REPRODUCTIVE PATHOPHYSIOLOGY OF PREPUBERTAL BUFFALO HEIFERS INOCULATED WITH Pasteurella multocida TYPE B:2 AND ITS IMMUNOGENS (LPS AND OMP)

HAYDER HAMZAH IBRAHIM

FPV 2016 1

REPRODUCTIVE PATHOPHYSIOLOGY OF PREPUBERTAL BUFFALO HEIFERS INOCULATED WITH *Pasteurella multocida* TYPE B:2 AND ITS IMMUNOGENS (LPS AND OMP)

By

HAYDER HAMZAH IBRAHIM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

August 2016

DEDICATION

This thesis is dedicated to:

The Spirit of my first wife

My mother, my second wife, my sons and daughters, who are the sources of support, happiness, love and inspiration.

My brother, who has supported me throughout my academic career.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Doctor of Philosophy

REPRODUCTIVE PATHOPHYSIOLOGY OF PREPUBERTAL BUFFALO HEIFERS INOCULATED WITH *Pasteurella multocida* TYPE B:2 AND ITS IMMUNOGENS (LPS AND OMP)

By

HAYDER HAMZAH IBRAHIM

August 2016

Chairman : Associate Professor Faez Firdaus Jesse Abdullah, PhD
Faculty : Veterinary Medicine

Haemorrhagic Septicaemia (HS) is an acute, highly fatal, septicaemic disease of bovines occurring in most tropical regions of Asia and Africa. Among bovines, buffaloes have been reported to be more susceptible than cattle following natural infection. This study was conducted in pre-pubertal female buffaloes experimentally infected by *Pasteurella multocida* type B:2 and its immunogens with the objectives of determining the changes in gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), progesterone, estrogen, interleukin-1β (IL-1β), interleukin 6 (IL-6) and tumour necrosis factor alpha (TNF-α) concentrations as well as pathological changes in the reproductive organs, mammary gland, supramammary lymph nodes and pituitary gland. Twenty-one clinically healthy pre-pubertal female buffalo calves of approximately eight months of age were selected for this study. The 21 buffalo calves were randomly divided into seven groups of three calves each. The seven treatment groups consisting of group 1 (three buffaloes) inoculated orally with sterile phosphate buffered saline (PBS) pH 7 (negative control group), group 2 (three buffaloes) inoculated with 10^{12} colony forming units (cfu) of *P. multocida* type B:2, orally, and group 3 (three buffaloes) inoculated with 10^{12} cfu of *P. multocida* B:2, subcutaneously. Buffaloes of group 4 (three buffaloes) and group 5 (three buffaloes) were inoculated with LPS extracted from *P. multocida B:2* orally and intravenously, respectively . Groups 6 and 7 were inoculated with OMP extracted from *P. multocida* B:2, orally and intravenously, respectively. After inoculation, all the calves were monitored at 2 hour intervals for the clinical signs of HS for the first 12 hours and twice daily thereafter until the end of the experiment at day 21. At the end of the study surviving buffaloes were euthanised by exsanguination before post-mortem examination was carried out where reproductive organs (ovary, oviduct, uterine horn, uterine body, vagina, cervix), supramammary lymph nodes, mammary glands and pituitary glands were harvested for isolation and identification of *P. multocida* B:2 and histopathogical examination. The blood samples were collected for determination of concentrations of proinflammatory cytokines (IL1-β, IL-6 and TNF-α) and GnRH, LH, FSH, progesterone and estrogen. Buffaloes of groups 3 and 7 showed typical HS clinical signs and survived for the 12

hours and 7**2** hours respectively, while all buffaloes of groups 2, 4, 5 and 6 survived throughout the 21-day experiment and showed only mild clinical response of HS. Groups inoculated with *Pasteurella multocida* B:2 and its immunogens showed significant decrease ($p<0.05$) in the concentrations of GnRH, FSH and LH, progesterone and estrogen hormones compared to the control group and it was observed that subcutaneous routes of inoculation with *Pasteurella multocida* B:2 and its OMP groups 3 and 7 respectively led to a significantly low levels of production of these hormones in buffalo calves. IL-1β, IL-6 and TNF-α concentrations showed significant ($p<0.05$) increase post inoculation with *Pasteurella multocida* B:2 and its immunogens compared with control group and it was observed that subcutaneous routes of inoculation with *Pasteurella multocida* B:2 and its OMP group 3 and 7 respectively led to a significantly high level of cytokine production in buffalo calves. Microscopic examination showed significant congestion, infiltration of inflammatory cells, degeneration and necrosis in the reproductive organs, pituitary gland, supramammary lymph nodes and mammary gland and buffaloes of groups 3 and 7 showed significant changes compared with groups 2, 4, 5 and 6. Successful isolation and PCR confirmation of *P. multocida* B:2 was achieved from different parts of the reproductive system, including ovary, oviduct, uterine horn, uterine body and vagina as well as mammary glands and supramammary lymph nodes of the buffaloes inoculated subcutaneously with *P. multocida* B:2. Therefore, it can be concluded that *P. multocida* and its immunogens (LPS and OMP), had detrimental negative effects on GnRH, FSH, LH concentrations as well as oestrogen and progesterone concentration in all treated groups. Apart from these, cytokine concentrations showed significant increase in calves following inoculation with *P. multocida* type B:2 and its immunogens (LPS and OMP). The gross and cellular changes were of typical HS lesions following subcutaneous inoculation while the oral and intravenously inoculated group showed less cellular changes; therefore, this work provides strong evidence of the involvement of the female reproductive system of buffaloes during the pathogenesis of the disease and shows that route of inoculation strongly affects the localization of the bacterium in the reproductive system.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PATOFISIOLOGI PEMBIAKAN KERBAU BETINA PRA-PUBERTI YANG DISUNTIK DENGAN *Pasteurella multocida* TYPE B:2 DAN IMUNOGENNYA (LPS DAN OMP)

Oleh

HAYDER HAMZAH IBRAHIM

Ogos 2016

Pengerusi : Profesor Madya Faez Firdaus Jesse Abdullah, PhD
Fakulti : Perubatan Veterinar

Septisemia berdarah (HS) ialah penyakit septisemia akut yang membawa maut, di kalangan bovin di kebanyakan kawasan tropika Asia dan Afrika. Di kalangan spesis bovin, kerbau telah dilaporkan sebagai lebih mudah dijangkiti berbanding dengan lembu melalui jangkitan semulajadi. Kajian ini telah dijalankan ke atas kerbau betina pra-puberti yang dijangkiti secara ujikaji oleh *Pasteurella multocida* jenis B:2 dan imunogennya dengan tujuan menentukan perubahan di dalam hormon melepaskan-gonadotropin (GnRH), hormon merangsang folikel (FSH), hormon peluteinan (LH), progesteron, estrogen, interleukin-1β (IL-1β), interleukin 6 (IL-6) dan kepekatan faktor nekrosis tumor alfa (TNF-α) serta perubahan patologi pada organ-organ pembiakan, kelenjar mamari, nodus limfa supramamari dan kelenjar pituitari. Dua puluh satu ekor anak kerbau betina pra-puberti yang sihat dari segi klinikal dalam anggaran umur lapan bulan telah dipilih untuk kajian ini. Anak-anak kerbau tersebut dibahagikan secara rawak kepada tujuh kumpulan yang mengandungi tiga anak kerbau setiap satu. Tujuh kumpulan rawatan itu yang terdiri daripada kumpulan 1 (tiga kerbau) disuntik secara mulut dengan salina steril bertimbal fosfat (PBS) pH 7 (kumpulan kawalan negatif), kumpulan 2 (tiga kerbau) disuntik dengan 10^{12} unit membentuk koloni (cfu) *P. multocida* jenis B:2, secara mulut, dan kumpulan 3 (tiga kerbau) disuntik dengan 10^{12} cfu *P. multocida* B:2, secara subkutis. Kerbau kumpulan 4 (tiga kerbau) dan kumpulan 5 (tiga kerbau) telah disuntik dengan LPS yang diekstrak daripada *P. multocida B:2* secara mulut dan intravena, masing-masing. Kumpulan-kumpulan 6 dan 7 telah disuntik dengan OMP yang diekstrak daripada *P. multocida* B:2, secara mulut dan intravena masing-masing. Selepas inokulasi, semua anak kerbau dipantau setiap 2 jam untuk tanda-tanda klinikal HS bagi 12 jam pertama dan dua kali sehari selepas itu sehingga akhir eksperimen pada hari ke-21. Pada akhir kajian, kerbau yang masih hidup dieutanasiakan secara penyembelihan sebelum pemeriksaan post-mortem dijalankan pada organ-organ pembiakan (ovari, oviduct, tanduk rahim, badan rahim, faraj, pangkal rahim), kelenjar limfa supramammari, kelenjar mamari dan kelenjar pituitari diambil untuk pengasingan dan pengenalpastian *P. multocida* B:2 serta pemeriksaan histopatologi. Sampel darah telah diambil untuk menentukan kepekatan

sitokin pro-inflamasi (IL1-β, IL-6 dan TNF-α) dan GnRH, LH, FSH, progesteron serta estrogen. Kerbau kumpulan 3 dan 7 menunjukkan tanda-tanda klinikal HS biasa dan masih hidup selepas 12 jam dan 7**2** jam masing-masing, manakala semua kerbau kumpulan 2, 4, 5 dan 6 masih hidup sepanjang eksperimen 21 hari itu dan menunjukkan hanya respons klinikal HS yang ringan. Kumpulan disuntik dengan *P. multocida* B:2 dan imunogennya menunjukkan penurunan yang signifikan ($p<0.05$) di dalam kepekatan GnRH, FSH dan LH, hormon-hormon progesteron dan estrogen berbanding dengan kumpulan kawalan dan diperhatikan bahawa laluan inokulasi subkutis dengan *P. multocida* B:2 dan kumpulan-kumpulan OMPnya 3 dan 7 masing-masing membawa kepada pengeluaran rendah hormon-hormon ini yang signifikan di kalangan anak kerbau. Kepekatan Interleukin 1 beta (IL-1β), IL-6 dan TNF-α menunjukkan peningkatan signifikan ($p<0.05$) pasca inokulasi dengan *Pasteurella multocida* B:2 dan imunogennya dibandingkan dengan kumpulan kawalan dan diperhatikan bahawa laluan inokulasi subkutis dengan *P. multocida* B:2 dan kumpulan OMPnya 3 dan 7 masing-masing membawa kepada tahap pengeluaran sitokin tinggi yang signifikan di kalangan anak kerbau. Pemerhatian melalui mikroskop menunjukkan konjesi yang signifikan, penyusupan sel-sel inflamasi, degenerasi dan nekrosis dalam organ-organ pembiakan, kelenjar pituitari, kelenjar limfa supramamari dan kelenjar mamari kerbau kumpulan 3 dan 7 dan menunjukkan perubahan signifikan berbanding dengan kumpulan 2,4,5 dan 6. Pengasingan yang dan pengesahan PCR. *Pastuerella multocida* B:2 berjaya dicapai dari bahagian-bahagian yang berbeza daripada sistem pembiakan, termasuk ovari, oviduct, tanduk rahim, badan rahim dan faraj serta kelenjar mamari dan nodus limfa supramamari kerbau yang disuntik secara subkutis dengan *P. multocida* 2. Oleh itu, boleh disimpulkan bahawa *P. multocida* jenis B:2 dan imunogennya (LPS dan OMP), mempunyai kesan negatif yang menjejaskan ke atas kepekatan GnRH, FSH, LH serta kepekatan estrogen dan progesteron di dalam semua kumpulan yang dirawat. Selain daripada itu, kepekatan sitokin menunjukkan peningkatan yang signifikan di kalangan anak kerbau berikutan inokulasi dengan *P. multocida* jenis B:2 dan imunogennya (LPS dan OMP). Perubahan kasar dan selular adalah tipikal sebagaimana lesi HS berikutan inokulasi subkutis manakala kumpulan disuntik secara mulut dan intravena menunjukkan kurang perubahan di peringkat sel; oleh yang demikian, kajian ini membuktikan penglibatan sistem pembiakan betina di kalangan kerbau semasa patogenesis penyakit ini dan menunjukkan bahawa laluan inokulasi sangat mempengaruhi kependudukan bakteria tersebut di dalam sistem pembiakan.

ACKNOWLEDGEMENTS

I would give the praise to Allah almighty, the most beneficent the most merciful who keep inspiring me, guiding me and always looking after me and directing me toward the utmost goodness.

I also would like to express my sincere gratitude and appreciations to my supervisor Associate Professor, Dr. Faez Firdaus Jesse Abdullah for the priceless guidance, their continued supervision, advice, Comments, encouragement throughout and support throughout the research period.

Many thanks and gratitude also goes to the supervisory committee for their guidance, advice and supervision starting with Professor Abd Wahid Haron; Professor Abdul Rahman Bin Omar and Professor Mohd Zamri Saad.

I must sincerely thank Mr. Mohd Jefri Norsidin for helpful and friendliness. Many thanks also go to Mr. Yap Keng Chee, Mr. Ganesanmurthi Perumal, Mr. Mohd Jamil Samad and Mr. Saipuzaman Ali for their help and technical assistance during the experiment work in laboratory. I am heartily grateful to my best friends, Dr. Eric Lim Teik Chung and Dr. Ali Dhiaa Marza, for helpful and friendliness.

I would like to express my utmost appreciation and gratitude to Universiti Putra Malaysia, School of Graduate Studies and Ministry of Higher Education for giving me the opportunity to pursue this study. My thanks and appreciations also go to Taman Pertanian Universiti, UPM, Faculty of Veterinary Medicine, UPM, Department of Veterinary Clinical Studies and Department of Microbiology and Pathology, Faculty of Veterinary Medicine for providing me with all the facilities pertaining to my research. This study was funded by the Research University Grant Scheme (RUGS), Universiti Putra Malaysia.

I cannot find the words in vocabulary to express my respect, gratitude, love and affections for my all family members because of whom I am able to purse my higher studies.

Finally, I thanks to all, those who helped me directly or indirectly during the period of my entire study. I am immensely thankful to all who's ever blessings paved me the ways and means to achieve this goal successfully.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Faez Firdaus Jesse Abdullah, PhD
Associate Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Chairman).

Abdul Wahid Haron, PhD
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Member).

Abdul Rahman Bin Omar, PhD
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Member).

Mohammed Zamri Saad, PhD
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Member).

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No: Hayder Hamzah Ibrahim / GS 39681

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Associate Professor Dr. Faez Firdaus Jesse Abdullah

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Abdul Wahid Haron

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Abdul Rahman Bin Omar

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Mohammed Zamri Saad

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

APP	Acute-phase proteins
BA	Blood agar
BHIA	Brain heart infusion agar
Bp	Base pair
CFU	Colony forming unit
CG	Gonadotropin
CL	Corpus luteum
CSY	Casein/sucrose/yeast
DNA	Deoxyribonucleic acid
E.coli	Escherichia coli
EBL	Embryonic bovine lung
EDTA	Ethylene diamine tetraacetic acid
ELISA	Enzyme Linked Immunosorbent Assay
FMD	Foot and mouth disease
FSH	Follicle-stimulating hormone
GnRH	Gonadotropin-releasing hormone
Gp130	Glycoprotein 130
HRP	Horseradish Peroxidase
HPA	Hypothalamic Pituitary Adrenocortical
HS	Haemorrhagic Septicaemia
I.V	Intravenous
IACUC	Institutional Animal Care and Use Committee
ICSH	Interstitial Cell Stimulating Hormone
IL 6	Interleukin 6

IL-1Ra	IL-1 receptor antagonist
IL-1β	Interleukin-1β
IL-6Ra	IL-6 receptor antagonist
LH	luteinizing hormone
LOS	lipo-oligosaccharide
LPS	Lipopolysaccharide
MCA	MacConkey Agar
OD	Optical density (absorbance)
ODC	Ornithine Decarboxylase
OMP	Outer-membrane protein
P.M	*Pasteurella multocida*
PAF	platelet-activating factor
PBS	Phosphate- buffered saline
PCR	Polymerase chain reaction
PLD	Phospholipase D
RIA	Radioimmunoassay
RPM	Revolutions per minute
S.C	Subcutaneous
SDS- PAGE	Sodium Dodecyl Sulphate – Polyacrylamide Gel Electrophoresis
T	Time
Tbp	Transferrin binding protein
TLR	Toll-like receptor
TNF-α	Tumour necrosis factor alpha
UDP-glucose	Uridine diphosphate glucose
UPM	Universiti Putra Malaysia

CHAPTER 1

INTRODUCTION

Haemorrhagic Septicaemia (HS) is a disease that greatly affects the buffaloes and cattle industry in Malaysian. The negative effect of this disease is due to its ability to spread fast (morbidity). It is also characterized by high mortality rates within the affected herds, with the mortality rate resembling that of an epidemic occurring in a non-endemic area resulting in very high loss that could cut across all age groups (FAO, 1994). Haemorrhagic Septicaemia has some other impacts which are indirect and these could include a decrease in meat and milk production because of physiological alterations in the infected animals (FAO, 1979) besides the need for treatment and vaccination of the animal which also incurs some expenses. The disease spreads rapidly within the affected herds, as the presence of carrier animals is a source of infection which eventually can lead to outbreaks (FAO, 1991; OIE, 2004).

Haemorrhagic Septicaemia, which is a bacterial disease, results in high fatality rates and especially among cattle and water buffaloes. In vulnerable animals, the progress of the disease is frequently rapid, from dullness and fever to death in the space of mere hours. Such rapid development of the disease means that few infected animals can be treated in time and be saved. Subclinical carriers can be responsible for spreading the disease among the herds (Zamri-Saad and Abubakar, 2011).

Haemorrhagic Septicaemia is the results of infection by *Pasteurella multocida subsp. multocida*, a Gram-negative coccobacillus in the family Pasteurellaceae. *P. multocida* is responsible for many diseases in animals, with two of its serotypes characteristically causing HS. Cattle and water buffaloes are the animals most affected by HS epidemics (Horadagoda et al., 2001). Cattle and water buffaloes are also the main reservoir hosts. Haemorrhagic Septicaemia is a significant disease affecting cattle and water buffaloes in Asia, Africa and the Middle East, with Southeast Asia recording the highest incidence. In Asia, HS is caused by the B:2 serotype, while it has also been isolated in the south of Europe, the Middle East, and in some African countries (Brown, 2008). On the other hand, Africa is the only region to have reported the E: 2 serotype. There appears to have been a recent reduction in the incidence of type E strains in southern Africa, while the prevalence of serotype B has increased. It seems that both the E: 2 and the B:2 serotype of *P. multocida* have been found to be absent among domesticated animals in America, Australia and New Zealand.

Haemorrhagic Septicaemia in Malaysia is generally controlled by the use of whole cell killed vaccine and the stressful condition is during the rainy season, when most outbreaks occurr (Jesse, 2011). The disease is an acute septicaemic condition with high fever, depression, swollen and haemorrhagic lymph nodes, diarrhea, and followed by sudden death. The morbidity rate varies considerably, but the mortality is high. (Carter, 1982). It is widely acknowledged that HS infects the respiratory and digestive tracts of host animals (Zamri-Saad and Abubakar, 2011), but it has not been previously reported

how the reproductive system is involved in the pathogenesis of HS and there are still many gray areas in the knowledge of HS (Carrigan et al., 1991). This study design presents the detailed detection and histopathological variances of the reproductive system, mammary glands, supramammary lymph node and pituitary glands of prepubertal female buffaloes experimentally infected with *P. multocida* B:2 and its immunogens.

Pasteurella multocida infection pathogenesis is a complex host specific factor and specific bacterial virulence factor interaction (Boyce & Adler, 2006). Various virulence factors are identified including the following surface adhesions, capsule, iron regulated, iron acquisition proteins, and lipopolysaccharide (Harper et al., 2006). Lipopolysaccharide (LPS) is one of the important virulence factors (Harper et al., 2011). It is the principal antigen for strain identification and is an important constituent of the outer membrane, which is very important for Gram negative bacteria cell survival (Raetz & Whitfield, 2002; Peng et al., 2005; Moffatt et al., 2010). During host immune response, LPS has a dominant role (Horadagoda et al., 2001; Jesse et al., 2013abc). The direct role played by the LPS in the disease processes by interacting directly with an innate host immune defense, which leads to host immune cells activation, including the release of acute phase proteins (Raetz & Whitfield, 2002; Jesse et al., 2013ac). LPS basically consists of 3 parts include O-polysaccharide, core oligosaccharide, and lipid A (Raetz & Whitfield, 2002). *P. multocida* LPS has no O-polysaccharide, thus it is referred as rough LPS (Rimler, 1990).

To the best knowledge of this researcher, no work has been done on the change of reproductive hormone and cytokine (IL1β, IL6 and TNFα) concentration of pre-pubertal female buffalo infected with *Pasteurella multocida* and its immunogens (LPS &OMP). Nevertheless, there is no report on the pathological changes in the reproductive system and pituitary gland of pre-pubertal female buffalo inoculated with *Pasteurella multocida* and its immunogens (LPS &OMP), This study was designed to determine the changes in Gonadotropin-releasing hormone (GnRH), Follicle-stimulating hormone (FSH), luteinizing hormone (LH) progesterone, estrogen, interleukin-1β, and interleukin 6 and Tumour necrosis factor alpha (TNF - α) concentrations as well as pathological changes in the reproductive organs, mammary gland, supramammary lymph node and pituitary gland of pre-pubertal female buffaloes experimentally infected by *Pasteurella multocida* B:2.

Problem statement

1. Gray areas exist in the knowledge and information about reproductive pathophysiology modifications in buffaloes due to *Pasteurella multocida* and its immunogens (LPS and OMP) infection.
2. Haemorrhagic septicemia has an insidious effect on reproduction which eventually affects the productivity of the buffaloes. The probable reasons for the sexual maturation at puberty seems to be an increase in the production of pituitary hormones culminating in bigger ovary size and greater activity and the hypothalamo-pituitary axis maturation resulting in secretion of gonadotrophins (Hunter, 1980). Studies have reported on Haemorrhagic Septicemia lesions in

the reproductive organs which influence the reproductive efficiency in prepubertal female buffaloes (Annas, et al., 2014b).

Hypothes of the study:

Pasteurella multocida type (B:2) and its immunogens (LPS and OMP) has the ability to induce lesions in the reproductive tract, concentrations of reproductive hormone and concentrations of cytokine (IL-1β, IL-6 and TNF α) in prepubertal female buffaloes.

Thus, the objectives of the current study are:

1. To measure the level of gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH) , estrogen and progesterone in prepubertal female buffaloes after inoculation of *P. multocida* type B:2 and its immunogens (LPS and OMP).
2. To study the histopathological changes of the reproductive organs, mammary gland , supramammary lymph nodes and pituitary gland in prepubertal female buffaloes after inoculation of *P. multocida* type B:2 and its immunogens (LPS and OMP).
3. To measure the concentration of proinflammatory cytokines IL-1β, IL-6 and TNF -α in prepubertal female buffaloes after inoculation of *P. multocida* type B:2 and its immunogens (LPS and OMP).
4. To identify the *P. multocida* in the reproductive organs and pituitary gland in pre-pubertal female buffaloes by using PCR.

REFERENCES

Abdullah, F. F. J., Adamu, L., Osman, A. Y., Haron, A. W., Saharee, A. A., Abdullah, R..(2013a). Biochemical and hematological alterations in mice inoculated with outer membrane protein, lipopolysaccharides and whole cells of Pasteurella multocida type B: 2. American Journal of Animal and Veterinary Sciences, 8(3), 152-163.

Abdullah, F. F. J., Adamu, L., Osman, A. Y., Saad, M. Z., Zakaria, Z., Abdullah, R., et al. (2013b). Acute Phase Protein Profile and Clinico-Pathological Changes in Mice Associated with the Infection of Pasteurella multocida Type B and the Bacterial Lipopolysaccharide and Outer Membrane Protein Immunogens. Journal of Animal and Veterinary Advances, 12:2, 186-193.

Abubakar M, Zamri-Saad M, Jasni S (2012). Ultrastructural changes and bacterial localization in buffalo calves following oral exposure to *Pasteurella multocida* B: 2. Pakistan Veterinary Journal 33:1,101–106.

Abubakar, M. S., and Zamri-Saad, M. (2011). Clinico-pathological changes in buffalo calves following oral exposure to *Pasteurella multocida* B: 2. Basic and Applied Pathology, 4:4, 130-135.

Adelman, J.P., Mason, A.J., Hayflick, J.S., Seeburg, P.H. (1986). Isolation of the gene and hypothalamic DNA for the common precursor of gonadotropin-releasing hormone and prolactin release inhibiting factor in human and rat. Proceedings of the National Academy of Sciences of the United States of America; 83: 179–183.

Affandi, A.S., Abdullah, J.F.F., Saharee, A.A., and Sabri, J. (2012). Clinical response and pathological changes associated with *Pasteurella multocida* type B:2 infection through oral route inoculation in mice. Proceedings of the 7th Seminar of Veterinary Sciences, Feb. 2-Mar. 2, University Putra Malaysia.

Ahima, R.S., Harlan, R.E. (1992). Glucocorticoid receptors in LHRH neurons. Neuroendocrinology; 56: 845–850.

Ahmed, S. A., Karpuzoglu, E. and Khan, D. (2010). Effects of sex steroids on innate and adaptive immunity, in Sex Hormones and Immunity to Infection, S. L. Klein and C. W. Roberts, Eds., pp. 19–51, Springer, Berlin, Germany.

Ahmed, W. M., Nada, A. R., and Shalaby, S. T. A. (1993). Uterine Humoral and Cellular Immune Response in Some Cases of Genital Disorders in Buffaloes. Reproduction in Domestic Animals, 28:4, 298-301.

Aishatu, O. M. (2015). Reproductive pathophysiological changes in non-pregnant Boer does inoculated with *Corynebacterium pseudotuberculosis* via intradermal, intranasal and oral routes, Thesis is submitted to the School Of Graduate Studies, Universiti Putra Malaysia.

Aitken, W.A. (1940). So-called hemorrhagic septicaemia. Journal of American Veterinary Medicine Associated, 96: 300–304.

Ali, O. S., Adamu, L., Jesse, F. F. A., Ilyasu, Y., Abba, Y., Hamzah, H., et al. (2014). Alteration in interleukin-1β and interleukin-6 in mice inoculated through the oral route using graded doses of *Pasteurella multocida* type B:2 and its lipopolysaccharide. American Journal of Animal and Veterinary Sciences, 9:4, 177-184.

Anderson ,W. J., Forrest, D .W., Schulze, A. L., Kraemer, D .C., Bowen, M .J. and Harms ,P. G. (1985). Ovarian inhibition of pulsatile luteinizing hormone secretion in prepubertal Holstein heifers. Domestic Animal Endocrinology, 2: 85-91.

Angele, M.K., Schwacha, M.G., Ayala, A. and Chaudry, I.H. (2000). Effect of gender and sex hormones on immune responses following shock. Shock, 14: 81-248.

Annas, S., Zamri-Saad, M., Abubakar, M., Jesse, F., and Zunita, Z. (2014a). Distribution of Pasteurella multocida B: 2 in the respiratory, gastrointestinal and urinary tracts of buffaloes following experimental subcutaneous inoculation. Journal of Veterinary Science and Technology, 5:3.

Annas, S., Zamri-Saad, M., Jesse, F. F., and Zunita, Z. (2014b). New sites of localization of Pasteurella multocida B:2 in buffalo surviving experimental haemorrhagic septicaemia. BMC Veterinary Research, 10:1, 88.

Ashihara, M., Suzuki, M., Kubokawa, K., Yoshiura, Y., Kobayashi M, Urano A, Aida K. (1995).Two differing precursor genes for the salmon type gonadotropin-releasing hormone exist in salmonids. Journal Molecular Endocrinol; 15: 1-9.

Ataei, S., Burchmore, R., Hodgson, J.C., Finucane,A., Parton, R. and Coote, J.G., (2009). Identification of immunogenic proteins associated with protection against haemorrhagic septicaemia after vaccination of calves with a live-attenuated aroa derivative of Pasteurella multocida B:2. Research Veterinary Sciences, 87: 207-210

Azad, N., Emanuele, N.V., Halloran, M.M., Tentler, J., Kelly, M.R. (1991). Presence of LHRH messenger RNA in rat spleen lymphocytes. Endocrinology, 128: 1679–1681.

Azad, N., Lapaglia, N., Abel K., Jurgens, K.A.J., Kirsteins, L., Emanuele, N.V., Kelley, M.R., Lawrence, A.M., Mohagheghpour, N. (1993). Immunoactivation enhances the concentration of luteinizing hormonereleasing hormone peptide and its gene expression in human peripheral T-lymphocytes. Endocrinology; 133: 215–223.

Azawi, O. I., Omran, S. N., and Hadad, J. J. (2007). Clinical, Bacteriological, and Histopathological Study of Toxic Puerperal Metritis in Iraqi Buffalo. Journal of Dairy Science, 90:10, 4654-4660.

Azawi, O. I., Omran, S. N., and Hadad, J. J. (2008). A Study of Endometritis Causing Repeat Breeding of Cycling Iraqi Buffalo Cows. Reproduction in Domestic Animals, 43:6, 735-743.

Azawi, O.I. (2008). Review: Postpartum uterine infection in cattle. Animal Reproduction Sciences, 105: 187-208.

Azawi, OI. (2013) .Pathogenesis of postpartum metritis in buffaloes: a review Buffalo Bull, 32:1.

Bain, R.V.S., DE Alwis, M.C.L., Carter, G.R. & Gupta, B.K. (1982). Haemorrhagic Septicaemia. FAO Animal Production and Health Paper, 33. FAO, Rome, Italy.

Balasch, J. (2003).Sex steroids and bone: current perspectives. Human reproduction update; 9: 207-22.

Balen, A.H., Braat, D.D.M., West, C., Patel, A., Jacobs, H.S. (1994).Cumulative conception and live birth rates after the treatment of an ovulatory infertility. An analysis of the safety and efficacy of ovulation induction in 200 patients. Human Reproduction, 9:1563–1570.

Balthazart, J., Cornil, C.A., Charlier, T.D., Taziaux, M. and Ball, G.F. (2009). Estradiol, a key endocrine signal in the sexual differentiation and activation of reproductive behavior in quail Journal of Experimental Zoology Part A: Ecological Genetics and Physiology, 311: 5, 323-345.

Basagoudanavar, S. H., Singh, D. K. and Vao, (2006), Immunization with Outer Membrane Proteins of Pasteurella multocida (6: B) Provides Protection in Mice, Journal of Veterinary Medicine, 53: 524-530.

Bateman, A., Singh, A., Kral, T., Solomon, S. (1989).The immune hypothalamic-pituitary-adrenal axis. Endocrinol Rev,10:92-112

Benkirane, A. and De Alwis, M.C.L. (2002). Haemorrhagic septicaemia, its significance, prevention and control in Asia. Veterinary Medicine Czechoslovakia, 47: 234–240.

Blackall, P. J., Christensen, H., Beckenham, T., Blackall, L. L. and Bisgaard, M.(2005). Reclassification of *Pasteurella gallinarum*, [*Haemophilus*] *paragallinarum*, *Pasteurella avium* and *Pasteurella volantium* as *Avibacterium gallinarum* gen. nov. Comb. nov., *Avibacteriumaragallinarum* comb. nov., *Avibacterium volantium comb. nov*. International Journal of Systematic Bacteriology, 55: 353-362.

Bogerd, J., Zandbergen, T., Andersson, E., Goos, H. (1994) .Isolation, characterization and expression of cDNAs encoding the catfish-type and chicken-II type gonadotropin-releasing hormone precursors in the African catfish. European Journal Biochemistry; 222: 541–549.

Borel, I.M., Freire, S.M., Rivera, E., Canellada, A., Binaghi, R.A., Margini, R.A., (1999). Modulation of the immune response by progesterone-induced lymphocyte factor. Scandinavian Journal of Immunology, 49:244–250.

Boucher, D. J., Adler, B. and Boyce, J. D. (2005). The Pasteurella multocida nrfE gene is upregulated during infection and is essential for nitrite reduction but not for virulence. Journal of Bacteriology, 187:2278-2285.

Bouman, A., Heineman, M. J. & Faas, M. M. (2005). Sex hormones and the immune response in humans. Human Reproduction Update, 11:.4, pp. 411-423.

Boyce, J. D., and Adler, B. (2000). The capsule is a virulence determinant in the pathogenesis of Pasteurella multocida M1404 (B: 2). Infection and immunity, 68:6, 3463-3468.

Boyce, J. D., Chung, J. Y., and Adler, B. (2000). Pasteurella multocida capsule: composition, function and genetics. Journal of Biotechnology, 83:1–2, 153-160.

Boyce, J. D., Seemann, T., Adler, B., and Harper, M. (2012). Pathogenomics of Pasteurella multocida. In K. Aktories, J. H. C. Orth and B. Adler (Eds.), Pasteurella multocida, 361: pp. 23-38: Springer Berlin Heidelberg.

Boyce, J., Harper, M., Wilkie, I., and Adler, B. (2010). Pasteurella. In J. F. Prescott (Ed.), Pathogenesis of Bacterial Infections in Animals. IA, USA: Blackwell Publishing.

Boyce, J.D. & Alder, B. (2000). A capsular Pasteurella multocida B: 2 can stimulate protective immunity against Pasteurellosis. Infection and Immunity, 2001: 1943–1946.

Boyce, J.D. and Adler, B. (2006). How does Pasteurella multocida respond to the host environment? Current Opinion in Microbiology, 9: 117-122.

Brach, MA. , Lowenburg, B., Mantovani, L., Schwulera, U., Mertelsmann, R. (1990). Herrmann E Interleukin-6 (IL-6) is an intermediate in IL-I-induced proliferation of leukemic human megakaryo blasts, Blood, 76:1972-1979.

Brannstrom, M., Norman, R.J., Seamark, R.E., Robertson, S.A. (1994). Rat ovary produces cytokines during ovulation. Biology of Reproduction, 50:88-94.

British Pharmacopoeia Commission (1998) .Monograph for Menotrophin. The Stationary Office, London, 1: 855–857.

Brown, C. (2008). Hemorrhagic septicemia. In: Foreign animal diseases. Boca Raton, FL: United States Animal Health Association; p. 297-300.

Caligaris, L., Astrada, J. and Taleisnik, S. (1972). Influence of age on the release of luteinising hormone induced by oestrogen and progesterone in immature rats. Journal of Endocrinology, 55: 97.

Cameron, I.T., Irvine, G. and Norman, J.E. (1996).Menstruation. In Scientific essentials of reproductive Medicine, Eds SG Hiller, HC Kitchener and JP Neilson. London: W.B. Saunders.

Carigan, M.J., Dawkins, H.J.S., Cockram, E.A & Hansen, A.T. (1991). *P. multocida* septicaemia in fallow deer. Australian Veterinary Journal, 68:201–203.

Carlton, L. G., John, F. P., Glenn, S., and Charles, O. (2004) Pathogenesis of Bacterial Infections in Animals. Blackwell Publishing, 3rd ed.273-277.

Carne, H.R., and Onon, E.O. (1978). Action of *Corynebacterium ovis* exotoxin on the endothelial cells of blood vessels. Nature, 271:246-248.

Carrigan, M.J., Dawkins, H.J., Cockram, F.A., Hansen, A.T. (1991). *Pasteurella multocida* septicaemia in fallow deer (*Dama dama*). Australian Veterinary Journal; 68:6, 201-203.

Carter, G.R. & DE Alwis, M.C.L. (1989). Haemorrhagic septicaemia. In: Pasteurella and Pasteurellosis, Adlam C. & Rutter J.M., eds. Academic Press, London, UK, 131–160.

Carter, G.R. (1982). Whatever happened to hemorrhagic septicemia? Journal of the American Veterinary Medical Association; 180:10, 1176-7.

Carter, G.R., Wise, D. (2003). Essential of veterinary bacteriology and mycology 6thEd. Iowa State Press .pp 149-152.

Cattanach, B.M., Iddon, C.A., Charlton, H.M., Chiappa, S.A., Fink, G. (1977).Gonadotropin-releasing hormone deficiency in a mutant mouse with hypogonadism. Nature 269: 338–340.

Ceciliani, F., Ceron, J., Eckersall, P., and Sauerwein, H. (2012). Acute phase proteins in ruminants. Journal of Proteomics, 75:14, 4207-4231.

Chandran, U.R., Attardi, B., Friedman, R., Zheng, Z.W., Roberts, J.L., DeFranco, D.B. (1996).Glucocorticoid repression of the mouse gonadotropin-releasing hormone gene is mediated by promoter elements that are recognized by heteromeric complexes containing glucocorticoid receptor. Journal of Biological Chemistry; 271: 20412–20420.

Chiba, K., Kobayashi, H., and Wakabayashi, K. (1997). Isolation and partial characterization of LH, FSH and TSH from canine pituitary gland. Endocrine Journal, 44: 205-218.

Cho, B.N., Seong, J.Y., Cho, H., Kim, K. (1994). Progesterone stimulates GnRH gene expression in the hypothalamus of ovariectomized, estrogen treated adult rats. Brain Researches; 652: 177–180.

Choi, S.J., Lee, K.H., Park, H.S., Kim, S.K., Koh, C.M. & Park, J.Y. (2005). Differential expression, shedding, cytokine regulation and function of TNFR1 and TNFR2 in human fetal astrocytes. Yonsei Medical Journal, 46: 818–826.

Christensen, H., Kuhnert, P., Bisgaard, M., Mutters, R., Dziva, F., Olsen, J.E. (2005). Emended description of porcine [Pasteurella] aerogenes, [Pasteurella] mairii and [Actinobacillus] International Journal of Systematic and Evolutionary Microbiology; 55:209-23.

Chrousos, G.P. (1995).The hypothalamic-pituitary-adrenal axis and immune-mediated inflammation. New England Journal of Medicine, 332: 1351- 62.

Chung, J., Wilkie, I., Boyce, J., Townsend, K., Frost, A., Ghoddusi,M., Adler, B. (2001). Role of capsule in the pathogenesis of fowl cholera caused by Pasteurella multocida serogroup A. Infection and Immunity, 69:2487–2492.

Chung, J.Y., Wilkie, I., Boyce, J.D. & Adler, B. (2005) Vaccination against fowl cholera with a capsular Pasteurella multocida A: 1. Vaccine, 23: 2751–2755.

Colak, M., Shimizu, T., Matsunaga, N., Murayama,C.,. Nagashima,S., Kataoka, M., Kawashima, C., Matsui, M., Van Dorland, H.A. , Bruckmaier , R.M. and Miyamoto, A. (2011). Oestradiol enhances plasma growth hormone and insulin-like growth factor-I concentrations and increased the expression of their receptors mRNAs in the liver of ovariectomized cows. Reproduction Domestic Animal, 46:5, 854-861.

Collins, F.M., (1977). Mechanism of acquired resistance to Pasteurella multocida infection. A review. Cornell Veterinary Journal, 67: pp.103-138.

Confer, A.W., Suckow, M.A., Montelongo, M., Dabo, S.M., Miloscio, L.J., Gillespie, A.J., and Meredith, G.L. (2001). Intranasal vaccination of rabbits with Pasteurella multocida A: 3 outer membranes that express iron-regulated proteins. American Journal Veterinary Research , 62: 697-703.

Critchley, H.O., Kelly, R.W., Brenner, R.M., Baird, D.T. (2001). The endocrinology of menstruation—a role for the immune system. Clinical endocrinology (Oxford), 7:701–710.

Cundell, D.R., Gerard, N.P., Gerard, C., Idanpaan-Heikkila, I. & Tuomanen, E.I. (1995). Streptococcus pneumoniae anchor to activate human cells by the receptor for platelet-activating factor. Nature, 377: 435–438.

Curran, E.M., Berghaus, L.J., Vernetti, N.J., Saporita, A.J., Lubahn, D.B., Estes, D.M., (2001). Natural killer cells express estrogen receptor-alpha and estrogen receptor-beta and can respond to estrogen via a non-estrogen receptor alpha-mediated pathway. Cellular Immunology, 214:12–20.

Cutolo, M., and Wilder, R. L. (2000). Different roles for androgens and estrogens in the susceptibility to autoimmune rheumatic diseases. Rheumatic Disease Clinics of North America, 26:4, 825-839.

Dabo, S. M., Confer, A. W., and Murphy, G. L. (1997). Outer membrane proteins of bovine Pasteurella multocida serogroup A isolates. Veterinary Microbiology, 54:2, 167-183.

Davies, R.L., MacCorquodale, R., Baillie, S. and Caffery, B. (2003). Characterization and comparison of Pasteurella multocida strains associated with porcine pneumonia and atrophic rhinitis. Journal of Medical Microbiology, 52: 59-67.

Dawkins, H. J. S., Johnson, R. B., Spencer, T. L. & Adler, B. (1990). *Pasteurella multocida* infections in mice with reference to haemorrhagic septicaemia in cattle and buffalo. Immunology and Cell Biology, 68: 57–61.

De Alwis, M.C.L. (1981). Mortality among cattle and buffaloes in Sri Lanka due to Haemorrhagic septicaemia. Tropical Animal Health *and* Production, 13: 195-202.

De Alwis, M.C.L. (1982). The immune status of buffalo calves exposed to natural infection with haemorrhagic septicaemia. Tropical Animal Health *and* Production, 14: 29-*30*.

De Alwis, M.C.L. (1984). Haemorrhagic septicaemia in cattle and buffaloes. Scientific and Technical Review of the Office International des Epizooties, 3: 707–730.

De Alwis, M.C.L. (1990a). Haemorrhagic Septicaemia. ACIAR Monograph No. 57, p. 33.

De Alwis, M.C.L. (1990b). Haemorrhagic Septicaemia. ACIAR Monograph No. 57, p. 36.

De Alwis, M.C.L. (1990c). Haemorrhagic Septicaemia. ACIAR Monograph No. 57, p. 38.

De Alwis, M.C.L. (1992a). Pasteurellosis in production animals: a review. Pasteurellosis in production animals. ACIAR Publishing, Canberra, Australia, 11-22.

De Alwis, M. C. L. (1992b). Haemorrhagic septicaemia-A general review. British Veterinary Journal, 148:2, 99-112.

De Alwis, M.C.L. (1995). Haemorrhagic septicaemia (Pasteurella multocida serotype B: 2 and E: 2 infection) in cattle and buffaloes. In: Donachie W, Lainson F.A, Hodgson JC, Eds. Haemophilus, Actinobacillus and Pasteurella. London: Plenum Press, 9–24.

De Alwis, M. C.L. (1999). Haemorrhagic septicaemia. Canberra, Australia: Australian Centre for International Agricultural Research (ACIAR).

De Alwis, M.C.L. and Carter G. R. (1980). Preliminary field trials with a streptomycin dependent live vaccine against haemorrhagic septicaemia. Veterinary Research. 106, 435-437.

De Alwis, M.C.L., Jayasekera, M.U. and Balasunderam, P. (1975). Pneumonic pasteurellosis in buffalo calves associated with Pasteurella multocida serotype 6:B. Ceylon Veterinary Journal, 23: 58-60.

De Alwis, M.C.L., Vipulasiri, A.A. (1981). An epizootiological study of haemorrhagic septicaemia in Sri Lanka. Ceylon Veterinary Journal, 28:24–35.

De Alwis, M.C.L., Wijewardana, T.G. (2006). Proceedings of the Fourth International Workshop of Haemorrhagic septicaemia. Kandy, Sri Lanka., FAO/APHCA Publication No: 13.

De Alwis, M. C. L., Wijewardana, T., Gomis, A. U., and Vipulasiri, A. A. (1990). Persistence of the carrier status in haemorrhagic septicaemia (Pasteurella multocida serotype 6: B infection) in buffaloes. Tropical Animal Health and Production, 22:3, 185-194.

De Alwis, M.C.L., Wijewardana T., Sivaram A., Vipulasiri A.A. (1986). The carrier and antibody status of cattle and buffaloes exposed to haemorrhagic septicaemia: Investigations on survivors following natural outbreaks. Sri Lanka Veterinary Journal, 34, 33–42.

De Angelis, P.L. & Padgett-McCue, A.J. (2000), Identification and molecular cloning of a chondroitin synthase from Pasteurella multocida type F. The Journal of Biological Chemistry, 275: 24124–24129.

De Angelis, P.L. & White, C.L. (2004). Identification of a distinct, cryptic heparosan synthase from Pasteurella multocida types A, D, and F. Journal of Bacteriology, 186: 8529–8532.

De Angelis, P.L. (1996). Enzymological characterization of the *Pasteurella multocida* hyaluronic acid synthase. Biochemistry, 35: 9768–9771.

Dejarnette, and Specialist, (2010). Reproductive anatomy and physiology of cattle. www.selectsires.com .

Desjardins, C .and Hafs, H. D. (1968). Levels of pituitary FSH and LH in heifers from birth through puberty. Journal of Animal Science, 27: 472.

Devendra, C. and Burns, M. 1983. Goat production in the tropics. 2nd Edition, Commonwealth Agricultural Bureau.

Dinarello, C.A. (2009). Immunological and inflammatory functions of the interleukin-1 family. Annual Review of Immunology*;* 27:519-550.

Dinarello, C.A., Renfer, L., Wolff, S.M. (1977) .Human leucocytic pyrogen: purification and development of a radioimmunoassay Proceedings of the National Academy of Sciences of the United States of America, 74:4624-7.

Dionissopoulos, L., Steele, M.A., AlZahal, O., Plaizier, J.C. and et al., (2011). Sub-acute Ruminal Acidosis (SARA) in dairy cows leads to increases in ruminal Lipopolysaccharide (LPS), plasma LPS binding protein and correlates with the rumen epithelial interleukin-6 (IL-6) response. Canadian Journal of Animal Science, 91: 503-503.

Dorella, F.A., Pacheco, L.G.C., Oliveira, S.C., Miyoshi, A. and Azevedo, V. (2006). *Corynebacterium pseudotuberculosis*: Microbiology, biochemical properties, pathogenesis and molecular studies of virulence. Veterinary Research, 37: 201-218.

Dowling, A., Hodgson, J.C., Schock, A., Donachie, W., Eckersall, P.D., McKendrick, I.J., (2002). Experimental induction of pneumonic pasteurellosis in calves by intratracheal infection with Pasteurella multocida biotype A: 3. Research in Veterinary Science, 73:1, 37-44.

Dudley, D.J., Trautman, M.S., Araneo, B.A., Edwin, S.S., Mitchell, M.D. (1992). Decidual cell biosynthesis of interleukin-6: regulation by inflammatory cytokines. Journal Clinical Endocrinology & Metabolism; 74:884-889.

Dutta, T.K., Singh, V.P. and Kumar, A.A., (2001). Rapid and specific diagnosis of Haemorrhagic septicemia by using PCR assay, Indian Journal of Animal Health, 40:101– 107.

Dziva, F., Muhairwa, A.P., Bisgaard, M., Christensen, H. (2008). Diagnostic and typing options for investigating diseases associated with *Pasteurella multocida.* Veterinary Microbiology: 128:1-2,1-22.

Echternkamp, S. E. and Hansel, W. (1973). Concurrent changes in bovine plasma hormone levels prior to and during the first postpartum estrous cycle. Journal of Animal Science, 37: 1362-1370.

Eckersall, P.D. and Bell, R. (2010). Acute phase proteins: Biomarkers of infection and inflammation in veterinary medicine. Veterinary Journal, 185: 23-27. DOI: 10.1016/j.tvjl.2010.04.009.

Ehrhart-Bornstein, M., Bornstein, S.R., Scherbaum, W.A. (1996).Sympathoadrenal system and immune system in the regulation of adrenocortical function. European Journal of Endocrinology, 135: 19-26.

Eisenberg, S.P., Evans, R.J., Arend, W.P., Verderber, E., Brewer, M.T., Hannum, C.H. (1990). Primary structure and functional expression from complementary DNA of a human interleukin-1 receptor antagonist. Nature; 343:341-6.

El-Wishy, A. B. (2007). The postpartum buffalo: I. Endocrinological changes and uterine involution. Animal Reproduction Science, 97:3–4, 201-215.

Eriksen, L., Aalbaek, B., Leifsson, P.S., Basse, A., Christiansen, T., Eriksen, E., Rimler, R.B. (1999). Hemorrhagic septicemia in fallow deer (Dama dama) caused by Pasteurella multocida. Journal of Zoo and Wildlife Medicine, 30:2,285-92.

Erlandsson, M.C., Jonsson, C.A., Islander, U., Ohlsson, C., Carlsten, H., (2003). Oestrogen receptor specificity in oestrogen-mediated effects on B lymphopoiesis and immunoglobulin production in male mice. Immunology, 108: 346–351.

Erlandsson, M.C., Ohlsson, C., Gustafsson, J.A., Carlsten, H., (2001). Role of oestrogen receptors (a) and (b) in immune organ development and in oestrogen-mediated effects on thymus, Immunology, 103: 17–25.

Euzeby, JP. (2013). List of Prokaryotic names with Standing in Nomenclature - Genus Pasteurella.

Faccio, L., Aleksandro, S. Da S., Alexandre, A. T., Raqueli, T. F., Lucas, T. G, Maira , M. C., Camila, B. O., Manuela, B. S., Rafael, N. M., Nathieli, B. B., Marta, M.M.F., Silvia ,G. M. (2013). Serum levels of LH, FSH, estradiol and progesterone in female rats experimentally infected by Trypanosoma evansi; Experimental Parasitology, 135: 110–115.

Faez, F. A. J., Yusuf, A., Abdulnasir, T., Muhammad, A. S., Mohammed, K., Lawan, A. , Haron, A.W., Mohd, L. M., Eric, L.T.C., Muhammad, F. R., Nafisah , B. M., Saharee, A.A. (2016). Gonado-hypophyseal lesions and reproductive hormonal changes in *Brucella melitensis*-infected mice and its lipopolysaccharides (LPSs);Comparative Clinical Pathology, 25: 1, 31-36.

Faez. F.J.A., Adamu, L., Hazirah, N., Osman, A.Y., Mansor, R., Haron, A.W., Saad, M.Z., Omar, A.R. and Saharee, A.A. (2013). Clinical and reproductive pathological changes associated with *Brucella melitensis* and its lipopolysaccharides in female mice via oral inoculation, American Journal of Animal and Veterinary Sciences, 8:3, 104-111.

FAO (1979). Proceedings of the Third International Workshop on Haemorrhagic Septicaemia, FAO-APHCA (Animal Production and Health Commission for Asia and the Far East), Colombo, Sri Lanka.

FAO (1991). Proceedings of the Fourth International Workshop on Haemorrhagic Septicaemia, Kandy, Sri Lanka. FAO-APHCA Publication No. 13

FAO-WHO-OIE, (1994). Animal Health Yearbook, (1994).

Farnworth, P.G., (1995). Gonadotropin secretion revised – how many ways can FSH Leave a gonadotropin. Journal of Endocrinology, 145: 387–395.

Farooq, U., Saeed, Z., Khan, M.A., Ali, I. and Qamar, M.F. (2011) .Sero-surveillance of haemorrhagic septicaemia in buffaloes and cattle in Southern Punjab, Pakistan. Pakistan Veterinary Journal, 31:3, 254-256.

Fauser, BCJM. Van Heusden, A.M. (1997). Manipulation of human ovarian function: physiological concepts and clinical consequences. Endocrine Reviews, 18:71–106.

Faustman, D. & Davis, M. (2010). TNF receptor 2 pathway: drug target for autoimmune diseases. Nature Reviews Drug Discovery, 9: 482–493.

Fernandez de Henestrosa, A.R., Badiola, I., Saco, M., Perez de Rozas, A.M., Campoy, S. & Barbe, J. (1997) .Importance of the galE gene on the virulence of Pasteurella multocida. FEMS Microbiology Letters, 154: 311–316.

Fiers, W. (1991) .Tumor necrosis factor characterization at the molecular, cellular and in vivo level. FEMS Microbiology Letters, 285: 199–212.

Foldi, J., Kulcsár, M., Pecsi, A., Huyghe, B., de S.A, C., Lohuis, J. A. C. M., *et al.* (2006). Bacterial complications of postpartum uterine involution in cattle. Animal Reproduction Science, 96:3–4, 265-281.

Foster, D. L. and Ryan, K .D. (1981). Mechanisms governing transition into adulthood. Journal of Reproduction and Fertility (Supplement 30), 75-90.

Franson, J.C., Smith, B.L. (1988). Septicemic pasteurellosis in elk (Cervus elaphus) on the United States National Elk Refuge, Wyoming. Journal Wildlife Disease, 24:4,715-7.

Galdiero, M., Folgore, A., Nuzzo, I. & Galdiero, E. (2000). Neutrophil adhesion and transmigration through bovine endothelial cells in vitro by protein H and LPS of Pasteurella multocida. Immunobiology, 202: 226–238.

Ganfield, D.J., Rebers, P.A. & Heddleston, K.L. (1976). Immunogenic and toxic properties of a purified lipopolysaccharide-protein complex from Pasteurella multocida. Infection Immunology, 14: 990–999.

García-Gómez, J.M., Gomez, S.P., Pablo E-M., Elies, F.-G., Emilio S.-O. (2013). Sparse Manifold Clustering and Embedding to discriminate gene expression profiles of glioblastoma and meningioma tumors. Computers in Biology and Medicine, 43(11):1863–1869.

Genazzani, A.R., Stomati, M., Morittu, A., Bernardi, F., Monteleone, P., Casarosa, E., Gallo, R., Salvestroni, C. and Luisi, M. (2000).Progesterone, progestagens and the central nervous system .Human Reproduction : 15: 14-27.

Givens, M.D. and Marley, M.S.D. (2008). Pathogens that cause infertility of bulls or transmission via semen. Theriogenology, 70:3,504-507.

Glencross, R. G .and Pope, G. S. (1981). Concentrations of estradiol 17 ß and progesterone in the plasma of dairy heifers before and after cloprostenol-induced and natural luteolysis and during early pregnancy. Animal Reproduction Science, 4: 93-106.

Glencross, R. G. Esslemont, R.J., Bryant, M .J. and Pope, G S. (1981). Relationships between the incidence of pre-ovulatory behaviour and the concentrations of Oestradiol-17 ß and progesterone in bovine plasma. Applied Animal Ethology, 7: 141-148.

Glencross, R. G., Munro, I. B., Senior, B. E. and Pope, G. S. (1973). Concentrations of oestradiol-17 ß, esterone and progesterone in jugular venous plasma of cows during the oestrous cycle and in early pregnancy. Acta Endocrinologica (Copenhagen), 73: 374.

Goldman, E and Green, H (2008) Practical handbook of microbiology (2 ed.): CRC Press.

Gonzalez-Hernandez, J.A., Ehrhart-Bornstein, M., Spath-Schwalbe, E., Scherbaum, W.A., Bornstein, S.R. (1996). Human adrenal cells express tumor necrosis factor-alpha messenger ribonucleic acid: evidence for paracrine control of adrenal function. Journal of Clinical Endocrinology and Metabolism, 81: 807-13.266.

Gonzalez-Padilla, E., Wiltbank, J .N. and Niswender, G. D. (1975). Puberty in beef heifers. 1. The interrelationships between pituitary, hypothalamic and ovarian hormones. Journal of Animal Science 40: 1091-1104.

Graydon, R., DE, P., and Hamid, H. (1992). The Pathology of Experimental Heamorragic Septicaemia in Cattle and Buffalo. Pasteurellosis in Production Animals, 105.

Grell, M. (1995) .Tumor necrosis factor (TNF) receptors in cellular signaling of soluble and membrane-expressed TNF. Journal of Inflammation, 47: 8–17.

Greyling, J.P.C. (2000). Reproduction traits in the Boer goat doe. Small Ruminant Research, 36: 171-177.

Grimaldi, C.M., Cleary, J., Dagtas, A.S., Moussai, D., Diamond, B. (2002). Estrogen thresholds for B cell apoptosis and activation. The Journal of Clinical Investigation. 109:1625–1633.

Grossman, C. (1989). Possible underlying mechanisms of sexual dimorphism in the immune response, fact and hypothesis, Journal of Steroid Biochemistry, 34: 1–6, pp. 241–251.

Hair-Bejo, M., Salina, S., Hafiza, H. and Julaida, S. (2000). In vivo vaccination against infectious bursal disease in broiler chickens. Journal of Veterinary Malaysia, 12:63-69.

Hansen, L.M. & Hirsh, D.C. (1989). Serum resistance is correlated with encapsulation of avian strains of Pasteurella multocida. Veterinary Microbiology, 21: 177–184.

Harmon, B.G., Glisson, J.R., Latimer, K.S., Steffens, W.L. & Nunnally, J.C. (1991). Resistance of Pasteurella multocida A: 3, 4 to phagocytosis by turkey macrophages and heterophils. American Journal of Veterinary Research, 52: 1507–1511.

Harper, M., Boyce, J. D., and Adler, B. (2006). Pasteurella multocida pathogenesis: 125 years after Pasteur. FEMS Microbiology Letters, 265:1, 1-10.

Harper, M., Cox, A., Adler, B. and Boyce, J.D. (2011). *Pasteurella multocida* lipopolysaccharide: The long and the short of it. Veterinary Microbiology, 153: 109-115.

Harper, M., Cox, A.D., St Michael, F., Wilkie, I.W., Boyce, J.D. & Adler, B. (2004). A heptosyl transferase mutant of Pasteurella multocida produces a truncated lipopolysaccharide structure and is attenuated in virulence. Infection Immunology, 72: 3436–3443.

Hatfaludi, T., Al-Hasani, K., Boyce, J. D., and Adler, B. (2010). Outer membrane proteins of Pasteurella multocida. Veterinary Microbiology, 144:1–2, 1-17.

Hattori, M., Hachisu, T., Shimohigashi, Y., and Wakabayashi, K. (1988). Conformation of the β subunit of deglycosylated human chorionic gonadotropin in the interaction at receptor sites. Molecular and Cellular Endocrinology, 57: 17-23.

Hattori, M.A., Ozawa, K., and Wakabayashi, K. (1985). Sialic acid moiety is responsible for the charge heterogeneity and the biological potency of rat Lutropin. Biochemical and Biophysical Research Communications, 127:501-508.

Hattori, M.A., Sakamoto, K., and Wakabayashi, K. (1983). The presence of LH components having different ratios of bioactivity to immunoreactivity in the rat pituitary glands. Endocrinology Japon, 30: 289-296.

Heddleston, K.L., Watko, L.P. & Rebers, P.A. (1964). Dissociation of a fowl cholera strain of Pasteurella multocida. Avian Disease, 8: 649–657.

Henrique, O.C., Ney Penteado de, C.N., Lia, M.R., Ieda, M., Flavia, C., Leonardo da, S.(2014). Influence of estradiol administration on estrogen receptors of nasal mucosa: an experimental study on guinea pigs. Brazil Journal of Otorhinolaryngology, 80: 18-23.

Hiramune, T., and de Alwis, M. C. (1982). Haemorrhagic septicaemia carrier status of cattle and buffaloes in Sri Lanka. Tropical Animal Health and Production, 14:2, 91-92.

Hirsh, D.C., MacLanchlan,J., Walker, R.L. (2005). Veterinary Microbiology. 2nd Ed. Blackwell Publishing, pp.87-88.

Hodgson, J. C., Dagleish, M. P. , Gibbard, L. Bayne, C. W. ,Finlayson, J., Moon, M. & Nath, M. (2013). Seven strains of mice as potential models of bovine pasteurellosis following intranasal challenge with a bovine pneumonic strain of *Pasteurella multocida* A: 3; comparisons of disease and pathological outcomes. Research in Veterinary Science, 94: 634–640.

Hohmann, H.P., Remy, R., Brockhaus, M. & van Loon, A.P. (1989) .Two different cell types have different major receptors for human tumor necrosis factor (TNF alpha). Journal of Biological Chemistry, 264: 14927–14934.

Holmes, B., Pickett, M.J., Hollis, DG. (1999). Pasteurella. In: Murray PR, Baron EJ, Pfaller MA, Tenover FC, Yolken RH, editors. Manual of Clinical Microbiology. 7th ed. Washington DC: American Society for Microbiology; p. 632-7.

Holmes, H.T., Patton, N.M., Cheeke, P.R., (1983). The incidence of vaginal and nasal Pasteurella multocida in a commercial rabbitry. Journal Applied Rabbit Research, 6: 95–96.

Holmes, H.T., Patton, N.M., Cheeke, P.R., (1984). The occurrence of Pasteurella multocida in newborn and weanling rabbits. Journal Applied Rabbit Research. 7:17–20.

Honda, M., Yamamoto, S., Cheng, M., Yasukawa, K., Suzuki, H., Saito, T., (1992). Human soluble IL-6 receptor: its detection and enhanced release by HIV infection. Journal Immunology; 148:2175-80.

Hopkins, B.A., Huang, T.H.M. & Olson, L.D. (1998). Differentiating turkey postvaccination isolants of Pasteurella multocida using arbitrarily primed polymerase chain reaction. Avian Disease. 42: 265–274.

Horadagoda, N. U., De-Alwis, M. C. L., Wijewardana, T. G. , Belak, K. , Gomis, A. U. I. & Vilulasiri , A. A. (1991). Experimental haemorrhagic septicaemia in buffalo calves. In: Proceedings of the Fourth International Workshop on Haemorrhagic Septicaemia, Sri Lanka, pp. 11–15.

Horadagoda, N. U., Hodgson, J. C., Moonb, G. M., Wijewardana T. G. &. Eckersall, P. D, (2001). Role of endotoxin in the pathogenesis of haemorrhagic septicaemia in the buffalo, Microbial Pathogenesis, 30: 171–178.

Horadagoda, N., Hodgson, J., Moon, G., Wijewardana, T.G., and Eckersall, P.D. (2002). Development of a clinical syndrome resembling haemorrhagic septicaemia in the buffalo following intravenous inoculation of Pasteurella multocida serotype B: 2 endotoxin and the role of tumour necrosis factor-α. Research in Veterinary Science, 72:3, 194-200.

Horai, R., Saijo, S., Tanioka, H., Nakae, S., Sudo, K., Okahara, A. (2000). Development of chronic inflammatory arthropathy resembling rheumatoid arthritis in interleukin 1 receptor antagonist-deficient mice. Journal of Experimental Medicine; 191:313-20.

Hughes, D. T., and Sperandio, V. (2008).”Inter-kingdom signalling: communication between bacteria and their hosts,” *Nature Reviews Microbiology*, 6: 2, pp. 111–120.

Hunter, R. H. F. (1980). Physiology and technology of reproduction in female domestic animals. Academic Press, London, UK. 393 pp.

Hurst, S.M., Wilkinson, T.S., McLoughlin, R.M., Jones, S., Horiuchi, S., Yamamoto, N. (2001) .Il-6 and its soluble receptor orchestrate a temporal switch in the pattern

of leukocyte recruitment seen during acute inflammation. Immunity; 14: 705-14.

Isurugi, K., Fukutani, K., Takayasu, H., Wakabayashi, K. and Tamaoki, B. (1974). Age-related changes in serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels in normal men. Journal Clinical Endocrinology Metab. 39: 955-957.

Iwasaki, A., Medzhitov, R. (2010). Regulation of adaptive immunity by the innate immune system. Science; 327:291–5.

Jabbar, A.A. AL .Saaidi, AL.-Rodh, M.A., and Najum, A.A. (2012). Clinical, Serological, Hormonal, Bacteriological and Molecular detection of Brucellosis in Aborted cows and buffalo.

Jamal, H., Nazrul, M.H.M., Masyitah, N., Mahmood, A.A., and Salmal, I. (2013). Alternative animal model for Pasteurella multocida and Haemorrhagic septicemia. Biomedical Research, 24: 263-266.

Janda, W.M., Mutters, R. (2010). Pasteurella, Mannheimia, Actinobacillus, Eikenella, Kingella, Capnocytophaga, and other miscellaneous gram-negative rods. Topley and Wilson's Microbiology and Microbial Infections. p. 1649-91.

Jesse, F. F. A., Abdinasir, Y. O., Lawan, A., Zakaria, Z., Abdullah, R., Zamri, M. S., et al. (2013f). Haematological and biochemical alterations in calves following infection with Pasteurella multocida type B: 2, bacterial lipopolysaccharide and outer membrane protein (OMP) immunogens. Asian Journal of Animal and Veterinary Advances, 8:6, 806-813.

Jesse, F. F. A., Adamu, L., Tijjani, A., Mohammed, K., Abba, Y., Sadiq, M. A., et al. (2014a). Hormonal and histopathological alterations in pituitary glands and reproductive organs of male and female mice orally inoculated with Pasteurella multocida type B: 2 and its lipopolysaccharides. American Journal of Animal and Veterinary Sciences, 9: 200-212.

Jesse, F. F. A., Ali, O. S., Adamu, L., Abba, Y., Hamzah, H. B., Mohd-Azmi, M. L., et al. (2014b). Modifications in serum Amyloid A and Haptoglobin in mice following oral inoculation of graded doses of P. multocida type B: 2 and its lipopolysaccharide. Research opinions in animal and veterinary sciences, 4:11, 587-592.

Jesse, F. F. A., Khaleel, M. M., Adamu, L., Osman, A. Y., Haron, A. W., Saad, M. Z., et al. (2013d). Polymerase chain reaction detection of Pasteurella multocida type B: 2 in mice infected with contaminated river water. American Journal of Animal and Veterinary Sciences, 8:3, 146-151.

Jesse, F. F. A., Lawan, A., Abdinasir, Y. O., Zakaria, Z., Abdullah, R., Zamri, M. S., et al. (2013e). Clinico-pathological responses of calves associated with infection of Pasteurella multocida type B and the bacterial lipopolysaccharide and outer membrane protein immunogens. International Journal of Animal and Veterinary Advances, 55: 190-198.

Jesse, F. F., Affandi, S. A., Osman, A. Y., Adamu, L., Saad, M. Z., Haron, A. W., et al. (2013b). Clinico-pathological features in mice following oral exposure to *Pasteurella multocida* B: 2. IOSR Journal of Agriculture and Veterinary Science, 3:4, 35-39.

Jesse, F., Adamu, L., Abdinasir, Y., Zakaria, Z., and Abdullah, R. (2013a). Acute phase protein profile in calves following infection with whole cell, lipopolysaccharide and outer membrane protein extracted from Pasteurella multocida type B: 2. Asian Journal of Animal and Veterinary Advances, 8:4, 655-662.

Jesse, F.F.A, (2011) Clinopathologic changes associated with Pasteurella multocida B: 2 infection and its bacterial lipopolysaccharides and outer membrane protein in mice and calves. Thesis PhD-Universiti Putra Malaysia.

Jesse, F.F.A., Adamu, L., Abdinasir, Y.O., Saad, M.Z. and Zakaria, Z. (2013c). Acute phase protein profiles and clinico-pathological changes in mice associated with the infection of Pasteurella multocida type B and the bacterial lipopolysaccharide and outer membrane protein immunogens. Journal of Animal and Veterinary Advances, 12: 186-193.

Jesse, F.F.A., Y.O. Abdinasir, L. Adamu, M.Y. Syamil and A.R. Omar *et al*., (2013g). Polymerase Chain reaction detection of *pasteurella multocida* type B: 2 in Mice Following Oral Inoculation. Asian Journal Animal Veterinary Advances, 8: 493-501.

Jones T.O., Husseini S.N. (1982). Outbreak of Pasteurella multocida in fallow deer (Dama dama). Veterinary Research, 10:451–452.

Jones, S.A., Horiuchi, S., Topley, N., Yamamoto, N., Fuller, G.M. (2001). The soluble interleukin-6.receptor: mechanisms of production and implications in disease. The FASEB Journal, 1:43-58.

Kahn, C.M. and Line, S. (2005). The Merck Veterinary Manual. 9th ed. Merial, USA. Kaplanski, G., Marin, V., Montero-Julian, F., Mantovani, A., Farnarier, C. (2003). IL-6: a regulator of the transition from neutrophil to monocyte recruitment during inflammation. Trends Immunology, 24: 25-29.

Kalra, PS., Sahu, A., Kalra, SP. (1990). Interleukin-1 inhibits the ovarian steroid induced luteinizing hormone surge and release of hypothalamic luteinizing hormone-releasing hormone in rats. Endocrinology; 126: 2145-52.

Khaleel, M. M., Abdullah, F. F. J., Adamu, L., Abba, Y., Haron, A. W., Saad, M. Z., et al. (2014). Histopathological changes in mice infected with river water contaminated by Pasteurella multocida type B: 2. American Journal of Animal and Veterinary Sciences, 9:2, 71.

Khan, A., Saleemi, M.K., Khan, M.Z., Gul, S., TIrfan, M., Qamar, M.S. (2011). Haemorrhagic septicemia in buffalo (Bubalus bubalis) calves under sub-tropical conditions in Pakistan. Pakistan Journal of Zoology, 43:295–302.

Khin, M. N., Zamri-Saad, M. & Noordin, M. M. (2010). Pathological changes in the lungs of calves following intratracheal exposure to *Pasteurella multocida* B: 2. Pertanika Journal of Tropical Agricultural Science, 33:113–117.

Khuder, Z., Osman, A.Y., Jesse, F.F., Haron, A.W., Saharee, A.A., Sabri, J., Yusoff, R. and Abdullah, R. (2012).Sex hormone profiles and cellular changes of reproductive organs of mice experimentally infected with *C. pseudotuberculosis* and its exotoxin phospholipase D (PLD). IOSR Journal of Agriculture and Veterinary Science, 1:3, 24-29.

Klein, S. L. (2000). The effects of hormones on sex differences in infection: from genes to behavior," Neuroscience and Biobehavioral Reviews, 24: 6, pp. 627–638.

Klein, S. L. (2004).Hormonal and immunological mechanisms mediating sex differences in parasite infection, Parasite Immunology, 26: 6-7, pp. 247–264.

Kragt, C. L. and Masken, J. R. (1972). Puberty - physiological mechanisms of control. Journal of Animal Science 34 (Supplement 1).

Kumar, A.A., Harbola, P.C., Rimler, R.B. & Kumar, P.N. (1996). Studies on Pasteurella multocida isolates of animal and avian origin from India. Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases. 17: 120–124.

Kumar, V., Abbas, A.K., Aster J.C. (2012). Robbins basic pathology. Elsevier Health Sciences.

Kylie, H., Van der Hoek, C., Woodhouse, M., Mats Brãnnstròm, M and Robert, J. N. (1998).Effects of interleukin (IL) 6 on Luteinizing Hormone- and IL-1β-Induced Ovulation and Steroidogenesis in the Rat Ovary1.Biology of Reproduction, 58: 1266-1271.

Lane, E. P., Kock, N. D., Hill, F. W. G., and Mohan, K. (1992). An outbreak of haemorrhagic septicaemia (septicaemic pasteurellosis) in cattle in Zimbabwe. Tropical Animal Health and Production, 24:2, 97-102.

Lee CW, Wilkie IW, Townsend KM, Frost AJ (2000). The demonstration of *Pasteurella multocida* in the alimentary tract of chickens after experimental oral infection. Veterinary Microbiology, 72: 47–55.

Lidor, Y.J., Xu, F.J., Martinez-Maza, O., Olt, G.J., Marks, J.R., Berchuck, A., Ramakrishnan, S., Berek, J.S., Bast, R.C. (1993). Constitutive production of macrophage colony-stimulating factor and interleukin-6 by human ovarian surface epithelium. Experimental Cell Research, 207:332-339.

Lin, J., Huang, S., Zhang, Q. (2002). Outer member proteins: key players for bacterial adaptation in host niches. Microbiology and Infection, 4:325-331.

Lmura, H., Fukata, J., Mori, T. (1991). Cytokines and endocrine function: an interaction between the immune and neuroendocrine systems. Clinical Endocrinology; 25: 107-1 5.

Loetscher, H., Pan, Y-CE., Lahm, H.W, Gentz, R., Brockhaus, M., Tabuchi, H. & Lesslauer, W. (1990). Molecular cloning and expression of the human 55 KD tumor necrosis factor receptor, Cell, 61: 351–359.

Lu, Y.S., Lai, W.C., Pakes, S.P. and Nie, L.C. (1991). A monoclonal antibody against a Pasteurella multocida outer membrane protein protects rabbits and mice against pasteurellosis. Infection and Immunity. 59: 172-180.

Lu, Y.S., Afendis, S.J. & Pakes, S.P. (1988). Identification of immunogenic outer membrane proteins of *Pasteurella multocida* 3: An in rabbits. Infection Immunology, 56: 1532–1537.

Lübke, A., Hartmann, L., Schroder W. and Hellmann, E. (1994). Isolation and partial characterization of the major protein of the outer membrane of Pasteurella haemolytica and Pasteurella multocida. Zentralblatt for bakteriologie, 281: 45-54.

Luciana, F., Aleksandro, S., Alexandre, A., Raqueli, T., Lucas, T., Gressler, M., Copetti, C. B., Manuela, B., Rafael, N., Nathieli, B., Marta, M.M.F. and Silvia, G. (2013). Serum levels of LH, FSH, estradiol and progesterone in female rats experimentally infected by Trypanosoma evansi, Experimental Parasitology, 135: 110–115.

Lunenfeld, B., Lunenfeld, E. (1997). Gonadotropic preparations lessons learned. Fertile Steril, 67:812–814.

Luo, Y., Glisson,, J.R., Jackwood, M.W., Hancock, R.E., Bains, M., Cheng I.H. & Wang, C. (1997).Cloning and characterization of the major outer membrane protein gene (*ompH*) of *Pasteurella multocida* X-73. Journal of Bacteriology, 179: 7856–7864.

Luo, Y., Zeng, Q., Glisson, J.R., Jackwood, M.W., Cheng, I.H .& Wang, C. (1999) .Sequence analysis of *Pasteurella multocida* major outer membrane protein (ompH) and application of synthetic peptides in vaccination of chickens against homologous strain challenge. Vaccine, 17: 821–831.

Macfarlane, J. S. and Worrall, K. (1970). Observations on the occurrence of puberty in *Bos indicus* heifers. East African Agricultural and Forestry Journal, 35: 409-410.

Machelon, V., Emilie, D., Lefevre, A., Nome, F., Durand-Gasselin, I., Testart, J. (1994). Interleukin-6 biosynthesis in human preovulatory follicles: some of its potential roles at ovulation. Journal of Clinical Endocrinology; 79:633-642.

Marandi, M.V. & Mittal, K.R. (1997) .Role of outer membrane protein H (ompH)- and ompA-specific monoclonal antibodies from hybridoma tumors in protection of mice against *Pasteurella multocida*. Infection and Immunity, 65: 4502–4508.

Maret, A., Coudert, J.D., Garidou, L., Foucras, G., Gourdy, P., Krust, A., Dupont, S., Chambon, P., Druet, P., Bayard, F., Guery, J.C., (2003). Estradiol enhances primary antigenspecific CD4 Tcells responses and Th1 development in vivo. Essential role of estrogen receptor alpha expression in hematopoietic cells. European Journal Immunology, 33: 512–521.

Marina, H., John, D., Boyce, A. D., Cox, F. k. St., Michael, Ian, W., Wilkie, P. J. and Ben Adler (2007). *Pasteurella multocida* Expresses Two Lipopolysaccharide Glycoforms Simultaneously, but Only a Single Form Is Required for Virulence: Identification of Two Acceptor-Specific Heptosyl I Transferases, Infection and Immunity, 75: 8, 3885-3893.

Marsh, C. B., Moore, S. A., Pope, H. A., and Wewers, M. D. (1994). IL-1ra suppresses Endotoxin-induced IL-1 beta and TNF-alpha release from mononuclear phagocytes. American Journal of Physiology, 267: 39-45.

Marz O, Siask F, Jelen P (1979). The *Pasteurella multocida* carrier in farm and laboratory animals. Comparative Immunology Microbiology and Infectious Diseases, 2:4:437-445.

Mckennedy, F.D. and Schillinger, J.E. (1938). Transmission of Pasteurella cuniculicidain rabbits by breeding. Journal of American Veterinary Medical Association, 93:161-164.

Mendes, S., Carmichael, K.P., Nunnally, J.C., Glisson, J.R., Cheng, I.H. & Harmon, B.G. (1994). Lesions resulting from attempted Shwartzman reaction in turkey poults inoculated with Pasteurella multocida lipopolysaccharide. Avian Disease, 38: 790–796.

Michael, P. M., Dara, J. C. and Mark, A. C. (2013). Structural and Functional Roles of FSH and LH as Glycoproteins Regulating Reproduction in Mammalian Species: in tech, http://dx.doi.org/10.5772/48681.

Mikuli, M. (1995).Effect of interleukin-2 and interleukin-6 on ovary in the ovulatory period- establishment of the new ovarian perfusion system and influence of interleukins on ovulation rate and steroid secretion. Hokkaido Igaku Zasshi, 70:561-572.

Misztal, T., Wańkowska, M., Górski, K., and Romanowicz, K. (2007). Central estrogen-like effect of genistein on growth hormone secretion in the ewe. Acta Neurobiologiae Experimentalis (Wars), 67:4, 411-419.

Miyaura, H. and Iwata, M., (2002). Direct and indirect inhibition of Th1 development by progesterone and glucocorticoids. Journal of Immunology, 168: 1087–1094.

Moffatt, J.H., Harper, M., Harrison, P., Hale, J.D., Vinogradov, E., Seemann, T., Henry, R., Crane, B., St Michael, F., Cox, A.D., Adler, B., Nation, R.L., Li, J. and Boyce, J.D. (2010). Colistin resistance in Acinetobacterbaumannii is mediated by complete loss of lipopolysaccharide production. Antimicrobial Agents and Chemotherapy, 54: 4971-4977.

Mohan, k., Singha, M.N., Singh, R.P., Gupta, B.K. (1968). A Study of immunity against Pasteurella multocida in Buffaloes Calves, and their Carrier status. Veterinary Record, 85:155-156.

Monisha, B. and Saxena, M. (2012). Interleukin-1 (IL- 1) family of cytokines: Role in Type 2 Diabetes. Clinical Chemistry Acta, 413: 1163-1170.

Mshelia, G.D., Bilal, V.T., Maina, V.A., Okon, K., Mamza, S.A., Peter, I.D. and Egwu, G.O. (2014). Microbiological studies on genital infections in slaughtered ewes from tropical arid zone of Nigeria. Sokoto Journal of Veterinary Sciences, 12:1, 18-22.

Murata, H., Shimada, N., and Yoshioka, M. (2004). Current research on acute phase proteins in veterinary diagnosis: an overview. The Veterinary Journal, 168:1, 28-40.

Mustafa, A.A., Ghalib, H.W. & Shigidi, M.T. (1978). Carrier rate of Pasteurella multocida in a cattle herd associated with an outbreak of haemorrhagic septicaemia in the Sudan. British Veterinary Journal, 134: 375–378.

Mutayoba, M.B., Eckersall, P.D., Jeffcoate, I.A., Cestnik, V., Holmes, P.H., (1994).Effects of Trypanosoma congolense infection in rams on the pulsatile secretion of LH and testosrone and responses to injection of GnRH. Journal of Reproduction & Fertility, 102:425–431.

Mutters, R., Ihm, P., Pohl, S., Frederiksen, W., Mannheim, W. (1985). Reclassification of the Genus Pasteurella Trevisan 1887 on the basis of deoxyribonucleic acid homology, with proposals for the new species Pasteurella dagmatis, Pasteurella canis, Pasteurella stomatis, Pasteurella anatis and Pasteurella langaa. International Journal of Systematic Bacteriology: 35:309-22.

Nakagawa-Tosa, N., Morimatsu, M., Kawasaki, M., Nakatsuji, H., Syuto, B., and Saito, M. (1995). Stimulation of haptoglobin synthesis by interleukin-6 and tumor necrosis factor, but not by interleukin-1, in bovine primary cultured hepatocytes. The Journal of Veterinary Medical Science, 57:2, 219-223.

Nawaz I, Munir UF, Kausar R, Khanum A (2006). Whole cell protein profiling of *Pasteurella multocida* field isolates from Pakistan. Pakistan Veterinary Journal, 26:4, 157-162.

Nishikawa, Y., (1985). Adherence of Escherichia coli in pathogenesis of endometritis and effects of estradiol examined by scanning electron microscopy. Infection and Immunity, 47: 318–321.

Nishikawa, Y., and Baba, T., (1985). In vitro adherence of Escherichia coli to endometrial epithelial cells of rats and influence of estradiol. Infection and Immunity, 50: 506–509.

Norman, R.J and Brannstrom, M. (1994). White cells and the ovary-incidental invaders or essential effectors? Journal of Endocrinology; 140:333-336.

Odell, W. D., Hescox, M. A. and Kiddy, C .A. (1970). Studies on hypothalamic pituitary-gonadal interrelations in prepubertal cattle. In: W R Butt, A C Croke and M E Ryle (eds), *Gonadotropins and ovarian development*. Longman, Edinburgh and London, UK.

Odugbo, M., Turaki, U., Itodo, A., Okwori, A., and Yakubu, R. (2005). Experimental hemorrhagic septicemia of calves with Pasteurella multocida Serotype E: 2: clinical, pathologic and microbiologic studies. Revue D'élevage et de Médecine Vétérinaire des Pays Tropicaux, 58:3.

OIE (2000). Manual of Standards for Diagnostic tests and Vaccines.

OIE (2004). Haemorrhagic Septicaemia. In Manual of Diagnostic Test and Vaccines Terrestrial Animal, 5th edition

OIE Terrestrial Manual, (2008). Haemorrhagic Septicaemia, Chapter 2.4.12, pp. 739–751.

OIE, (2012). Haemorrhagic septicemia. Terrestial Manual, pp: 1-13.

Okay, S., Özcengiz, E., Gürsel, İ., and Özcengiz, G. (2012). Immunogenicity and protective efficacy of the recombinant Pasteurella lipoprotein E and outer membrane protein H from Pasteurella multocida A: 3 in mice. Research in Veterinary Science, 93:3, 1261-1265.

Onuma, H., Hahn, J. and Foote, R, H. (1970). Factors affecting superovulation, fertilization and recovery of super ovulated ova in prepubertal cattle. Journal of Reproduction and Fertility, 21: 119-126.

Othman, A. M., Jesse, F. F. A., Adamu, L., Abba, Y., Adza Rina, M. N., Saharee, A. A., Wahid, A. H. and Zamri-Saad ,M.(2014). Changes in Serum Progesterone and Estrogen Concentrations in Non-Pregnant Boer does Following Experimental Infection with *Corynebacterium Pseudotuberculosis,* Journal Veterinary Advance, 4:5, 524-528.

Othman, S., Parton, R., and Coote, J. (2012). Interaction between mammalian cells and Pasteurella multocida B: 2. Adherence, invasion and intracellular survival. Microbial Pathogenesis, 52:6, 353-358.

Pabs-Garnon, L. F. and Soltys, M. A. (1971). Multiplication of Pasteurella multocida in the spleen, liver and blood of turkeys inoculated intravenously. Canadian Journal of Comparative Medicine, 35: 147-149.

Pace, L., Kreeger, J., Bailey, K., Turnquist, S., and Fales, W. (1993). Serum levels of tumor necrosis factor-α in calves experimentally infected with Pasteurella haemolytica Al. Veterinary immunology and immunopathology, 35:3, 353-364.

Palmieri, C., Schiavi, E., Della Salda, L. (2011).Congenital and acquired pathology of ovary and tubular genital organs in ewes: Journal of Theriogenology, 75:393-410.

Pampori, Z., and Pandita, S. (2013). Reproductive cycle stage bias in physiological and immune responses to endotoxin challenge in Murrah buffaloes (Bubalus bubalis). Buffalo Bulletin, 32:4, 270-282.

Pandit, K.K. & Smith, J.E. (1993). Capsular hyaluronic acid in Pasteurella multocida type A and its counterpart in type D. Research in Veterinary Science, 54: 20–24.

Pati, U.S., Srivastava, S.K., Roy, S.C. and More, T. (1996). Immunogenicity of outer membrane protein of Pasteurella multocida in buffalo calves. Veterinary Microbiology, 52: 301-311.

Peng, D., Hong, W., Choudhury, B.P., Carlson, R.W. and Gu, X.X. (2005). Moraxella catarrhalis bacterium without endotoxin, a potential vaccine candidate. Infection and Immunity, 73: 7569-7577.

Pépin, M., Seow, H.F., Corner, L., Rothel, J.S., Hodgson, A.L., Wood, P.R. (1997). Cytokine gene expression in sheep following experimental infection with various strains of *Corynebacterium pseudotuberculosis* differing in virulence. Veterinary Research, 28:2,149-163.

Perera, B. (2011). Reproductive cycles of buffalo. Animal reproduction science, 124:3, 194-199.

Peters, A. R. (1984). Reproductive activity of the cow in the postpartum period. 1. Factors affecting the length of the postpartum acyclic period. British Veterinary Journal, 140: 76-83.

Peters, A. R. and Ball, P. J. H. (1987). *Reproduction in cattle*. Butterworth's, London, UK. pp. 51.

Petersen, H. H., Nielsen, J. P., and Heegaard, P. M. H. (2004). Application of acute phase protein measurements in veterinary clinical chemistry. Veterinary Research, 35:2, 163-187.

Praveena, P. E., Periasamy, S., Kumar, A. A., and Singh, N. (2010). Cytokine profiles, apoptosis and pathology of experimental Pasteurella multocida serotype A1 infection in mice. Research in Veterinary Science, 89:3, 332-339.

Pruimboom, I.M., Rimler, R.B., Ackermann, M.R. & Brogden, K.A. (1996) .Capsular hyaluronic acid-mediated adhesion of Pasteurella multocida to turkey air sac macrophages. Avian Disease, 40: 887–893.

Pudney, J., Quayle, A.J., Anderson, D.J. (2005). Immunological microenvironments in the human vagina and cervix: mediators of cellular immunity are concentrated in the cervical transformation zone. Biology of Reproduction: 73:1253–63.

Radostits, O.M., GAY, C.C., Hinchcliff, K.W. and Constable, P.D., (2007). Veterinary medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th Ed. Saunders Ltd, Philadelphia, USA.

Ram, S., Cox, A.D., Wright, J.C. (2003) .Neisserial lipooligosaccharide is a target for complement component c4b. Inner core phosphoethanolamine residues define C4b linkage specificity, Journal of Biological Chemistry, 278: 50853–50862.

Ramdani & Adler, B. (1991). Opsonic monoclonal antibodies against lipopolysaccharide (LPS) antigens of Pasteurella multocida and the role of LPS in immunity. Veterinary Microbiology, 26: 335–347.

Ramirez, V. D. and McCann, S. M. (1963). Comparison of the regulation of luteinizing hormone (LH) secretion in immature and adult rats. Endocrinology, 76: 452.

Rania, K.D., Ramadan, D.I., Mohy, A.M., Raafat, H.A., and El-Kateb, S.M., et al., (2014). Interleukin-1 β gene polymorphisms in Egyptian patients with rheumatoid arthritis. Comparative Clinical Pathology, 23: 689-694.

Ranjan R, Panda S, Acharya A, Singh A, Gupta M (2011) .Molecular diagnosis of Haemorrhagic Septicaemia-A Review. Veterinary World, 4:4,189–192.

Rebers, P.A., Phillips, M., Rimler, R., Boykins, R.A., Rhoades, K.R., (1980). Immunizing properties of Westphal lipopolysaccharide from an avian strain of Pasteurella multocida. American Journal of Veterinary Research, 41: 1650–1654.

Reichlin, S. (1993). Neuroendocrine-immune interactions. New England Journal of Medicine, 329: 1246-53.

Relman, D. A., and Persing, D. H. (1996). Genotypic methods for microbial identification, p. 3–31. *In* D. H. Persing (ed.), PCR protocols for emerging infectious diseases: a supplement to Diagnostic Molecular Microbiology: Principles and Applications. ASM Press, Washington, D.C.

Rhoades, K. R., Heddleston, K. L., and Rebers, P. A. (1967). Experimental hemorrhagic septicemia: gross and microscopic lesions resulting from acute infections and from endotoxin administration. Canadian Journal Of Comparative Medicine And Veterinary Science, 31:9, 226.

Rhoades, K.R. & Rimler, R.B. (1987). Effects of Pasteurella multocida endotoxins on turkey poults. Avian Disease, 31: 523–526.

Rider, V., Jones, S., Evans, M., Bassiri, H., Afesar, Z., Abdou, N.I., (2001). Estrogen increases CD40 ligand expression in T cells from women with systemic lupus erythematosus. Journal of Rheumatology, 28: 2244–2249.

Rimler R.B. (1993).Serology and virulence of haemorrhagic septicaemia Pasteurella multocida isolated from domestic and feral ruminants, 44–46.

Rimler R.B., Wilson K.R. (1994). Re-examination of Pasteurella multocida serotypes that caused haemorrhagic septicaemia in North America. Veterinary Research, 134: 256.

Rimler, R. B., and Rhoades, K. R. (1989). *Pasteurella multocida*, p. 37–73. *In* C. Adlam and J. M. Rutter (ed.), Pasteurella and pasteurellosis. Academic Press Limited, London, England.

Rimler, R.B. (1990). Comparisons of Pasteurella multocida lipopolysaccharides by sodium dodecyl sulfate-polyacrylamide gel electrophoresis to determine relationship between group B and E hemorrhagic septicemia strains and serologically related group A strains. Journal of Clinical Microbiology, 28:654–659.

Rimler, R.B. (1994). Presumptive identification of Pasteurella multocida serogroups A, D and F by capsule depolymerisation with mucopolysaccharidases. Veterinary Record, 134*:* 191–192.

Rimler, R.B., Rhoades, K.R. (1987). Serogroup F, a new capsule serogroup of Pasteurella multocida. Journal Clinical Microbiology, 25:615-618.

Roberta, S.D., Bruna, F.R.F., Sebastião, L.A.G., Maria, L.R.R., Euloir, P., Adriana, C.P.S. (2012). Influence of combined oral contraceptives on the periodontal condition. Journal of Applied Oral Sciences, 20: 253-259.

Roser, J.F. (1999). Subfertility and infertility in the stallion. World Equine Veterinary Review, 4: 32–37.

Russell, M.W., Mestecky, J. (2002). Humoral immune responses to microbial infections in the genital tract. Microbes and Infection, 4:667–77.

Russell, W. L. and Douglas, P. M. (1945). Offspring from unborn mothers. Proceedings of the National Academy of Sciences of the United States of America, 31: 402.

Saharee, A., Salin, N., Rasedee, A., and Jainudeen, M. (1992). Haemorrhagic septicaemia carriers among cattle and buffalo in Malaysia. Pasteurellosis in Production Animals Bali, 89-91.

Saharee, A.A., 2006. Haemorrhagic septicaemia in cattle and buffaloes: Are we ready for freedom. Inaugural Lecture, Universiti Putra Malaysia, 1-29.

Saharee, A.A., Salim, N.B., Rasedee, A. and Jainudeen, M.R. (1993) .Haemorrhagic septicaemia carriers among cattle and buffalo in Malaysia. Pasteurellosis in Production Animals. ACIAR Proceeding, 43: P89-91.

Salmassi, A., Schmutzler, A.G., Huang, L., Hedderich, J, Jon, W., Mettler, L. 2004). Detection of granulocyte colony-stimulating factor and its receptor in human follicular luteinized granulosa cells. Fertile and Sterility, 81(Suppl 1):786–791.

Schall, T.J., Lewis, M., Koller, K.J., Lee, A., Rice, G.C., Wong, G.H.W., Gatanaga, T., Granger, G.A., Lentz, R., Raab, H. (1990). Molecular cloning and expression of a receptor for human tumor necrosis factor Cell, 61: 361–370.

Schams, D., Schallenberger, E., Gombe, S. and Karg, H. (1981). Endocrine patterns associated with puberty in male and female cattle. Journal of Reproduction and Fertility (Supplement 30): 103-110.

Schenkein, H.A., Barbour, S.E., Berry, C.R., Kipps, B. & Tew, J.G. (2000). Invasion of human vascular endothelial cells by Actinobacillus actinomycetemcomitans via the receptor for platelet-activating factor. Infection and Immunity, 68: 5416–5419.

Schillo, K. K., Dierschke, D. J. and Hauser, E. R. (1982). Regulation of luteinizing hormone secretion in prepubertal heifers: Increased threshold to negative feedback of estradiol. Journal of Animal Science, 54: 325-336.

Schillo, K. K., Dierschke, D. J. and Hauser, E. R. (1983). Estrogen induced release of luteinizing hormone in prepubertal and post pubertal heifers. Theriogenology, 19: 727.

Schmidt, M., C. Ammon, P.C. Schon, C. Manteuffel and G. Hoffmann, (2014). The suitability of infrared temperature measurements for continuous temperature monitoring in gilts. Archiv Tierzucht, 57: 1-12. DOI: 10.7482/0003-9438-57-021.

Selsted, M.E., and Ouellette, A.J. (1995). Defensins in granules of phagocytic and non-phagocytic cells. Rends in Cell Biology; 5:114–9.

Serino, L. & Virgil, M. (2002). Genetic and functional analysis of the phosphorylcholine moiety of commensal Neisseria lipopolysaccharide. Molecular Microbiology, 43: 437–448.

Shah, N. H., Biewenga, J., Shah, N. H., and de Graaf, F. K. (1996). Vacuolating cytotoxic activity of Pasteurella multocida causing haemorrhagic septicaemia in buffalo and cattle. FEMS Microbiology Letters, 143:1, 97-101.

Shallali, A., Hussein, A., Salih, M., and Dafalla, E. (2001). A preliminary report on bacteria isolated from the female genital tract of Sudanese sheep and goats. The Sudan Journal of Veterinary Research, 17:56-63.

Sheldon, I.M., Cronin, J., Goetze, L., Donofrio, G. and Schuberth, H.J. (2009). Defining postpartum uterine disease and the mechanisms of infection and immunity in the female reproductive tract in cattle. Biology of Reproduction, 81: 1025-1032.

Sheldon, I.M., Lewis, S.L., LeBlanc, S., and Gilbert, R.O. (2006). Defining postpartum uterine disease in cattle. Theriogenology, 65: 1516.

Shioya, N. and Wakabayashi, K. (1998). In vivo bioactivities and kinetic parameters of rat luteinizing hormone components: Discrepancy between in vitro and in vivo assays. Endocrine Journal, 45: 307-314

Shivachandra, S. B., Viswas, K. N., and Kumar, A. A. (2011). A review of hemorrhagic septicemia in cattle and buffalo. Animal Health Research Reviews, 12: 1, 67-82.

Singh, V.P, Kumar, A.A., Srivastava, S.K. & Rathore, B.S. (1996). Significance of HS in Asia: India. International Workshop on Diagnosis and Control of HS. Bali, Indonesia, Indonesian Department of Agriculture, p.16.

Smith, C., Davis, T., Anderson, D., Solam, L., Beckmann, M., Jerzy, R., Dower, S., Cosman, D. & Goodwin , R. (1990). A receptor for tumor necrosis factor defines an unusual family of cellular and viral proteins. Science 248:4958, 1019–1023.

Smith, J. F., Fairclough, R. J., Payne, E. and Peterson, A. J. (1975). Plasma hormone levels in the cow. 1. Changes in progesterone and oestrogen during the normal oestrous cycle. New Zealand Journal of Agricultural Research, 18: 123-129.

Sneath, P.H., Stevens, M. (1990). Actinobacillus rossii sp. nov., Actinobacillus seminis sp. nov., nom. rev., Pasteurella bettii sp. nov., Pasteurella lymphangitidis sp. nov., Pasteurella mairi sp. nov., and Pasteurella trehalosi sp. *International Journal of* Systematic and Evolutionary Microbiology; 40:148-53.

Snipes, K.P. & Hirsh, D.C. (1986). Association of complement sensitivity with virulence of Pasteurella multocida isolated from turkeys. Avian Disease, 30: 500–504.

Snipes, K.P., Ghazikhanian, G.Y. & Hirsh, D.C. (1987).Fate of Pasteurella multocida in the blood vascular system of turkeys following intravenous inoculation: comparison of an encapsulated, virulent strain with its avirulent, acapsular variant. Avian Disease, 31: 254–259.

Spangelo, B.L., Judd, A.M., Call, G.B., Zumwalt, J. & Gorospe, W.C. (1995).Role of the cytokines in the hypothalamic–pituitary–adrenal and gonadal axes. Neuroimmunomodulation, 2: 299–312.

Spangelo, B.L., Judo, A.M., Isakson, P.C. & Macleod, RM. (1989). Interleukin-6 stimulates anterior hormone release in vitro. Endocrinology, 125: 575–577.

Srivastava, S. (1998). Outer membrane protein of Pasteurella multocida serotype B:2 is immunogenic and antiphagocytic. Indian Journal of Experimental Biology, 36:530-532.

St Michael, F., Li, J. & Cox, A.D. (2005) Structural analysis of the core oligosaccharide from Pasteurella multocida strain X73. Carbohydrate Research, 340: 1253–1257.

Stenken, J. A., and Poschenrieder, A. J. (2015). Bioanalytical chemistry of cytokines, A review. Analytica Chimica Acta, 853: 95-115.

Swanson, L.V., Hafs, H. D. and Morrow, D. A. (1972). Ovarian characteristics and serum LH, prolactin, progesterone and glucocorticoid from first estrus to breeding size in Holstein heifers. Journal of Animal Science, 34: 284-293.

Swords, W.E., Buscher, B.A., Ver Steegli, K., Preston, A., Nichols, W.A., Weiser, J.N., Gibson, B.W. & Apicella, M.A. (2000) .Non-typeable Haemophilus influenzae adhere to and invade human bronchial epithelial cells via an interaction of lipooligosaccharide with the PAF receptor. Molecular Microbiology, 37: 13–27.

Tabatabaei M, Liu Z, Finucane A, Coote J (2002). Protective immunity conferred by attenuated aroA derivatives of *Pasteurella multocida* B: 2 strains in a mouse model of hemorrhagic septicemia. Infection and Immunity, 70:7, 3355-62.

Tabibzadeh, S., Santhanam, U., Seghal, P.B., May, LT. (1989). Cytokine induced production of IFN-P/IL-6 by freshly explanted endometrial stromal cells; modulation by estradiol 17-d. Journal of Immunology, 142:3134-3139.

Takikawa, M. and Wakabayashi, K. (1994) .Quantitative analysis of hypothalamic-hypophyseal-testicular system: Why testosterone can act under negative feedback control. Endocrine Journal. 41: 257-265.

Tartaglia, L.A. & Goeddel, D.V. (1992). Two TNF receptors. Immunology Today, 13: 151–153.

Teng, C.T., Beard, C., Gladwell, W., (2002a). Differential expression and estrogen response of lactoferrin gene in the female reproductive tract of mouse, rat, and hamster. Biology of Reproduction, 67:1439–1449.

Teng, C.T., Gladwell, W., Beard, C., Walmer, D., Teng, C.S., Brenner, R., (2002b). Lactoferrin gene expression is estrogen responsive in human and rhesus monkey endometrium. Molecular Human Reproduction, 8: 58–67.

Terzano, G., Vittoria, L. B., Borghese, A. (2012). Overview on Reproductive Endocrine Aspects in Buffalo, Journal of Buffalo Science, 1:126-138.

Thomas, J. (1972). The control of haemorrhagic septicaemia in west Malaysia. Tropical Animal Health Production, 4: 95-101.

Tomer, P., Chaturvedi, G. C. and, Monga, D. P. (2004). Detection of fimbriae on haemorrhagic septicaemia associated Pasteurella multocida (B: 2) isolates. Indian Journal of Animal Sciences, 74: 1199-1201.

Townsend, K. M., Frost, A. J., Lee, C. W., Papadimitriou, J. M., and Dawkins, H. J. (1998). Development of PCR assays for species-and type-specific identification of *Pasteurella multocida* isolates. Journal of Clinical Microbiology, 36:4, 1096-1100.

Townsend, K.M., Boyce, J.D., Chung, J.Y., Frost, A.J. & Adler, B. (2001). Genetic organization of Pasteurella multocida cap Loci and development of a multiplex capsular PCR typing system. Journal of Clinical Microbiology, 39:3, 924–929.

Truscott, W.M. & Hirsh, D.C. (1988). Demonstration of an outer membrane protein with antiphagocytic activity from Pasteurella multocida of avian origin. Infection and Immunity, 56: 1538–1544.

Tsuji, M. & Matsumoto, M. (1989). Pathogenesis of fowl cholera: influence of encapsulation on the fate of Pasteurella multocida after intravenous inoculation into turkeys. Avian Disease, 33: 238–247.

Turner, R.T., Riggs, B.L. and Spelsberg, T.C. (1994). Skeletal effects of estrogen. Endocrine Reviews. 15:3, 275-300.

Unluhizarci K, Bayram F, Colak R, et al. (2011), Clinical case seminar: distinct radiological and clinical appearance of lymphocytic hypophysitis. Journal of Clinical Endocrinology and Metabolism; 86:1861Y1864.

Usmani, R. H., Ahmad, N., Shafiq, P., and Mirza, M. A. (2001). Effect of subclinical uterine infection on cervical and uterine involution, estrous activity and fertility in postpartum buffaloes. Theriogenology, 55:2, 563-571.

Wajant, H., Pfizenmaier, K. & Scheurich, P. (2003) .Tumor necrosis factor signaling. Cell Death Differ, 10:45–65.

Weissberger, A.J., Ho, K.K. and Lazarus, L. (1991). Contrasting effects of oral and transdermal routes of estrogen replacement therapy on 24-hour Growth Hormone (GH) secretion, insulin-like growth factor I and GH-binding protein in postmenopausal women. Journal of Clinical Endocrinology and Metabolism, 72:2, 374-381.

Wijewardana TG, De Alwis MCL, Bastianz HLG. (1986). Cultural, biochemical and pathogenicity studies on strains of *Pasteurella multocida* isolated from carrier animals and outbreaks of haemorrhagic septicaemia. Sri Lanka, Veterinary Journal*;* 34: 43–57.

Wijewardana, T.G. & Sutherland, A.D. (1990). Bactericidal activity in the sera of mice vaccinated with Pasteurella multocida type A. Veterinary Microbiology, 24: 55–62.

Wilkie, I. W., Harper, M., Boyce, J. D., and Adler, B. (2012). Pasteurella multocida: Diseases and pathogenesis. In K. Aktories, J. H. C. Orth and B. Adler (Eds.), Pasteurella multocida, 361: pp. 1-22): Springer Berlin Heidelberg.

Williams, E. J., Fischer, D. P., Noakes, D. E., England, G. C., Rycroft, A., Dobson, H., et al. (2007). The relationship between uterine pathogen growth density and ovarian function in the postpartum dairy cow. Theriogenology, 68:4, 549-559.

Williams, E. J., Fischer, D. P., Pfeiffer, D. U., England, G. C., Noakes, D. E., Dobson, H., et al. (2005). Clinical evaluation of postpartum vaginal mucus reflects uterine bacterial infection and the immune response in cattle. Theriogenology, 63:1, 102-117.

Wilson, B. A. & Ho, M. (2013). *Pasteurella multocida*: From zoonosis to cellular microbiology. Clinical Microbiology Reviews, 26: 631–655.

Wira, C.R., Fahey, J.V., Ghosh, M., Patel, M.V., Hickey, D.K., Ochiel, D.O. (2010).Sex hormone regulation of innate immunity in the female reproductive tract: the role of epithelial cells in balancing reproductive potential with protection against sexually transmitted pathogens. American Journal Reprod Immunology; 63:544–65.

Wira, C.R., Fahey, J.V., Sentman, C.L., Pioli, P.A., Shen L. (2005a). Innate and adaptive immunity in female genital tract: cellular responses and interactions. Immunology Reviews, 206:35–06.

Wira, C.R., Ghosh, M., Smith, J.M., Shen, L., Connor, R.I., Sundstrom, P., et al. (2011).Epithelial cell secretions from the human female reproductive tract inhibit sexually transmitted pathogens and Candida albicans but not Lactobacillus. Mucosal Immunology, 4:335–42.

Wira, C.R., Grant-Tschudy, K.S. and Crone-Godrean. M.A. (2005b). epithelial cells in the female reproductive tract: A central role as sentinels of immune protection. American Journal Reprod Immunology, 53: 65-81.

Wright, S. D. (1999). Toll, a new piece in the puzzle of innate immunity. Journal of Experimental Medicine. 189:605-609.

Yoshioka, M., Ito, T., Miyazaki, S., and Nakajima, Y. (1998). The release of tumor necrosis factor-α, interleukin-1, interleukin-6 and prostaglandin E:2 in bovine Kupffer cells stimulated with bacterial lipopolysaccharide. Veterinary immunology and immunopathology, 66:3, 301-307.

Zaid K.M. (2015). Ethiopathogenesis of Caseous lymphadenitis in goat's thesis submitted to the school of graduate studies, Universiti Putra, Malaysia, in fulfillment of the requirements for the degree of doctor of philosophy January.

Zaid, K., Abdulnasir,Y.O., Jesse, F. F. A., Haron, A. W., Saharee, A.A., Sabri, J., Yusoff, R. and Abdullah, R. (2012). Sex hormone profiles and cellular changes of reproductive organs of mice experimentally infected with *C.pseudotuberculosis* and its exotoxin phospholipase D (PLD). Journal of Agriculture and Veterinary Sciences, I: 24-29.

Zamri-Saad, M. and Abubakar, M.S. (2011). Clinico-pathological changes in buffalo calves following oral exposure to *Pasteurella multocida* B:2. Basic and Applied Pathology, 4:130-135.

Zamri-Saad, M., Ernie, Z., and Sabri, M. (2006). Protective effect following intranasal exposure of goats to live *Pasteurella multocida* B: 2. Tropical Animal Health and Production, *38*:7-8, 541-546.

Zhang, H., Ainsworth, A.J., (1994). Investigation of the poultry idiotypic network using Pasteurella multocida. Veterinary Immunology and Immunopathology, 41: 2, 73-88; 38 ref.

Ziltener, H.J., Maines-Bandiera, S., Schrader, J.W., Auersperg, N. (1993).Secretion of bioactive interleukin- 1, interleukin-6 and colony-stimulating factors by human ovarian epithelium. Biology Reproduction, 49:635-641.

Zychlinsky, A.B., Fitting, J.M., Vaillon, C. and Sansonetti, P.J. (1994).Interleukin-1 is released by macrophages during apoptosis induced by Shigella flexneri. Journal of Clinical Investigation, 94:1328-1332.

APPENDICES

Appendix A

1-Gram's stain

a - Ammonium oxalate crystal violet
Solution 1: Crystal violet 2.0 gm
Ethyl alcohol (95 per cent) 20.0 ml
Solution 2: Ammonium oxalate 0.8 gm
Distilled water 80.0 ml
Solution 1 and 2 was mixed well and then filtered.

b- Gram's iodine solution
Iodine 1.0 gm
Potassium iodide 2.0 gm
The ingredients were dissolved in distilled water to make total volume 300 ml and then filtered.

c - Acetone or Ethyl alcohol (decolorizer)

d- Safranin (counter stain)
Safranin-O (2.5 per cent solution) in 95% alcohol 10 ml
Distilled water 100 ml

2- Indole test

a) Kovac's reagents

Paradimethylaminobenzaldehyde	50 gm
Pure amyl or Isoamyl alcohol	75 ml
Concentrated pure hydrochloric acid	25 ml

The aldehyde was dissolved in the alcohol by gentle warming in water bath, cooled and then hydrochloric acid was added. It was protected from light and stored at 4ºC temperature.

b) Tryptone water

Tryptone	10 gm
Sodium chloride	5 gm
Distilled water	1000 ml

The ingredients were dissolved in distilled water by gentle warming and then sterilized at 15 psi pressure, 121ºC temperature for 20 minutes.

3-Brain Heart Infusion Broth (BHI broth)

Dehydrated, HiMedia)
Ingredients Grams/liter

Peptic digest of animal tissues	10.00
Calf brain, infusion (solids) Yeast extract	12.50
Beef heart Infusion (solids)	5.00
Dextrose	2.00
Sodium chloride	5.00
Disodium phosphate	2.50
Final pH (at 25oC)	7.4 + 0.2

Suspended 37 gm in 1000 ml distilled water, distributed in test tube and sterilized by Autoclaving at 15 psi pressure, 121ºC for 20 minutes.

4-Blood Agar (BA)

Blood agar base (Dehydrated, HiMedia)

Ingredients	Grams/liter
Beef heart, infusion form	500.00
Tryptose	10.00
Sodium chloride	5.00
Agar	15.00

Final pH (at 25oC) 7.3 + 0.2

Suspended 40 gm of dehydrated blood agar base in 1000 ml distilled water and sterilized by autoclaving at 15 psi pressure, 121ºC temperature for 20 minutes. The molten medium was cooled to about 50ºC temperature and aseptically 5% v/v sterile defibrinated sheep blood was added. The above medium was mixed well and poured into sterile petri plates.

5-MacConkey Agar (MCA) (Dehydrated, HI Media)

Ingredients	Grams/liter
Peptic digest of animal tissue	20.00
Lactose	10.00
Bile salt	5.00
Sodium chloride	5.00
Neutral red	0.07
Agar	15.00

Final pH (at 25oC) 7.5 + 0.2

Suspended 55.07 gm of dehydrated MCA in 1000 ml distilled water and sterilized by autoclaving at 15 psi pressure 121ºC for 20 minutes. The molten medium was cooled to about 50ºC temperature and poured into sterile petri plates.

Table : 1(Appendix. A): Biochemical tests used for identification of *P. multocida* isolation from productive organs, mammary gland, and pituitary gland and supramammary lymph node of pre-pubertal female buffaloes

Organ	Oxidase	Urease	Indole	Motility	Growth (MAC)	ODC	Trehalose	Mannitol	sorbitol	Dulcitol	Result
Ovary	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Oviduct	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Uterine horn	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Uterine body	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Cervix	+	-	+	-	-	-	-	-	-	-	*P. multocida*
Vagina	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Mammary gland	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Supramammary lymph node	+	-	+	-	-	+	-	+	+	-	*P. multocida ss. multocida*
Pituitary gland	+	-	+	-	-	-	-	-	-	-	*P. multocida*

Appendix B

1-Sodium Dodecyl Sulphate – Polyacrylamide Gel Electrophoresis (SDS-PAGE):

Discontinuous SDS- PAGE was performed according to Laemmli (1970) using Bio-Rad Mini – protean Tetra Cell gel slabs, 70 (l) × 75 (W) × 0.75 mm following the manufacturers Bio-Rad, laboratories). Reagents for SDS- PAGE were prepared as described in Appendix A. The resolving and stacking gel with 12% and 4% acrylamide respectively, were used. Sample was diluted at 1:4 with sample buffer and heated at 95^0C for 5 minutes. Electrophoresis was performed at RT with constant voltage of 50 volts for the first 15 minutes followed with 100 volts for 1 hour using electrophoresis buffer.

2-SDS- PAGE of the LPS Extraction

The crude Lipopolysaccharide extract that was prepared using the LPS Extraction Kit from Intron Biotechnology was then run on mini SDS – PAGE as described above to observe whether any protein bands were present or not in the extraction.

3-SDS – PAGE of the Crude OMP

The crude outer membrane protein extract that was prepared using the Qiagen Protein Extraction Kit was then run on mini SDS- PAGE. Molecular weight standards (Kaleidoscope Pre stained or High Range Standards).

4-Coomassie Brilliant Blue R- 250 Staining and Destaining

The SDS – PAGE gels were fixed and stained with 0.25% Coomassie brilliant blue R-250 (Bio-Rad , laboratories) in methanol: water (4:1:5 , v:v:v) for I hour at RT with gentle shaking (micro plate Shaker EAS 2/4 , SLT, Lab instruments, Austria). Destaining was carried out with methanol water, (6: 4, v: v) until the background was clear.

5-Reagents for Polyacrylamide Gel Electrophoresis (SDS – PAGE)

1-30 % Acrylamide Mix

Acrylamide	146.0 g
Bis – acrylamide	4.0 g
Distilled water	500 ml

Dissolved in 500 ml distilled water in a volumetric flask and filter through a whatman No. 1 filter. Store at 4^0C. This solution is highly toxic and should be handled accordingly.

2-Sodium dodecyl Sulphate

SDS 10.0 g
Distilled water 100 ml
Dissolved in distilled water with gentle stirring

3- Staining solution (Coomassie Brilliant Blue)

Coomassie Brilliant Blue 2.5 g
50% methanol 900 ml
Glacial acetic acid 100 ml
Dissolve Coomassie Brilliant Blue in methanol: distilled water (1:1, v: v) and glacial acetic acid. Filter the solution through No. 1 filter to remove any particulate matter

4-Destaining solution

Methanol 600 ml
Distilled water 400 ml
Destaining solution is prepared by mixing methanol and distilled water together.

Appendix C

1-Assay procedure for progesterone

The antibody coated tubes provided were labeled for standard (S0-S5), total count, non-specific binding, quality control and the samples; 50µl of the standard solution was added to the labeled tubes mentioned above except the samples tubes; 50µl of the experimental samples (control and infected) were added to the samples tubes. 500 µl of radioactive tracer substance was added into each tube (standard, total count, non-specific binding, quality control and samples) and were mixed vigorously for 2 minutes and incubated for 1 hour at 18 - 25ºC with shaking (350 rpm). After incubation, the contents were aspirated except the total control and a non-specific binding tube which was used to measure the sensitivity of the radioactive tracer. The bounding was measured in Wallace wiz3ad 1470 automatic gamma. The sensitivity of the assay was the minimal detection limit of the assay which is zero standard and calculated as twice the standard deviation of the zero standards.

2-Assay procedure for estrogen

The antibody coated tubes provided were labeled for standard (S0-S6), total count, non-specific binding, quality control and the samples. An amount of 100µl of the standard solution was added to the labeled tubes mentioned above except the samples tubes. 100µl of the experimental samples (control and infected) were added to the samples tubes. 500 µl of radioactive tracer substance was added into each tube (standard, total count, non-specific binding, quality control and samples) and mixed vigorously for 2 minutes and incubated for 3 h at 18 -250 C with shaking (350 rpm). After incubation, the contents were aspirated except the total control and a non-specific binding tube which is used to measure the sensitivity of the radioactive tracer. The bounding was measured in Wallace wizad 1470 automatic gamma. The sensitivity of the assay is the minimal detection limit of the assay, which is the zero standard and is calculated as twice the standard deviation of the zero standards.

3-Assay procedure for LH and FSH

The antibody coated tubes provided were labeled for standard (S0-S5), total count, non-specific binding, quality control and the samples; 100µl of the standard solution was added to the labeled tubes mentioned above except the sample tubes. 100µl of the experimental samples (control and infected) were added to the sample tubes. 50 µl of radioactive tracer substance was added into each tube (standard, total count, non-specific binding, quality control, and samples) and were mixed vigorously for 2 minutes and incubated for 90 min at 18 - 250 C with shaking (350 rpm). After incubation, the contents were aspirated except the total control and a non-specific binding tube which is used to measure the sensitivity of the radioactive tracer. After that, the contents were washed twice with 2 ml of wash solution. The bounding was measured in Wallace wizad 1470 automatic gamma. The sensitivity of the assay is the minimal detection limit of the assay, which is the zero standards and is calculated as twice the standard deviation

of the zero standards. The assay procedure for LH and FSH is the same, the only difference being the coating of each tube with specific antibodies.

Appendix D

1- Embedding

After the tissue is cleared with alcohol, it is then transferred into a melted parafinwax, each piece of tissue is placed in a position with its appropriate identifying name beside the tissue pan. The tissue is placed down gently with forceps and flattened. The tissue pan is. Then filled with the melted liquid paraffin wax, after which the pan is placed at the cooler part of the machine containing ice, it makes it harder and it is removed gently.

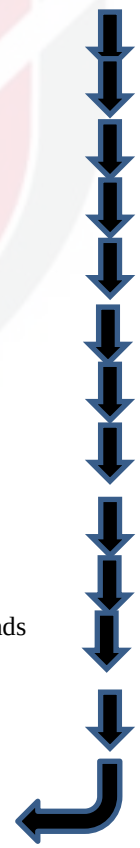
2-Sectioning

This is the process whereby the blocks are sectioned into a thin ribbon. 3 microtome thickness is used to cut the block gently and the ribbon like is allowed to flow on the water bath and is picked up gently with cover slide and allowed to dry overnight

3-Staining

Harris Hematoxylin and Eosin Staining

Submerge slides in Xylene	5 mins
Submerge slides in 100% Ethanol/ Alcohol	5 mins
Submerge slides in 70% Ethanol/ Alcohol	5 mins
Rinse	1-2 mins
Submerge slides in in Hematoxylin	5 mins
Rinse	3-5 mins
Dip the slides in 1% Acid Alcohol 3 dips	3 seconds
Running tap water	5 mins
Submerge slides in Eosin	1 min
Spray and dry the slides with 95% Alcohol	
Rinse the slides in running tap water	5- 10 seconds
Spray and dry the slides with 95% Alcohol, clean and leave the slides to dry	
Mount with DPX, Ready for viewing	



Appendix E

PCR procedure

Colony +2µl of Dnaozone (Template)

1- Buffer (Tri-Hcl)	2µL
2- MgCl2	2µL
3-d NTP	0.5µL
4- a - Primer 1 forward	0.5µL
b- Primer 1 reverse	0.5µL
5- a - Primer 1 forward	0.5µL
b- Primer 1 reverse	0.5µL
6-Taq polymerase	0.5µL
7- DNATemplate	2µL
8 - H_20	41µL
	50µ L

Primer design

The primer for the amplification of the *P. multocida* was referenced to (OIE, 2012). The forward primer used was: 5'-AGG CTC GTT TGG ATT ATG AAG -3' while the reverse primer used was: 5'-ATC CGC TAA CAC ACT CTC -3' for P. multocida in general. The base pair for *P. multocida* in general was 460 base pair. The forward primer used was: 5'- ATC CGC TAT TTA CCC AGT GG -3' while the reverse primer used was : 5'-GCT GTA AAC GAA CTC GCC AC -3' for P. multocida type B: 2. The base pair for *P. multocida* in general was 620 base pair.

BIODATA OF STUDENT

Hayder Hamzah Ibrahim was born on the first of July 1966 in Babylon Government area of Iraq. He attended AL- Qabas Primary school, Babylon from 1972-1978 and AL-Faihaa Secondary school, Babylon from 1978-1984.He attended University of Baghdad, Faculty of Veterinary Medicine, after his secondary school education from 1984 -1990. After his University education in 1990, he worked briefly at the Teaching Veterinary Hospital (TVH) for 1 year as a Trainee. Hayder Hamzah Ibrahim gained a contract employment at the Technical Institute babil - Al Furat Al-Awast Technical University, Ministry of Higher Education &Scientific Research from 1997 to 1998 as Research Assistant in the Department of community health .He was employed as a permanent staff in the Technical Institute babil - Al Furat Al-Awast Technical University, Ministry of Higher Education &Scientific Research. He got MSc in Medical microbiology, college of medicine, Kuffa University in 2005. During his worker as Head of library unit, Head of scientific unit, Head of Nursing Department, Assistant Professor in analytic pathology Department in Babylon technical institute - Al Furat Al-Awast Technical University, he published 12 articles. He gained entry into Doctor of Philosophy in the field of Bacteriology under supervision of Assist prof Dr. Faez Firdaus Jesse Abdullah at the Faculty of Veterinary Medicine, Universiti Putra Malaysia in the 2014. Hayder Hamzah Ibrahim published two articles in impact factor and cited journal during his study. Hayder Hamzah Ibrahim has attended conference proceedings of the 7th Malaysian Association of Veterinary Pathology (MAVP) Scientific Conference, 2015 held at Malakai. He is blissfully married with four children.

LIST OF PUBLICATIONS

Molecular detection and pathology of *Pasteurella multocida* B: 2 n the reproductive system of pre-pubertal buffalo calves (Bubalus bubalis)

Hayder Hamzah Ibrahim & Yusuf Abba & Ihsan Muneer Ahmed & Faez Firdaus Abdullah Jesse & Eric Lim Teik Chung & Ali Dhiaa Marza & Mohd Zamri-Saad & Abdul Rahman Omar & Md Zuki Abu Bakar &Abdul Aziz Saharee & Abdul Wahid Haron & Mohd Azmi Mohd Lila: Comparative Clinical Pathology .DOI 10.1007/s00580-015-2184-y. March 2016, Volume 25, Issue 2, pp 319–326

Clinical and Histopathological Study on Reproductive Lesions caused by *Pasteurella multocida* type B: 2 immunogens in Buffalo heifers

H. H. Ibrahim ,F. F. A. Jesse, Y. Abba , E. L. T. Chung, A. D. Marza,,A. W. Haron, M. Zamri-Saad, A. R. Omar & A. A. Saharee : *Bulgarian Journal of Veterinary Medicine*, 2016, ISSN 1311-1477; DOI: 10.15547/bjvm.969

Submitted articles

Involvement of reproductive system of cattle and buffaloes in *Pasteurella multocida* B: 2 infection: A review of pathophysiological changes.
Hayder Hamzah Ibrahim , Faez Firdaus Jesse Abdullah ,Eric Lim Teik Chung, Ali Dhiaa Marza , Mohd Zamri-Saad , Abdul Wahid Haron , Mohd A.
Pertanika Journal of Scholarly Research Reviews http://www.pjsrr.upm.edu.my.

Reproductive Hormonal Variations and Adenohypophyseal Lesions in Pre-pubertal Female Buffalo Inoculated with *Pasteurella multocida* type B: 2 and its immunogens.
Faez Firdaus Jesse Abdullah, Hayder Hamzah Ibrahim, Yusuf Abba, Eric Lim Teik Chung, Ali Dhiaa Marza, Mazlina Mazlan, Mohd Zamri-Saad, Abdul Rahman Omar, Md Zuki Abu Bakar, Abdul Aziz Saharee, Abd Wahid Haron, Mohd Azmi Mohd Lila.
Veterinary Research journal.

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION: _____

TITLE OF THESIS / PROJECT REPORT:

REPRODUCTIVE PATHOPHYSIOLOGY OF PREPUBERTAL BUFFALOES HEIFERS INOCULATED WITH PASTEURELLA MULTOCIDA B:2 AND ITS IMMUNOGENS (LPS AND OMP)

NAME OF STUDENT : HAYDER HAMZAH IBRAHIM

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐	**PATENT**	Embargo from_____ until _____ (date) (date)

Approved by:

_____	_____
(Signature of Student)	(Signature of Chairman of Supervisory Committee)
New IC No/ Passport No.:	Name:
Date :	Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]