence of gross abnormality. Tissue sample from ovaries were fixed for a minimum of 3 days in Bouin's solution while sections from other parts of the female reproductive tracts were fixed in 10% buffered formalin. Tissue sections were trimmed and processed in a Tissuematon (Scientific, Fisher Co.), embedded in paraffin, cut at 5 microns, mounted and stained with hematoxylin and eosin (H & E) according to Humason (19 72).

For histopathological examination, slides were initially screened under low power (x100) magnification and detail examinations were done under high dry power (x450) and oil immersion (x1000).

Photographs were taken of both gross and microscopic lesions of some specimens.

Pus from 3 cases of pyometra was innoculated on blood and MacConkey agar plates and incubated aerobically and anaerobically at 37°C for 48 h. Gram stain was used to study the types of micro-organisms present.

R E S U L T S

The types and incidence of gross pathological conditions of the female genitalia are summarised in Table 5.

A total of 38 gross abnormalities were recorded from the 850 tracts examined.

The fluid of the ovarian follicular cysts (plate XVI) was slightly yellow or amber colored. The volumes ranged from 17 - 22.5mls.

The uterus in the pyometra cases was tense and firm and on incision a thick creamy pus was observed (plate XV). Corynebacterium pyogenes was isolated from all the 3 cases. Two of the pyometra cases however occurred concurrently with follicular cystic degeneration.

One case each of fetal maceration and early embryonic mortality were recorded in this investigation. In the case

of the fetal maceration, the decomposed fetal parts were observed within a foul smelling serosanguinous fluid within the uterus. In the case of early embryonic mortality, only the dried amniotic membranes were noted with complete resorption of amniotic fluid and a well developed corpus luteum on the ovary. The ticks observed at the vulva were identified as Hyalomma dromedarii (plate XVII). The incompletely developed cervix lacked the typical cervical folds and there was no patency between it and the vagina. Four cases of ecchymotic hemorrhages were noted grossly in the uterine horns and body.

A summary of the histopathologic findings in cases of follicular cystic degeneration, hemorrhagic cysts, hemorrhagic endometritis, pyometra is given in table 6 while plates XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI, and XXVII show examples of some of the conditions.

DISCUSSION

The overall incidence of genital abnormalities (4.47%) is quite low compared to the results obtained by Shalash (1965) and Nawito et al. (1967) in Egypt who recorded an incidence of 19.46% and 16.72% respectively. El-Wishy (1988) however, recorded an incidence of 2.77% from 1264 genital organs of camels also in Egypt.

In this investigation, the incidence of ovarian follicular cystic degeneration (0.83%) is in accord with the incidence of 0.82% reported by Shalash (1965) from a study of 1701 female

genital tracts. It is however higher than the incidence (0.16%) obtained by El-wishy (1988). Ovarian cystic degeneration is usually associated with hormonal disturbances especially thyroxine, LH and FSH (Mukasa-Mugerwa, 1981) Abdo et al. (1968) attributed the increase in number and size of Graafian follicles in ovaries with cystic degeneration to low thyroid function which promotes the release of FSH by anterior pituitary and results in growth of large number of follicles. They stated that the thyroid of camels with cystic ovaries were inactive. Henricson (1956) attributed the occurrence of cystic ovaries in cattle to a disturbed balance between FSH and LH which prevents ovulation, thus giving rise to follicular or luteal cysts. He also observed that ovarian cysts have a genetic basis. It may be possible that the occurrence of ovarian cysts in the camel may have a similar pathophysiology.

Only 3 cases of pyometra were observed in this study. This is quite low compared to 38 cases observed by Shalash (1965) from 1701 genital tracts and 40 cases obtained by Nawito (1973) from 2075 genitalia examined. The isolation of C. pyogenes from all the cases in this study is consistent with the observation by Hegazy et al. (1979) that most severe purulent endometritis was associated with the presence of C. pyogenes. The significance of the occurrence of pyometra with ovarian degeneration observed in this investigation is not quite clear.

The observation in this study of 1 case of focal abscesses on the serosa of the left uterine horn agree with Nawito et al.

(1967) who observed 7 small abscesses on the external surface of the uterus in 1 case from 2075 genitalia examined. Shalash (1965) recorded 4 cases of hemorrhagic endometritis (0.24%), 19 cases of hemorrhagic cysts (1.22%), 17 cases of early embryonic mortality (0.99%) and 11 cases of macerated fetuses (0.65%) from a total of 1701 genital tracts examined. The finding in this study is generally less than the result obtained by Shalash (1965) and Nawito et al. (1967). The differences in the incidences may be attributed to the difference in sampls, sizes and perhaps a low level of reproductive diseases in camels in this area.

The incidence of vulvar tick infestation (1,77%) was the highest of the abnormalities recorded in this investigation. Although ticks do not appear to play any important role in disease transmission in camels as they do in other domestic species (Higgins, 1983), Steward (1950) recorded the death of a camel from anaemia and loss of blood due to hyperinfestation of upto 100 nymphs and adult Hyalomma spp per square inch ($2.5cm^2$).

Endometrial hemorrhages were noted both grossly and histopathologically. The hemosiderin pigments observed indicates the destruction of erythrocytes (Smiths et al., 1972). Hemorrhages in the camel uterus might be caused by trauma during breeding or post-partum hemorrhage. However, as the genital tracts were abattoir specimens, a history of recent parturition could not be obtained. The observation of a chronic endometritis

lesion in one of the sections may indicate some previous infection. Roberts (1971) ascribed a significant proportion of conception failures to varying degrees of chronic metritis or endometritis.

Shalash (1965) has noted that pathological changes in the fallopian tubes and ovarian bursa were quite common. In this investigation, no lesion was noted in the fallopian tubes.

It may be concluded from the results of this investigation that female genital diseases may not be a serious limitation to camel production in this area.

Table 5: Incidence of different genital abnormalities of the female camel (Camelus dromedarius) in Kano, Nigeria.

ABNORMALITY/LESION	TOTAL	PERCENTAGE
Ovarian follicular cysts	7	0.83
Hemorrhagic cysts of the ovaries	4	0.47
Pyometra	3	0.35
Early embryonic mortality	1	0.12
Focal endometrial abscess of left uterine horn	1	0.12
Focal abscess on serosa of left uterine horn	1	0.12
Endometrial hemorrhages	4	0.47
Fetal maceration	1	0.12
Imcomplete development of cervix	1	0.12
Vulvar tick infestation	15	1.77
	38	4.47

Table 6: Histopathological lesions of the female genitalia of the one-humped camel (Camelus dromedarius) in Kano, Nigeria.

LESION	DESCRIPTION
Uterine Hemosiderosis	Hemosiderin pigments which appeared as golden yellow pigments were noted within the lamina propria of the uterine horns and body. There was also sloughing of the mucosal epithelium. In addition hypertrophied blood vessels were observed in one slide.
Chronic endometritis	There was sloughing of the endometrium and infiltration mainly by neutrophils and lymphocytes. Degeneration of the uterine glands and fibrous connective tissue proliferation were also observed.
Hemorrhagic endometritis	There were hemorrhages within the lamina propria of the uterine body, sloughing of the endometrium, and the presence of inflammatory exudate with neutrophilic infiltration. A cystic gland was also noted in one slide.
Ovarian follicular cysts	The cyst wall consists of the granulosa cells and the thecal cells (theca interna and theca externa). Some of the cells seem to be undergoing hydropic degenerative changes. A cavity containing proteinacious fluid was noted in one of the sections.

LESION	DESCRIPTION
Pyometra	There was sloughing of the endometrium and leukocytic infiltration. Nuclei of leukocytes appeared clumped together.
Acute endometritis	Hyperemia and sloughing of the epithelium were noted. There was inflammatory cellular reaction. "Toxic neutrophils" - neutrophils with clumped nuclei were noted in high numbers.
Hemorrhagic cysts	Hemorrhages and hemosiderin pigments were noted within the cyst wall. Hemorrhages were also noted within the ovarian stroma in one of the sections.

PLATE XV: Photograph of pyometra (arrow).

PLATE XVI: Photograph of a camel female genitalia. Note the follicular cyst (arrow) in the ovary.



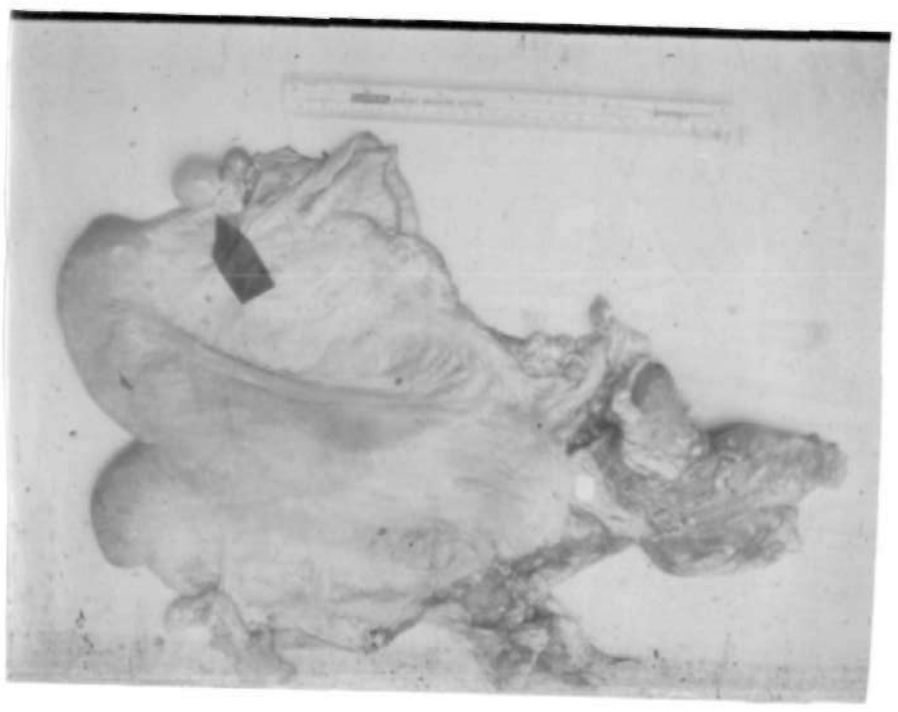
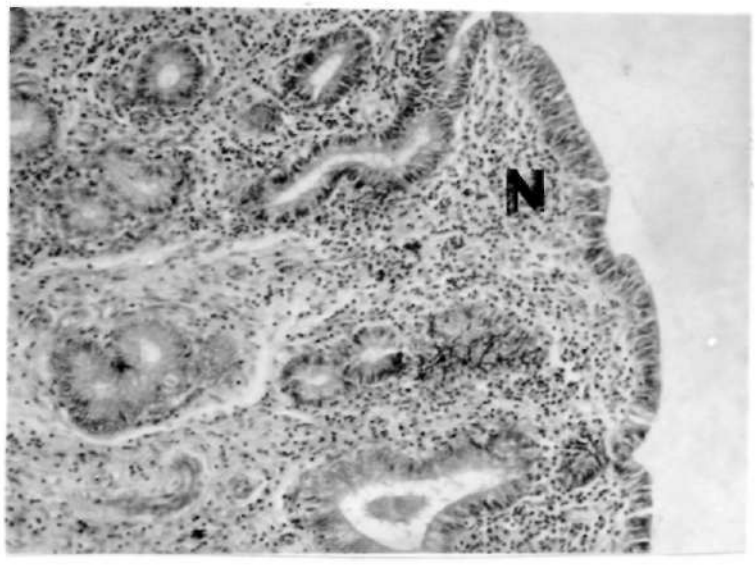


PLATE XVII: Photograph of vulvar tick infestation. Note the presence of ticks (Hyalomma dromedarii) around the vulva (arrow).



PLATE XVIII: Hemorrhagic endometritis. Note the presence of neutrophils (N) within the endometrium. H & E X160.

PLATE XIX: A cystic gland (C) within the submucosa of the uterus. H & E X160.


N

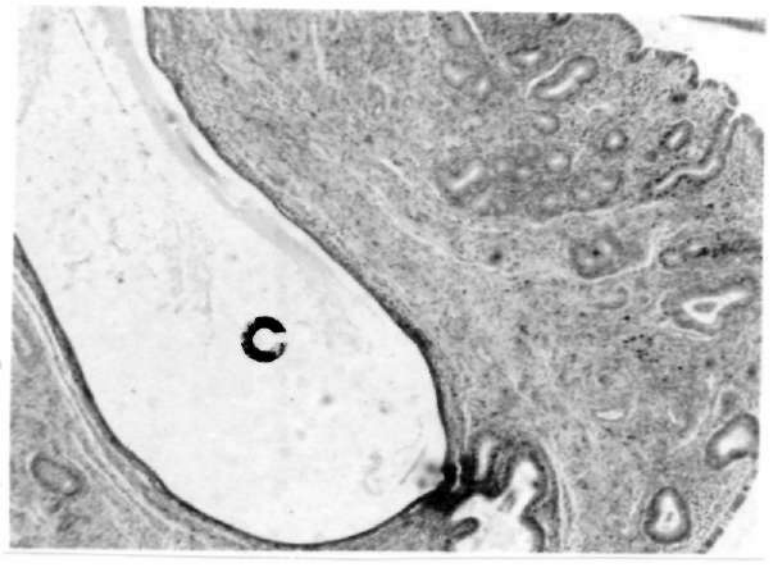
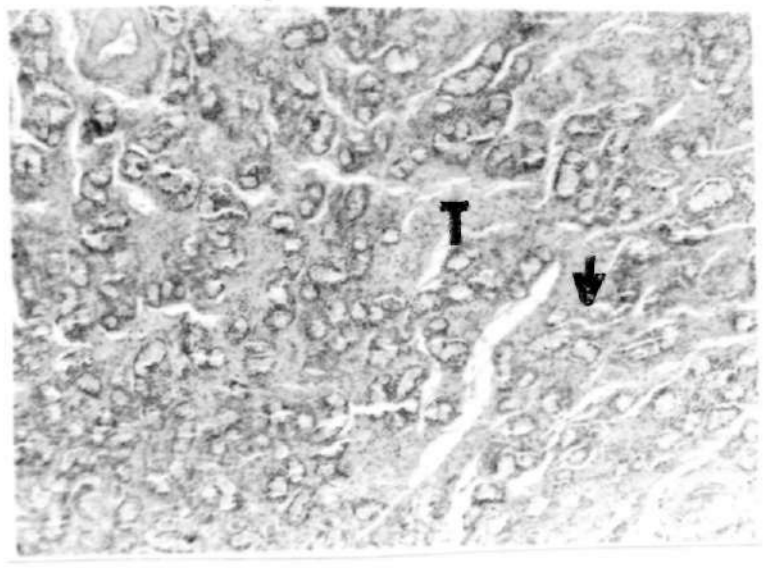

C

PLATE XX: Chronic endometritis. Note the fibrous connective tissue (T) proliferation within the submucosa and degeneration of the uterine glands (arrow). H & E X63.

PLATE XXI: Uterine hemosiderosis. Note the presence of hemosiderin pigments (Z) within the lamina propria and submucosa H & E X160.


T

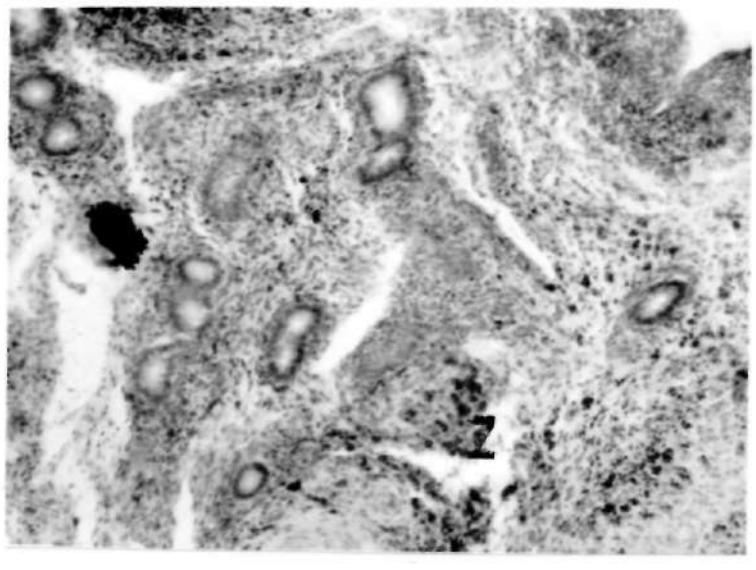
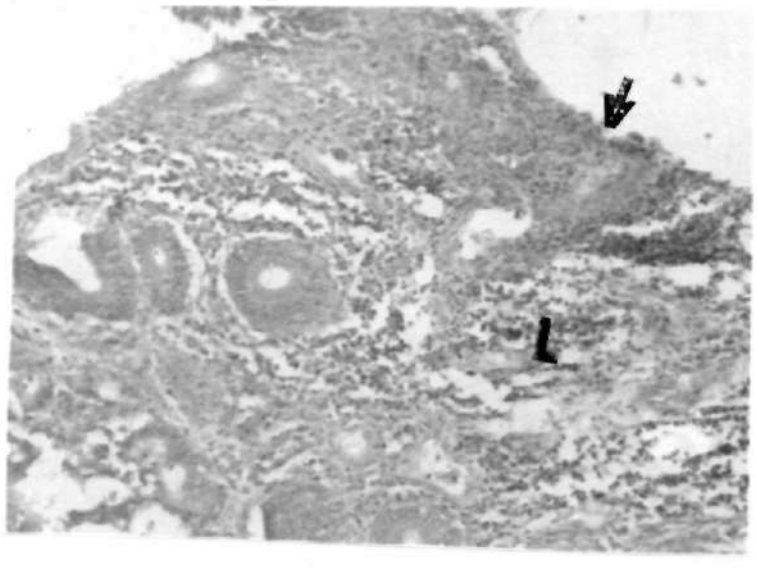


PLATE XXII: Pyometra. Note the sloughing of the uterine epithelium (arrow) and the presence of inflammatory leukocytes (L) with clumped nuclei. H & E X160.

PLATE XXIII: Acute endometritis. Note the sloughing of the uterine epithelium (arrow) and the presence of "toxic neutrophils" (X). H & E X160.


L

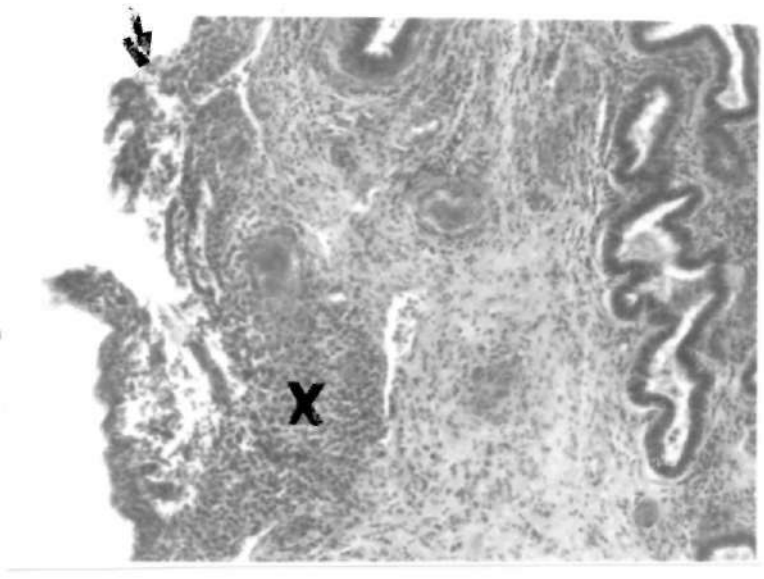
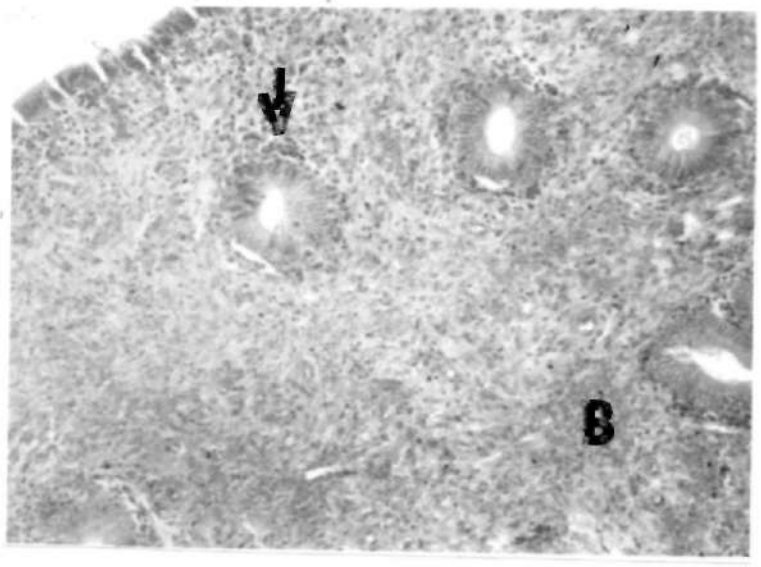

X

PLATE XXIV: Hemorrhagic endometritis. Note the presence of hemorrhage (B) within the submucosa and neutrophils (arrow) around the uterine glands. H & E X160.

PLATE XXV: Follicular cystic degeneration. The thecal cells (theca externa and interna) (J) and the degenerated membrana granulosa cells (D) form the cyst wall. H & E X63.


V
B

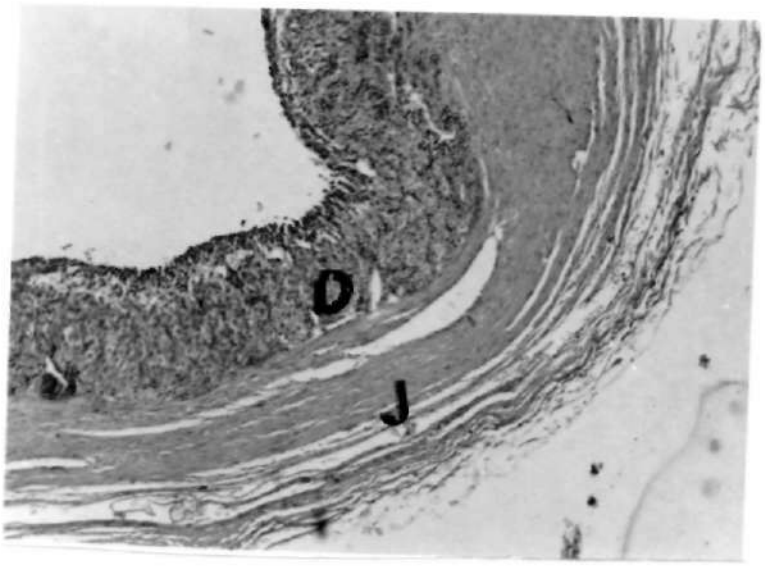
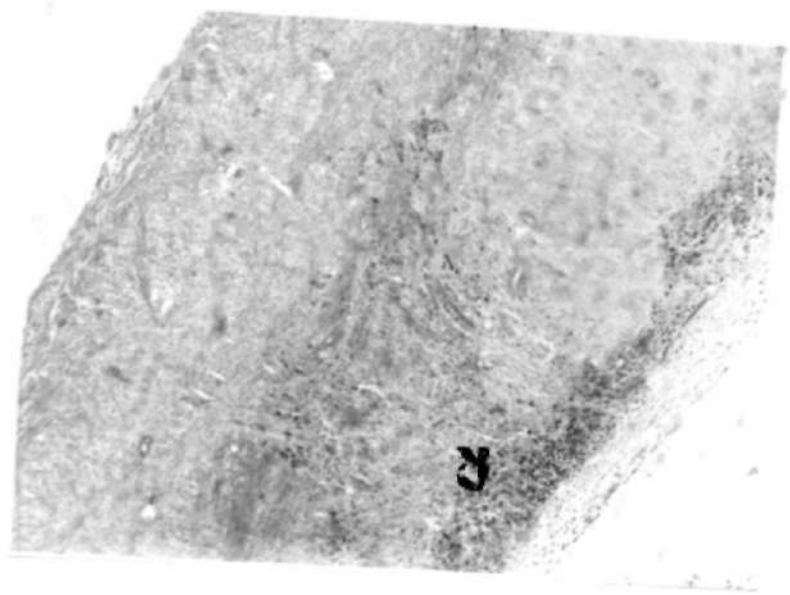

D
J

PLATE XXVI: Hemorrhagic cyst in the ovary. Note the presence of hemorrhage and hemosiderin pigments (R) in the cyst wall.



CHAPTER V

PREGNANCY WASTAGE IN SLAUGHTERED CAMELS IN KANO, NIGERIA

INTRODUCTION

A source of wastage well recoghized by abattoir personnel but perhaps overlooked by veterinarians and stockowners is the slaughter of pregnant cows (Ladds et al., 1975). The destruction of fetuses in the slaughtering of pregnant animals must be attributed to the inadequacy of veterinary insepction at the level of the slaughter house, since in nearly all countries the law forbids the slaughtering of pvegnant animals (ECA Technical Publication, 1988).

Shalash and Nawito (1964) obtained a pregnancy rate of 45.49% from 1,728 female genitalia of camels examined at the Cairo abattoir in Egypt. Ojo et al. (1977) reported a fetal waste of 50.9% in cattle in Zaria, Nigeria. Musa (1979) noted 506 (70.08%) pregnant genital organs from a total of 922 females genital organs of camels slaughtered at Tamboul, near Khartoum, Sudan.

Camel mmeat is extensively consumed in the Northern parts of Nigeria. Majority of the camels slaughtered at the abattoirs originate from the neighboring Niger and Chad Republics. At the Kano abattoir alone, 19,762 and 16,999 camels were slaughtered in 1986 and 1987 respectively (Anonymous, 1988).

The economic significance of pregnancy wastage as a result of the slaughter of pregnant animals is that a huge financial loss is incurred annually from the destruction of

thousands of fetuses at the abattoirs. There has been scanty report of fetal wastage in camels in Nigeria.

This study was designed to investigate the level of fetal losses as a result of the slaughtering of pregnant camels at the Kano abattoir.

MATERIALS AND METHODS

Several visits were made to the Kano abattoir to study fetal losses from the slaughtering of pregnant camels between October 1987 and April, 1988. A total of 850 genital tracts were examined for pregnancy. Fetuses were removed from pregnant uteri and crown-rump lengths (CRL) determined using a plastic tape in order to estimate the approximate ages of the fetuses in accordance with Musa (1969) as cited by Mukasa-Mugerwa (1981). The sexes of the fetuses were recorded in order to determine the sex ratio. Records were also made of the number of embryos encountered. An estimate of the economic losses resulting from the slaughter of pregnant camels at the Kano abattoir is provided as Appendix III.

R E S U L T S

A total of 422 pregnant tracts were obtained from 850 genital tracts examined giving a pregnancy rate of 49.64%. All pregnancies were in the left uterine horns. It comprised of 137 embryos and 284 fetuses. CRL of the fetuses ranged from 10 to 124cm and were aged between 80 and 365 days. The sex ratio was 129 (45.42%) to 155 (54.82%) males to females, respectively.

A histogram depicting the number of embryos/fetuses and their ages is shown in fig. 1.

Embryos and fetuses in the first trimester constituted 206 (48.82%) while fetuses in the second and third trimesters were 151 (37.78%) and 65 (15.40%) respectively, /¯ C-R measurements and the sexes of all fetuses are shown in appendix II ¯/

DISCUSSION

The result of this investigation showed that about half (49.64%) of the female camels slaughtered at the Kano abattoir were pregnant at the time of slaughter. The result obtained in this study is similar to that of Ojo et al. (1977) who obtained a pregnancy rate of 50.9% in cattle from 3 slaughter slabs in Zaria, Nigeria. It is however, higher than those of Shalash and Nawito (1964), El-wishy (1988) who obtained a pregnancy rate of 45.49% and 32.91% respectively from 1728 and 1264 female camel genitalia in Egypt. Musa (1979) however, obtained a higher incidence (70.08%) than in the present investigation.

The sex ratio obtained in this study 45.42M: 54.82F is close to that reported by Shalash (1965) who obtained a sex ratio of 47.48 and 52.52 for male and female, respectively, from 516 camel fetuses.

More than half of the pregnant camels were in the second and third trimesters. Pregnancy would have been readily diagnosed

by rectal examination at the ante-mortem inspection using the method of Musa and Abusineina (1978a). Rectal palpation for pregnancy in camels is not done at this abattoir during ante-mortem inspection.

The FCA (1988) estimated the economic losses from the slaughtering of 17,000 pregnant cows in a single year in Nigeria over a 10-year period to be about US $14 million. From this study, it is estimated that a financial loss of about ₦6.075M. (Six million, seventy five thousand naira) will be incurred over a 10-year period from the destruction of 4,500 camel fetuses annually at the Kano abbattoir alone.

Given the important role camels are required to play in meeting the nutritional demands of Nigerians, there is the need to develop a practicable pregnancy detection method for this species. For now, it is advocated that rectal palpation be carried out in all female camels presented for slaughter. Government should also develop incentives for the retention of pregnant camels by their owners, butchers, Government or private enterprises.

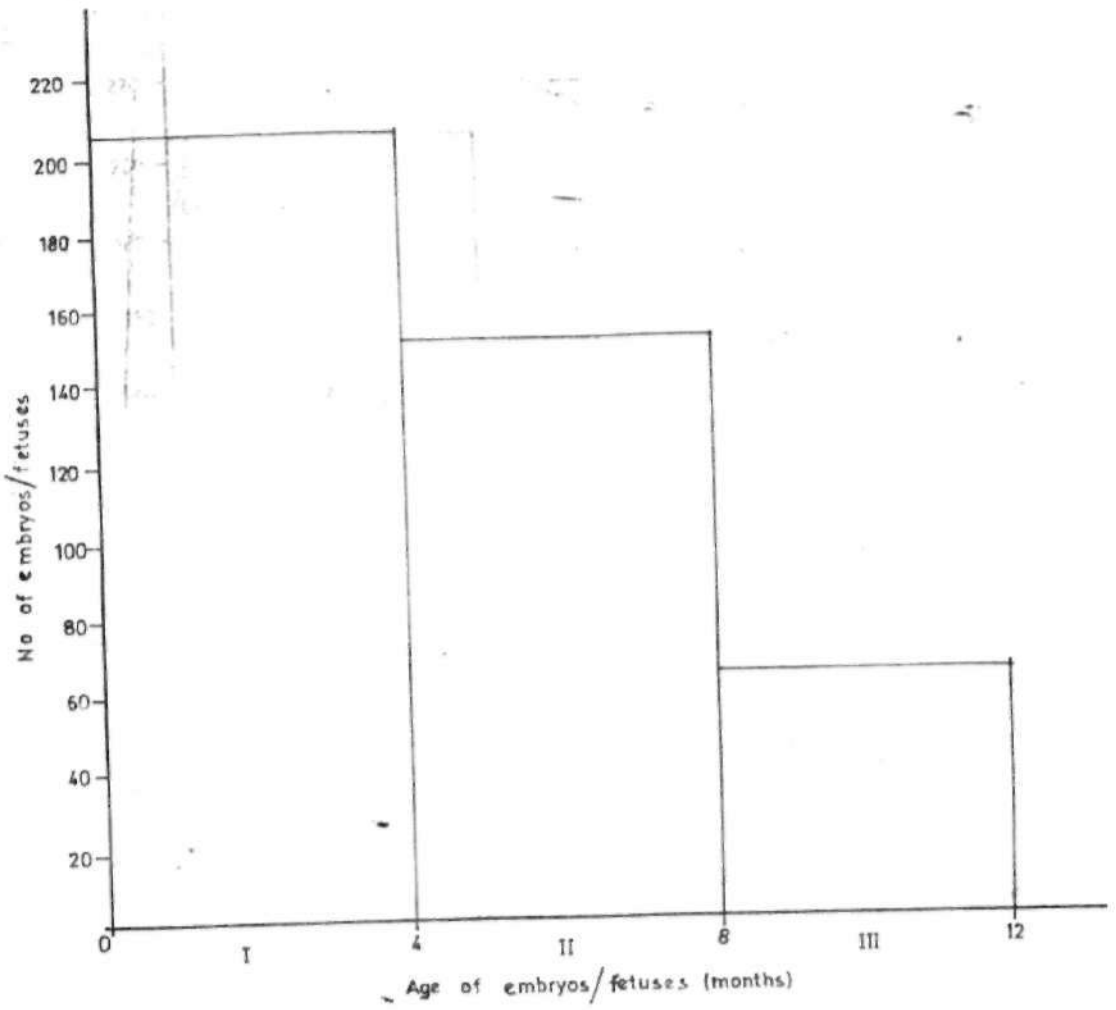


Fig I Trimester distribution of embryos/fetuses

KEY

I	First Trimester
II	Second Trimester
III	Third Trimester





CHAPTER VI

GENERAL DISCUSSION AND CONCLUSIONS.

GENERAL DISCUSSION AND CONCLUSIONS

Information on reproduction in the camel is generally scanty. There has been no previous study of the female genitalia of camels in Nigeria.

The genital dimensions and weights are in agreement with those of other workers elsewhere. The ovarian dimensions and weights obtained in this study are similar to those obtained by Tayes, 1948; Abdallah, 1965; Shalash, 1965; Musa, 1979; and Arthur et al., 1985. However, the mean ovarian weights varied with those of Abdo et al. (1968) and Chahrasbi et al. (1975) whose figures were higher. The differences may be attributed to the breed and types of animals used in those studies. The left ovary was more active in follicular development and weighed higher (4.76 ± 2.11g compared to 4.40 ± 2.04g) than the right ovary although there was no statistical difference ($P > 0.05$). This difference is attributable to the activity of the ovaries in terms of follicular development, since the weight of the ovaries depends to a large extent on the number and sizes of follicles present. The same similarity (Abdallah, 1967; Arthur et al., 1985; Ismail, 1987) and difference (Abdo et al., 1968) existed in the length of the fallopian tubes.

The mean uterine weight obtained in this study (199.06 ± 87.46g) is slightly less than the figure (278.22 ± 84.56g) quoted by Shalash (1965) and Nawito et al. (1967) during follicular activity. The dimensions of the cervix is also similar

to that obtained by Shalash (1965). It should however be noted that the camel cervix is not very firm in consistency like that of the cow. This may be due to the fewer fibrous connective tissue and less pronounced muscularis layers of the camel cervix compared to that of the bovine. The length of the vagina in this study (22.51 ± 3.48cm) is less than that (30 - 35cm) reported by Shalash (1965) for Egyptian camels.

The histology of the ovary in this study is similar to the findings of Tayes (1948), Abdallah (1968), and Abdo et al. (1968). Shehata (1964) found medullary tubes in the ovary of the adult camel and concluded that the camel ovary possibly secretes a substance which causes persistence of both mesonephric structures. Medullary tubes were not observed in the present investigation. As all the 50 genital tracts used in the study were from non-pregnant tracts, histologic features of the corpus luteum was not described.

Sections from the ampulla of the oviducts showed mucosal folds that were taller than sections from the isthmic region. The circular muscle layer was however thicker in the isthmic region than in the ampullary area. This observation is in conformity with the findings by Abdallah (1967) in Sudan.

The histology of the uterine horn and body was similar. The epithelial lining consisted of columnar cells with uterine glands in submucosa. The muscularis consisted of an inner circular and outer longitudinal muscle layers. This is in

accord with the findings of Abdallah (1960). Although the left uterine horn is longer and supports conceptuses in over 99% of pregnancies, histologically they were similar.

Histologically, the cervix and vagina of the dromedary was similar to that of the cow. The columnar epithelium of the cervix changed abruptly to stratified squamous towards the vagina. The vagina was lined by stratified squamous non-keratinizing epithelium with goblet cells in sections from the cranial portion. It is concluded that although the camel female genitalia may differ grossly from that of other domestic species, the histologic features show no clear differences.

The results of bacteriologic study of 50 uteri of one-humped camel showed the presence of Staphylococcus aureus in 8% and Escherichia coli in 2%. No bacteria were isolated from the other 45 uterine swabs. Hegazy et al. (1979) reported the isolation of S. aureus and E. coli, amongst others, from 24 uteri showing gross lesions of endometritis which was not seen in this study. It is concluded that the normal healthy camel uterus should be bacteriologically negative and that any organisms found there may be regarded as potential pathogens.

The survey of the incidence of female genital disorders of camels showed 38 (4.47%) abnormalities from a total of 850 genital tracts examined. Most of the conditions encountered were reported by Shalash (1965) and Nawito et al. (1967) in Egypt.

The general incidence of the genital disorders was low compared to the rate of 19.46% and 16.72% reported by Shalash (1965) and Nawito et al. (1967) respectively. The difference in the incidence may be attributed to the difference in sample sizes and may be low level of reproductive disease of camels in this area. Vulvar tick infestation had the highest incidence of 1.77% in this investigation. Ticks do not appear to play an important role in disease transmission in camels as they do in other domestic species (Higgins, 1983). Ticks however cause thickening of the skin, occasional abscesses and irritation to the camel.

The significance of the low level of female genital pathology noted from this study is that female genital pathology may not be a serious limitation to camel production in this area. It is advocated that a wider survey covering a greater number of samples and areas be carried out in order to ascertain the level of female genital pathology of camels in Nigeria.

The result of the pregnancy wastage study showed a total of 422 pregnant tracts from 850 genital tracts examined giving a pregnancy wastage rate of 49.46%. The result obtained in this study is similar to that of Ojo et al. (1977) who obtained a pregnancy rate of 50.9% in cattle from 3 slaughter slabs in Zaria, Nigeria. It is however slightly higher than that of Shalash and Nawito (1964) who obtained a pregnancy rate of 45.59% from 1728 female genitalia of camels in Egypt. The sex

ratio obtained in this study, 45.42% M: 54.82% F is close to the ratio (47.52 M: 52.52 F) obtained by Shalash (1965).

The economic significance of pregnancy wastage is that a huge financial loss is incurred from the destruction of thousands of fetuses at the abattoirs.

Routine ante-mortem rectal palpation for pregnancy diagnosis in camels is not done at this abattoir. Since the law forbids the slaughtering of pregnant animals, efforts must be made to put a stop to this practice. Government should develop incentives for the retention of pregnant camels by their owners, butchers, government or private enterprises. There is also the need to include the teaching of camel medicine and reproduction in the veterinary curriculum especially in this part of the country to reflect the importance of this specie of animals.

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APPENDIX I

DIMENSIONS AND WEIGHTS OF CAMEL OVARIES

CASE NO.	LEFT OVARY				RIGHT OVARY			
	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)
KN 01	3.5	1.82	0.850	2.90	3.0	1.56	0.90	2.50
KN 02	5.0	3.0	0.715	5.742	5.2	3.0	0.865	4.835
KN 03	3.3	1.7	0.500	1.50	3.0	1.6	0.5	1.473
KN 04	3.0	2.8	0.875	3.967	3.2	2.5	0.85	4.375
KN 05	3.1	2.5	0.575	2.04	3.0	2.2	0.55	2.10
KN 06	3.7	3.0	0.835	5.565	3.6	2.9	0.78	5.76
KN 07	3.0	2.5	0.700	3.13	2.8	2.4	0.67	3.03
KN 08	3.2	2.5	0.800	4.682	2.7	2.2	0.67	3.36
KN 09	2.9	1.6	0.650	1.02	2.6	1.7	0.56	1.236
KN 10	3.2	2.3	0.675	2.10	3.0	2.2	0.65	2.00
KN 11	3.1	2.4	0.725	1.80	3.0	2.0	0.75	2.054
KN 12	3.2	2.9	0.875	4.650	3.6	2.7	0.70	3.04
KN 13	3.4	3.0	0.675	6.325	3.8	3.0	0.70	6.47

DIMENSIONS AND WEIGHTS OF CAMEL OVARIES

CASE NO.	LEFT OVARY				RIGHT OVARY			
	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)
KN 14	3.0	2.5	0.900	4.60	3.5	2.8	0.80	5.25
KN 15	4.2	3.2	0.550	6.768	3.9	2.7	0.88	6.860
KN 16	3.5	2.6	0.875	4.677	3.6	2.8	0.75	3.984
KN 17	3.6	2.8	0.800	3.756	3.4	2.7	0.675	3.561
KN 18	2.9	2.3	0.600	2.128	3.1	2.0	0.50	1.826
KN 19	4.5	3.0	0.800	6.52	4.0	2.8	0.90	7.50
KN 20	3.3	2.5	0.800	3.50	3.5	2.6	0.70	3.193
KN 21	3.6	3.0	0.825	7.318	4.0	2.8	0.75	6.840
KN 22	5.0	3.3	0.800	6.056	5.2	3.3	1.0	8.378
KN 23	3.8	3.0	0.500	4.415	3.5	2.8	0.45	3.233
KN 24	3.7	3.0	0.750	3.302	3.5	2.5	0.78	3.00
KN 25	3.6	2.5	0.650	2.20	3.4	2.3	0.60	2.00
KN 26	3.5	2.5	0.450	2.370	3.2	2.8	0.50	2.630
KN 27	4.1	3.0	0.650	6.930	3.9	3.2	0.65	5.982

DIMENSIONS AND WEIGHTS OF CAMEL OVARIES

CASE NO.	LEFT OVARY				RIGHT OVARY			
	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)
KN 28	3.6	2.5	0.900	5.037	3.2	2.5	0.70	3.06
KN 29	4.2	3.0	0.800	9.260	3.9	3.0	0.775	6.370
KN 30	3.4	3.0	0.500	3.60	3.0	2.5	0.60	3.30
KN 31	4.0	3.0	1.000	5.579	3.7	2.7	0.70	4.95
KN 32	4.1	3.5	1.000	8.100	3.9	3.0	1.0	6.130
KN 33	3.5	3.0	0.900	4.167	3.0	2.7	0.65	2.658
KN 34	3.0	2.9	0.700	3.362	3.3	2.8	0.65	3.98
KN 35	3.9	2.8	0.750	3.710	3.4	2.7	0.60	2.912
KN 36	3.2	2.9	0.675	3.100	3.5	2.8	0.80	3.183
KN 37	4.5	4.0	0.800	8.56	4.0	3.5	0.90	9.69
KN 38	3.6	3.0	0.600	3.20	3.5	2.8	0.86	6.20
KN 39	3.8	2.5	0.600	4.50	3.0	2.4	0.50	3.50
KN 40	4.0	2.7	0.900	8.55	4.2	3.2	0.75	8.58
KN 41	3.3	2.6	0.450	4.485	3.6	2.7	0.70	5.545
KN 42	4.0	2.8	0.8	8.55	3.0	2.5	0.70	4.270

DIMENSIONS AND WEIGHTS OF CAMEL OVARIES

CASE NO.	LEFT OVARY				RIGHT OVARY			
	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)	Length (cm)	Diameter (cm)	Thickness (cm)	Weight (g)
KN 43	2.8	2.2	0.55	2.350	2.7	2.5	0.50	2.430
KN 44	4.2	3.0	0.65	6.065	3.8	3.0	0.90	7.960
KN 45	4.3	3.4	0.85	7.867	3.6	3.0	0.60	5.896
KN 46	3.5	2.7	0.70	5.278	3.2	2.9	0.65	4.274
KN 47	3.0	2.2	0.60	2.677	2.7	2.2	0.55	2.106
KN 48	4.0	2.7	0.75	6.20	3.5	2.5	0.60	6.20
KN 49	3.2	2.7	0.604	4.299	3.7	2.4	0.706	6.736
KN 50	4.2	3.5	1.0	7.80	3.9	3.3	1.1	6.550

DIMENSIONS AND WEIGHTS OF CAMEL OVIDUCTS

CASE NO.	LEFT OVIDUCT Length (cm)	Diameter (cm)	Weight (g)	RIGHT OVIDUCT Length (cm)	Diameter (cm)	Weight (g)
KN 01	17.4	0.225	1.96	17.0	0.25	1.748
KN 02	28.0	0.25	5.442	26.5	0.265	4.835
KN 03	17.8	0.30	2.070	18.0	0.225	2.160
KN 04	22.1	0.250	2.820	26.2	0.250	2.245
KN 05	22.9	0.30	3.120	22.7	0.30	2.688
KN 06	25.5	0.30	8.90	24.0	0.36	7.50
KN 07	25.2	0.30	8.920	23.5	0.35	8.430
KN 08	18.8	0.40	5.120	17.5	0.33	4.380
KN 09	18.5	0.24	1.755	15.3	0.225	1.955
KN 10	20.2	0.275	3.50	24.5	0.275	4.118
KN 11	21.5	0.30	2.02	20.5	0.325	2.370
KN 12	23.5	0.335	4.650	21.8	0.25	3.540
KN 13	24.2	0.475	6.00	23.5	0.45	5.700
KN 14	20.5	0.30	4.45	19.3	0.250	4.051

DIMENSIONS AND WEIGHTS OF CAMEL OVIDUCTS

CASE NO.	LEFT OVIDUCT			RIGHT OVIDUCT		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 15	13.0	0.40	3.170	17.8	0.40	4.40
KN 16	19.2	0.335	4.479	19.8	0.40	4.330
KN 17	16.5	0.30	2.140	13.0	0.25	2.130
KN 18	15.5	0.20	1.638	10.0	0.25	1.140
KN 19	25.0	0.35	6.560	21.8	0.36	4.20
KN 20	18.5	0.40	3.100	15.5	0.35	2.920
KN 21	24.5	0.30	4.740	19.0	0.375	4.900
KN 22	19.2	0.30	3.05	25.0	0.30	4.960
KN 23	19.5	0.30	4.560	16.4	0.35	4.00
KN 24	17.6	0.75	8.850	14.5	0.28	2.560
KN 25	19.3	0.25	1.060	18.5	0.245	2.020
KN 26	25.5	0.25	4.100	24.7	0.275	3.770
KN 27	24.5	0.335	4.420	21.2	0.375	4.00

DIMENSIONS AND WEIGHTS OF CAMEL OVIDUCTS

CASE NO.	LEFT OVIDUCT			RIGHT OVIDUCT		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 28	20.5	0.29	3.80	16.5	0.30	3.843
KN 29	23.3	0.30	5.100	19.5	0.30	4.70
KN 30	23.8	0.30	6.370	22.9	0.35	5.570
KN 31	23.5	0.275	6.00	18.5	0.30	3.400
KN 32	21.5	0.35	3.880	15.0	0.375	2.500
KN 33	27.0	0.28	6.100	26.2	0.35	6.300
KN 34	23.0	0.30	3.720	24.5	0.28	4.440
KN 35	20.5	0.30	3.416	18.0	0.32	3.272
KN 36	26.0	0.30	5.400	25.0	0.30	4.020
KN 37	24.8	0.30	4.375	23.5	0.28	4.878
KN 38	23.5	0.35	6.300	19.5	0.38	3.950
KN 39	17.7	0.375	4.953	17.3	0.30	4.914
KN 40	19.8	0.30	6.160	18.7	0.30	5.350

DIMENSIONS AND WEIGHTS OF CAMEL OVIDUCTS

CASE NO.	LEFT OVIDUCT			RIGHT OVIDUCT		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 41	18.2	0.20	4.20	23.0	0.30	4.40
KN 42	16.0	0.375	3.50	12.8	0.30	3.480
KN 43	18.5	0.40	4.020	22.0	0.30	4.100
KN 44	25.0	0.30	6.570	21.5	0.350	3.820
KN 45	18.5	0.275	4.00	16.7	0.25	3.140
KN 46	21.8	0.35	6.130	23.5	0.28	4.940
KN 47	21.2	0.35	4.735	18.8	0.30	4.290
KN 48	21.3	0.375	4.220	17.8	0.40	4.040
KN 49	22.3	0.30	4.330	16.8	0.30	2.670
KN 50	22.8	0.34	5.130	18.6	0.30	4.950

DIMENSIONS AND WEIGHTS OF CAMEL UTERI

CASE NO.	LEFT UTERINE HORN		RIGHT UTERINE HORN		BODY		WEIGHT OF UTERUS
	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	(g)
KN 01	8.0	4.0	4.2	3.0	3.2	4.0	28.804
KN 02	15.5	7.0	11.0	5.5	3.5	3.0	246.145
KN 03	8.0	3.9	4.7	2.9	4.2	4.3	45.50
KN 04	9.0	5.0	7.5	4.5	4.0	5.0	82.570
KN 05	10.0	5.5	6.0	4.9	3.5	6.0	120.0
KN 06	15.0	8.5	10.0	7.5	4.0	9.0	281.760
KN 07	13.5	7.5	9.0	6.0	4.0	7.5	238.370
KN 08	12.0	6.5	8.0	5.2	3.5	7.0	156.04
KN 09	9.0	2.6	7.0	2.5	2.1	3.37	77.075
KN 10	9.0	3.275	7.0	3.2	3.5	3.725	97.614
KN 11	8.4	2.3	6.0	2.375	2.5	2.620	46.650
KN 12	12.0	3.575	9.0	3.1	3.0	4.8	185.650
KN 13	17.0	5.5	13.0	4.5	4.0	5.5	246.853

DIMENSIONS AND WEIGHTS OF CAMEL UTERI

CASE NO.	LEFT UTERINE HORN		RIGHT UTERINE HORN		BODY		WEIGHT OF UTERUS
	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	(g)
KN 14	14.5	5.3	11.5	3.8	4.0	4.4	266.300
KN 15	15.0	4.6	9.0	4.0	4.0	4.2	284.934
KN 16	14.0	4.7	9.5	3.5	4.5	4.4	230.110
KN 17	8.0	2.5	7.0	2.4	2.5	3.0	60.550
KN 18	8.5	2.4	8.0	2.6	3.0	3.5	75.60
KN 19	14.2	5.0	9.5	3.5	3.0	6.0	225.110
KN 20	11.0	3.5	9.0	2.9	3.0	3.8	159.660
KN 21	17.0	6.2	12.0	4.2	4.2	5.7	159.860
KN 22	14.0	5.3	9.0	3.6	3.5	6.0	249.98
KN 23	16.0	5.7	12.0	4.4	4.0	5.5	252.349
KN 24	8.0	2.8	7.0	2.8	3.0	2.9	80.970
KN 25	9.0	2.4	7.5	2.25	2.1	3.0	58.489
KN 26	11.0	4.2	8.5	3.1	3.0	4.3	189.510

DIMENSIONS AND WEIGHTS OF CAMEL UTERI

CASE NO.	LEFT UTERINE HORN		RIGHT UTERINE HORN		BODY		WEIGHT OF UTERUS
	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	(g)
KN 27	14.0	4.2	12.5	4.1	3.5	4.8	342.980
KN 28	13.0	4.0	10.0	3.6	3.5	5.5	214.940
KN 29	16.0	5.2	9.0	3.7	3.5	5.4	306.920
KN 30	15.0	3.8	10.0	3.3	4.0	3.9	228.850
KN 31	13.5	4.4	9.5	3.6	4.0	4.6	240.14
KN 32	14.0	4.6	11.0	3.6	4.0	4.8	232.960
KN 33	16.0	4.6	12.0	4.15	4.5	5.4	350.760
KN 34	15.0	4.5	11.0	3.8	3.5	4.8	223.548
KN 35	13.0	4.3	9.5	4.9	4.0	4.9	222.77
KN 36	14.0	4.6	9.5	3.8	4.0	4.9	253.53
KN 37	18.0	5.5	13.0	4.8	4.0	5.9	317.570
KN 38	11.0	4.5	9.0	3.2	2.6	4.9	158.890
KN 39	14.0	4.8	9.0	3.6	3.0	5.1	279.210
KN 40	18.0	5.4	12.0	4.0	3.5	5.5	316.710

DIMENSIONS AND WEIGHTS OF CAMEL UTERI

CASE NO.	LEFT UTERINE HORN		RIGHT UTERINE HORN		BODY		WEIGHT OF UTERUS (g)
	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	
KN 41	14.5	5.0	10.0	3.3	4.0	5.0	259.000
KN 42	17.5	5.5	12.5	4.4	3.0	6.5	267.380
KN 43	9.5	2.7	6.0	2.4	3.0	3.3	66.100
KN 44	14.5	4.8	9.5	3.45	3.0	6.0	228.640
KN 45	13.0	4.4	10.0	3.4	3.2	5.0	239.700
KN 46	18.5	5.2	11.0	4.5	3.0	6.0	317.560
KN 47	13.0	4.8	9.0	3.9	3.0	5.4	158.840
KN 48	17.0	5.1	12.0	3.9	3.4	5.7	252.150
KN 49	14.0	4.9	10.0	4.0	3.2	5.2	158.833
KN 50	15.8	5.6	11.5	3.8	3.0	5.8	168.540

DIMENSIONS AND WEIGHTS OF THE CAMEL CERVIX AND VAGINA

CASE NO.	CERVIX Length (cm)	CERVIX Diameter (cm)	CERVIX Weight (g)	VAGINA Length (cm)	VAGINA Diameter (cm)	VAGINA Weight (g)
KN 01	3.0	3.8	9.840	22.8	3.6	45.00
KN 02	8.0	8.5	119.850	31.0	6.5	322.506
KN 03	7.5	5.0	44.968	17.0	4.0	44.550
KN 04	8.0	4.25	74.01	22.0	4.5	106.230
KN 05	6.0	6.5	54.0	27.0	5.0	146.50
KN 06	10.5	7.0	190.960	22.9	4.2	165.00
KN 07	8.0	7.0	145.145	23.0	5.0	208.638
KN 08	8.5	7.0	158.540	24.0	6.0	145.00
KN 09	5.0	3.0	8.850	17.0	2.37	84.330
KN 10	5.0	3.2	9.414	17.5	4.375	158.330
KN 11	4.0	2.575	9.170	16.5	3.24	67.480
KN 12	4.0	4.6	56.00	17.0	6.0	175.710
KN 13	6.0	5.6	85.070	24.0	4.1	271.660

DIMENSIONS AND WEIGHTS OF THE CAMEL CERVIX AND VAGINA

CASE NO.	CERVIX			VAGINA		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 14	5.0	4.2	66.430	19.0	6.0	132.972
KN 15	4.0	4.8	69.273	19.0	4.5	246.380
KN 16	5.0	3.8	58.560	23.0	3.3	184.620
KN 17	4.5	3.2	18.500	20.0	2.8	60.185
KN 18	5.0	3.6	26.614	20.0	3.5	88.70
KN 19	6.0	5.0	95.50	22.0	4.5	165.580
KN 20	3.8	4.3	27.077	25.0	3.4	176.642
KN 21	4.2	5.7	102.00	30.0	4.0	169.226
KN 22	6.0	5.8	142.570	30.0	3.8	218.705
KN 23	6.5	5.8	103.369	23.0	4.0	198.445
KN 24	5.5	3.8	48.150	26.0	4.0	190.636
KN 25	4.3	2.6	9.700	14.0	3.2	62.647
KN 26	5.0	4.3	52.043	28.0	4.0	212.260

DIMENSIONS AND WEIGHTS OF THE CAMEL CERVIX AND VAGINA

CASE NO.	CERVIX			VAGINA		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 27	5.5	4.6	94.550	20.0	3.5	141.550
KN 28	6.5	4.8	63.153	22.0	3.7	141.192
KN 29	6.0	4.4	95.430	22.0	3.9	185.470
KN 30	6.0	4.1	61.920	23.5	3.5	140.140
KN 31	5.0	4.2	61.00	26.0	3.8	196.540
KN 32	6.0	4.0	86.960	24.0	4.5	263.460
KN 33	6.0	5.6	89.770	25.0	4.2	257.783
KN 34	6.0	4.6	61.043	23.5	4.1	74.725
KN 35	6.2	4.4	67.014	23.8	4.0	173.540
KN 36	5.2	5.0	77.700	24.0	4.0	275.700
KN 37	6.0	6.0	186.230	26.0	4.4	308.822
KN 38	5.0	4.8	78.564	22.0	3.6	150.775
KN 39	5.5	4.75	114.668	19.0	3.8	221.183

DIMENSIONS AND WEIGHTS OF THE CAMEL CERVIX AND VAGINA

CASE NO.	CERVIX			VAGINA		
	Length (cm)	Diameter (cm)	Weight (g)	Length (cm)	Diameter (cm)	Weight (g)
KN 40	4.5	5.2	104.700	24.0	3.6	278.204
KN 41	5.5	5.2	98.692	23.0	4.3	209.760
KN 42	5.0	5.2	93.027	22.8	4.5	185.000
KN 43	5.0	4.0	27.100	17.5	3.3	117.630
KN 44	6.0	5.0	108.519	22.6	4.5	188.950
KN 45	6.0	4.4	96.547	22.0	4.0	258.950
KN 46	5.5	5.8	92.610	22.0	4.5	220.193
KN 47	6.0	4.5	70.270	21.0	4.2	245.203
KN 48	5.0	5.3	97.893	22.0	3.8	218.914
KN 49	5.0	5.8	74.249	22.3	4.8	210.073
KN 50	5.8	5.0	65.000	22.8	4.2	142.230

WEIGHTS OF FEMALE GENITAL TRACTS OF CAMELS

CASE NO.	WEIGHT (g)	CASE NO.	WEIGHT (g)
KN 01	190	KN 26	480
KN 02	700	KN 27	610
KN 03	160	KN 28	450
KN 04	280	KN 29	650
KN 05	340	KN 30	460
KN 06	660	KN 31	540
KN 07	510	KN 32	620
KN 08	470	KN 33	730
KN 09	190	KN 34	400
KN 10	290	KN 35	504
KN 11	140	KN 36	640
KN 12	440	KN 37	830
KN 13	630	KN 38	440
KN 14	510	KN 39	650
KN 15	640	KN 40	760
KN 16	530	KN 41	600
KN 17	170	KN 42	570
KN 18	200	KN 43	230
KN 19	500	KN 44	560
KN 20	380	KN 45	600
KN 21	600	KN 46	670
KN 22	640	KN 47	510
KN 23	580	KN 48	580
KN 24	330	KN 49	460
KN 25	150	KN 50	420

APPENDIX II

SEX AND ESTIMATED AGES OF FETUSES RECOVERED FROM SLAUGHTERED CAMELS IN KANO ABATTOIR

SERIAL NO	SEX	C-R (cm)	EST. AGE (Days)
KNF 001	M	59	213
KNF 002	F	88	264
KNF 003	F	85	267
KNF 004	F	101	303
KNF 005	M	83	255
KNF 006	F	100	300
KNF 007	M	82	254
KNF 008	M	30	140
KNF 009	M	82	255
KNF 010	F	78	240
KNF 011	F	71	237
KNF 012	F	55	206
KNF 013	F	114	335
KNF 014	M	35	165
KNF 015	F	48	206
KNF 016	F	68	228
KNF 017	F	83	255
KNF 018	F	81	253
KNF 019	F	89	267
KNF 020	F	84	256
KNF 021	M	112	330
KNF 022	F	93	281
KNF 023	M	116	335

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 024	M	64	224
KNF 025	M	45	186
KNF 026	M	87	266
KNF 027	M	99	307
KNF 028	F	28	135
KNF 029	M	100	330
KNF 030	M	119	340
KNF 031	M	124	360
KNF 032	M	110	330
KNF 033	F	104	320
KNF 034	F	112	330
KNF 035	F	95	298
KNF 036	F	100	315
KNF 037	M	111	330
KNF 038	M	99	315
KNF 039	M	34	165
KNF 040	F	30	143
KNF 041	M	115	335
KNF 042	M	107	330
KNF 043	M	73	240
KNF 044	F	83	255
KNF 045	M	97	300
KNF 046	M	69	236
KNF 047	M	89	280
KNF 048	M	76	248
KNF 049	F	105	330

SERIAL NO	SEX	C-R (cm)	EST. AGE (Days)
KNF 050	M	22	120
KNF 051	F	41	180
KNF 052	F	118	340
KNF 053	F	97	299
KNF 054	M	20	110
KNF 055	F	98	315
KNF 056	M	108	330
KNF 057	F	55	210
KNF 058	F	19	110
KNF 059	M	10	80
KNF 060	F	12	85
KNF 061	F	31	140
KNF 062	M	99	315
KNF 063	M	35	165
KNF 064	M	32	142
KNF 065	M	12	85
KNF 066	M	99	310
KNF 067	F	110	345
KNF 068	F	54	195
KNF 069	F	86	264
KNF 070	M	60	210
KNF 071	M	68	230
KNF 072	M	45	185
KNF 073	F	102	330
KNF 074	M	175	240
KNF 075	F	38	170

SERIAL NO	SEX	C-R (cm)	EST. AGE (Days)
KNF 076	F	48	190
KNF 077	M	41	182
KNF 078	F	48	190
KNF 079	F	24	120
KNF 080	M	16	92
KNF 081	M	82	264
KNF 082	M	22	145
KNF 083	F	26	128
KNF 084	M	15	90
KNF 085	F	18	110
KNF 086	F	50	198
KNF 087	M	116	360
KNF 088	M	84	260
KNF 089	M	19	110
KNF 090	M	21	112
KNF 091	F	25	122
KNF 092	F	16	100
KNF 093	F	117	360
KNF 094	F	80	250
KNF 095	M	22	115
KNF 096	M	23	117
KNF 097	F	25	122
KNF 098	F	30	140
KNF 099	M	80	250
KNF 100	M	27	128
KNF 101	F	45	180

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 102	M	32	150
KNF 103	F	60	218
KNF 104	F	48	190
KNF 105	F	21	112
KNF 106	M	25	122
KNF 107	M	16	98
KNF 108	M	25	122
KNF 109	F	22	115
KNF 110	F	18	108
KNF 111	F	82	252
KNF 112	F	101	350
KNF 113	M	46	188
KNF 114	F	44	184
KNF 115	M	28	131
KNF 116	F	18	108
KNF 117	F	32	150
KNF 118	M	25	122
KNF 119	M	21	112
KNF 120	F	38	175
KNF 121	M	32	150
KNF 122	M	16	92
KNF 123	F	28	133
KNF 124	M	34	156
KNF 125	F	49	195
KNF 126	M	40	177
KNF 127	F	47	190

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 128	F	23	117
KNF 129	M	15	102
KNF 130	F	20	111
KNF 131	M	27	128
KNF 132	M	18	108
KNF 133	F	23	117
KNF 134	M	64	220
KNF 135	F	34	156
KNF 136	M	21	112
KNF 137	M	55	202
KNF 138	M	32	150
KNF 139	F	33	152
KNF 140	F	28	133
KNF 141	F	17	105
KNF 142	F	25	124
KNF 143	F	14	95
KNF 144	F	10	82
KNF 145	M	28	133
KNF 146	F	22	116
KNF 147	M	93	282
KNF 148	M	16	102
KNF 149	M	33	152
KNF 150	M	24	120
KNF 151	F	18	108
KNF 152	F	25	124
KNF 153	F	26	128

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 154	F	104	320
KNF 155	F	32	150
KNF 156	F	27	128
KNF 157	F	58	270
KNF 158	M	20	110
KNF 159	M	35	158
KNF 160	M	22	116
KNF 161	F	35	158
KNF 162	F	26	128
KNF 163	M	29	135
KNF 164	M	14	97
KNF 165	M	19	112
KNF 166	F	46	190
KNF 167	F	40	176
KNF 168	F	61	225
KNF 169	F	20	111
KNF 170	F	37	170
KNF 171	F	25	122
KNF 172	F	31	152
KNF 173	F	28	134
KNF 174	F	36	165
KNF 175	M	20	111
KNF 176	F	22	116
KNF 177	F	23	117
KNF 178	M	115	358
KNF 179	F	113	354

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 180	M	49	195
KNF 181	M	28	134
KNF 182	M	26	128
KNF 183	F	20	111
KNF 184	F	25	124
KNF 185	F	120	360
KNF 186	F	101	315
KNF 187	M	33	157
KNF 188	F	30	140
KNF 189	F	52	200
KNF 190	F	43	202
KNF 191	M	78	247
KNF 192	F	12	90
KNF 193	M	26	128
KNF 194	M	18	108
KNF 195	F	29	136
KNF 196	F	30	140
KNF 197	F	29	136
KNF 198	F	33	152
KNF 199	M	22	115
KNF 200	M	18	108
KNF 201	F	112	360
KNF 202	F	32	150
KNF 203	F	22	115
KNF 204	M	30	140
KNF 205	M	34	156

SERIAL NO	SEX	C-R (cm)	EST. AGE (Days)
KNF 206	F	18	108
KNF 207	M	12	88
KNF 208	F	39	172
KNF 209	M	27	130
KNF 210	F	26	128
KNF 211	M	16	92
KNF 212	F	22	115
KNF 213	F	26	128
KNF 214	M	72	230
KNF 215	F	14	89
KNF 216	M	25	122
KNF 217	M	35	158
KNF 218	F	37	170
KNF 219	F	27	130
KNF 220	F	10	108
KNF 221	F	25	122
KNF 222	F	24	120
KNF 223	M	67	233
KNF 224	F	56	205
KNF 225	F	23	117
KNF 226	M	26	128
KNF 227	M	16	98
KNF 228	M	18	108
KNF 229	M	27	128
KNF 230	F	21	112
KNF 231	M	32	150

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 232	M	22	116
KNF 233	M	24	120
KNF 234	F	26	129
KNF 235	F	41	182
KNF 236	M	34	156
KNF 237	F	55	195
KNF 238	F	94	288
KNF 239	M	40	177
KNF 240	M	31	144
KNF 241	M	30	160
KNF 242	M	60	210
KNF 243	F	28	133
KNF 244	M	26	128
KNF 245	F	25	122
KNF 246	F	41	182
KNF 247	F	18	108
KNF 248	F	29	136
KNF 249	F	54	194
KNF 250	F	35	158
KNF 251	M	30	140
KNF 252	F	24	120
KNF 253	F	27	128
KNF 254	F	23	147
KNF 255	F	36	165
KNF 256	F	31	144
KNF 257	F	30	140

SERIAL NO.	SEX	C-R (cm)	EST. AGE (Days)
KNF 258	F	11	84
KNF 259	M	90	270
KNF 260	M	82	245
KNF 261	F	29	136
KNF 262	F	59	208
KNF 263	F	38	175
KNF 264	M	25	122
KNF 265	M	58	207
KNF 266	M	18	108
KNF 267	M	15	102
KNF 268	M	37	170
KNF 269	F	19	110
KNF 270	M	24	120
KNF 271	F	39	172
KNF 272	M	45	185
KNF 273	M	32	150
KNF 274	F	65	220
KNF 275	M	44	184
KNF 276	F	36	165
KNF 277	M	35	158
KNF 278	F	30	140
KNF 279	M	35	158
KNF 280	F	92	285
KNF 281	M	52	202
KNF 282	F	42	180
KNF 283	F	40	176
KNF 284	F	27	130

APPENDIX III

ECONOMIC LOSSES AS A RESULT OF THE SLAUGHREING OF PREGNANT CAMELS AT KANO ABATTOIR

Assumption(s):

In assessing the losses and waste from the slaughtering of a pregnant camel, it is assumed that each fetus would have developed into a calf. However, to estimate the number of calves that would have been born and reached culling age, it is essential to subtract the expected mortalities from the total number of fetuses destroyed. This difference would be attributable to the slaughtering of pregnant camels and thereby to the inadequacy of veterinary inspection at the level of the slaughterhouse, (ECA, 1988).

1. Average number of camels slaughtered per year at Kano = 18,000.
2. Average number of female camels slaughtered in one year = 9,000.
3. Pregnancy wastage in 50% of 9,000 = 4,500.
4. Expected mortalities (40%) of 4,500 = 1,800.
5. Total number of calves that would have been born and attained culling age = 2,700.
6. Sex ratio (M50:F50) in 2700 = 1350 male and 1350 females.
7. Each female calf is expected in 10 years to have at least 2 viable offsprings (both valued at ₦1,500.00).
8. Each of the adult male (1350) and adult females (1350) at ten years is valued at ₦1,500.00 per camel.
9. Total value of adult males = ₦1,500 x 1,350 = 2,025,000.
   Total value of adult females = ₦1,500 x 1,350 = 2,025,000.
   Total value of offsprings from 1,350 female camels at ₦1,500 for the 2 offsprings from each camel = ₦1500 x 1350 = 2,025,000.

Total = ₦6,075,000.00

10. Economic loss over a ten year period from the slaughter of 4,500 pregnant camels at the Kano abattoir in a single year is estimated at ₦6,075,000.00 (Six million, seventy five thousand naira).

APPENDIX IV

BACTERIA ISOLATED FROM THE UTERINE HORNS OF CAMELS

Case No.	Bacteria isolated
KN 05	Staphylococcus aureus
KN 10	Staphylococcus aureus
KN 13	Staphylococcus aureus
KN 21	Escherichia coli
KN 40	Staphylococcus aureus

There was no growth from the rest (45 uterine swabs) after 48 hours incubation.