
**UNIVERSITI PUTRA MALAYSIA**

# *DIVERSITY AND EPIDEMIOLOGY OF BOVINE HAEMOPARASITES AND THEIR POTENTIAL ARTHROPOD VECTORS IN PENINSULAR MALAYSIA*

**OLA-FADUNSIN SHOLA DAVID**

**FPV 2017 7**

# DIVERSITY AND EPIDEMIOLOGY OF BOVINE HAEMOPARASITES AND THEIR POTENTIAL ARTHROPOD VECTORS IN PENINSULAR MALAYSIA

**By**

**OLA-FADUNSIN SHOLA DAVID**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in fulfilment of the requirements for the Degree Doctor of Philosophy**

**February 2017**

## DEDICATION

This Thesis is dedicated to God Almighty for the life and health he gave me to pursue this degree, to my lovely family: my wife (Mrs Ola-Fadunsin Olufunmilayo Josephine), my children (Mishael, Michael and Esther), my ever supportive parents (Engr. Lt. Col. (rtd) and Mrs T. O. Ola-Fadunsin) and also my wonderful siblings (Mrs Seyi Nwankwo, Engr. Segun Ola-Fadunsin, Dr. (Mrs) Ibukun Eboji and Mr solomon Ola-Fadunsin).

Abstract of the thesis presented to the senate of the Universiti Putra Malaysia in fulfilment of the requirement for the degree Doctor of Philosophy

# DIVERSITY AND EPIDEMIOLOGY OF BOVINE HAEMOPARASITES AND THEIR POTENTIAL ARTHROPOD VECTORS IN PENINSULAR MALAYSIA

By

**OLA-FADUNSIN SHOLA DAVID**

**February 2017**

**Chairman : Reuben Sharma, DVM, MVSc, PhD, MRSB, CBiol.**
**Faculty : Veterinary Medicine**

Bovine haemoparasites are cosmopolitan in distribution, mainly due to the global nature of the cattle livestock industry, and the abundance and widespread dispersal of their arthropod vectors. These haemopathogens are known to cause substantial economic losses to the cattle industry due to decreased productivity and high mortality rates. In spite of their importance, there remains a dearth of information on the epidemiology of haemoparasitic diseases in many parts of the world. The present study therefore aimed to determine the diversity and epidemiology (prevalence, spatial distribution, occurrence of co-infection and risk factors) of bovine haemoparasites in Peninsular Malaysia, and the diversity, spatial distribution, and temporal dynamics of potential arthropods vectors. Blood samples were collected from 1,045 heads of beef and dairy cattle on 43 farms from six geographical zones in Peninsular Malaysia, and subjected to PCR amplification of species-specific genetic fragments for the detection of the various haemoparasites. Molecular detection revealed the presence of these haemoparasites and their prevalence; *Anaplasma marginale* (72.6%), *Theileria orientalis* (49.8%), *"Candidatus Mycoplasma haemobos"* (47.0%), *Babesia bovis* (32.5%), *Babesia bigemina* (30.5%), and *Trypanosoma evansi* (17.9%). There was no distinct pattern of haemoparasites spatial distribution in the country. The six haemoparasites were present in all the sampled farms except one where infection with *T. orientalis* and *T. evansi* were not detected. There was no consistent pattern in the prevalence of cattle haemoparasites according to various epidemiological factors. Our study showed that 92.1% of the total cattle sampled were infected with either one or more species of haemoparasites. Triple haemoparasite species co-infection was the most common. Using multivariable logistic regression, cattle breed and age were identified as the most common risk factors for haemoparasites infection among the cattle. To determine the diversity and spatial distribution of potential arthropod vectors, haematophagous flies were trapped in 25 of the sampled farms and ticks were collected from 15 farms. Three types of traps (Nzi, Malaise and Intercept) were deployed on the farms, and flies belonging to seven genera and 36 species [*Musca* (17

species), *Stomoxys* (6 species), *Tabanus* (6 species), *Chrysops* (4 species), and a species each of *Haematopota*, *Haematobia* and *Haematobosca*] were trapped. Two species of ticks *Rhipicephalus microplus* and *Haemaphysalis bispinosa* were found to parasitize the cattle. To determine the temporal activity patterns of haematophagous diptera on cattle farms and the efficacy of various trapping methods, two each of the Nzi, Malaise and Intercept traps were set in two selected cattle farms (dairy and beef) over a period of one year, accumulating to 216 trap-days. Five genera of flies from 27 species were caught in both farms. The highest abundance was recorded for *Musca crassirostris* (62.4%), followed by *Stomoxys indicus* (15.6%), *M. inferior* (12.8%), *S. calcitrans* (4.2%), *M. sorbens* (1.0%), *M. ventrosa* (0.8%), *S. sistens* (0.8%), *M. bakeri* (0.8%), *M. conducens* (0.6%), *M. asiatica* (0.2%) and *T. minimus* (0.2%). The other species were caught in small numbers. Diurnal activity of the flies followed variable patterns, but peak activity was common in the late evenings (1900hrs). The Nzi trap proved to be the most efficient in trapping a higher diversity and number of haematophagous flies. There was no significant correlation between climatic variables (rainfall and temperature), and the abundance of diptera on the cattle farms. This present study constituted the first attempt in the country to document the molecular epidemiology and risk factors of bovine haemoparasites, and the diversity and dynamics of their potential arthropod vectors. It is envisaged that the data obtained will afford a clearer understanding of the epidemiology of bovine haemoparasitic diseases in Peninsular Malaysia. This in turn could be used to formulate effective treatment, control and prevention measures to assist in improving the health of local cattle in the country.

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

**KEPELBAGAIAN DAN EPIDEMIOLOGI HEMOPARASIT DALAM LEMBU DAN POTENSI VEKTOR ARTROPOD DI SEMENANJUNG MALAYSIA**

Oleh

**OLA-FADUNSIN SHOLA DAVID**

**Februari 2017**

**Pengerusi : Reuben Sharma, DVM, MVSc, PhD, MRSB, CBiol.**
**Fakulti : Perubatan Veterinar**

Parasit darah dalam lembu adalah meluas dalam penyebarannya, terutama disebabkan oleh sifat global industri lembu ternakan, dan kelimpahan dan penyebaran meluas vektor artropod mereka. Parasit patogen darah ini diketahui menyebabkan kerugian ekonomi yang besar kepada industri lembu kerana produktiviti menurun dan kadar kematian yang tinggi. Walaubagaimanapun kepentingannya, masih terdapat kekurangan maklumat mengenai epidemiologi penyakit hemoparasit di banyak tempat di dunia. Oleh itu, kajian ini bertujuan untuk menentukan kepelbagaian dan epidemiologi molekul (kelaziman, pengagihan tempat, berlakunya jangkitan bersama dan faktor risiko) hemoparasit dalam lembu di Semenanjung Malaysia, dan kepelbagaian, taburan, dan dinamik sementara bagi potensi vektor artropod. Sampel darah telah dikumpul daripada 1,045 ekor lembu daging dan lembu tenusu di 43 ladang dari enam zon geografi di Semenanjung Malaysia, saunpet birtakluk kepada PCR penggandaan spesies khusus serpihan genetik untuk mengesan pelbagai parasit darah. Pengesan molekul mendedahkan kehadiran parasit darah ini dan kedar mereka; *Anaplasma marginale* (72.6%), *Theileria orientalis* (49.8%), *"Candidatus Mycoplasma haemobos"* (47.0%), *Babesia bovis* (32.5%), *Babesia bigemina* (30.5%), dan *Trypanosoma evansi* (17.9%). Tidak ada corak yang ketara pada pengagihan tempat parasit darah di negara ini. Enam hemoparasit hadir di semua ladang yang disampel kecuali salah satu di mana jangkitan *T. orientalis* dan *T. evansi* tidak dikesan. Tiada corak konsisten dalam corak hemoparasit lembu mengikut pelbagai faktor epidemiologi. Kajian menunjukkan bahawa 92.1% daripada jumlah lembu yang diuji dijangkiti dagin sama ada satu atau lebih hemoparasit. Jangkitan bersama tiga spesies hemoparasit adalah paling biasa. Menggunakan regresi pembolehubah logistik, baka lembu dan umur telah dikenal pasti sebagai faktor risiko yang paling biasa untuk jangkitan hemoparasit antara lembu. Untuk menentukan kepelbagaian dan taburan spatial untuk potensi vektor artropod, lalat penghisap darah diperangkap dalam 25 ladang dan sengkenit dikumpulkan dari padc 15 ladang. Tiga jenis perangkap (Nzi, Malaise dan Intercept) telah ditempatkan di ladang-ladang, dan lalat dari tujuh genus

dan 36 spesies [*Musca* (17 spesies), *Stomoxys* (6 spesies), *Tabanus* (6 spesies), *Chrysops* (4 spesies), dan satu spesies bagi setiap *Haematopota*, *Haematobia* dan *Haematobosca*] telah terperangkap. Dua spesies sengkenit *Rhipicephalus microplus* dan *Haemaphysalis bispinosa* didapati mengerumuni lembu. Untuk menentukan corak sementara aktiviti Diptera penghisap darah di ladang lembu dan keberkesanan pelbagai kaedah memerangkap, dua bagi setiap Nzi, Malaise dan Intercept perangkap telah ditetapkan dalam dua ladang lembu yang dipilih (tenusu dan daging) dalam tempoh satu tahun, terkumpul sehingga 216 perangkap-hari. Lima genera lalat dari 27 spesies telah diperangkap dalam kedua-dua ladang. Kadar tertinggi dicatatkan untuk *Musca crassirostris* (62.4%), diikuti oleh *Stomoxys indicus* (15.6%), M. rendah (12.8%), *S. calcitrans* (4.2%), *M. sorbens* (1.0%), *M. Ventrosa* ( 0.8%), S. sistens (0.8%), *M. Bakeri* (0.8%), *M. conducens* (0.6%), *M. asiatica* (0.2%) dan *T. minimus* (0.2%). Spesies lain telah diperangkap dalam bilangan yang kecil. Corak ktiviti diurnal lalat ikuti berubah-ubah, tetapi aktiviti puncak adalah biasa pada waktu lewat petang (1900hrs). Perangkap Nzi terbukti menjadi yang paling berkesan dalam memerangkap dagin kepelbagaian dan bilangan lalat penghisap darah yang lebih tinggi. Terdapat hubungan yang signifikan antara pembolehubah iklim (hujan dan suhu), dan kelimpahan Diptera di ladang-ladang lembu. Kajian ini merupakan percubaan pertama di negara ini untuk mendokumentasikan epidemiologi molekul dan faktor-faktor risiko hemoparasit lembu, dan kepelbagaian dan kedinamik potensi vektor artropod mereka. Adalah dijangkakan bahawa data yang diperolehi akan mampu memberi pemahaman yang lebih jelas mengenai epidemiologi penyakit hemoparasit lembu di Semenanjung Malaysia. Seterusnya boleh digunakan untuk merangka rawatan, kawalan dan pencegahan langkah yang berkesan untuk membantu meningkatkan kesihatan ternakan tempatan.

## ACKNOWLEDGEMENTS

I will like to give all the glory, praise, honour and adoration to the Almighty God for His grace, favour and mercies without which this work would not have started and be completed. My profound gratitude and appreciation goes to my chairman supervisory committee, Dr. Reuben Sharma for his invaluable guidance, patience, motivation, immense knowledge, continuous support and encouragement throughout the course of my PhD study. With heart full of gratitude, I will like to appreciate my co-supervisors, Associate Prof. Dr. Faez Jesse Firdaus Abdullah and Prof Dr. Rehana Abdullah Sani for their advice, encouragement, guidance and supervision during my study.

Many thanks goes to Dr. Sule Waidi Folorunsho for initiating the whole Malaysia success story and Dr. Farouk Bande for his support and assistance during my time of seeking admission for this study and during the study. Special appreciation to my fellow lab mates: Collin, Anna, Priya, Dr. Gimba, Dr. Konto, Dr. Donea, Mrs. Aida, Dr. Vish, Shahir, Ruvi, Zarith, Dila and Dilaila for the acceptance, support, times of working into the night and the great friendship we have established. My profound gratitude goes to the staff of Parasitology Laboratory, Faculty of Veterinary Medicine, UPM, Mrs. Maizatul Akmal, Mr. Rashid Abdul Rahman and Mrs. Amlizawaty Amzah for their ready assistance and creating an enabling environment to carry out my research. I am greatly indebted to my father and friend, Mr. John Jeffery who played a great role in the identification of the flies and ticks collected during this work. My sincere gratitude to Dr. Chandrawathani Panchadcharam for every technical assistance to make this research a success. A well-deserved appreciation to Dr. Aroop Mukherjee for guiding and helping with the statistics in this thesis, I am very grateful boss. Special thanks to all the government and private farms that allowed me to obtain samples from their animals.

My sincere appreciation to my Pastors: Pastor and Pastor (Mrs.) Seyi Omisore, my friends: Dr. Tanko, Mr. Ibitoye, Dr. Ibitoye, Mr. Donatus, to mention but a few who made my stay in Malaysia wonderful.

My unreserved appreciation to my parents, Engr. Lt. Col. (rtd) and Mrs. T. O. Ola-Fadunsin for their financial, moral and spiritual support all through the period of this degree, to my wonderful siblings, Engr. and Mrs. Ngozi Nwangwo, Engr. and Mrs. Segun Ola-Fadunsin, Prince and Dr. (Mrs) Lawrence Eboji and Mr. and Mrs. Solomon Ola-Fadunsin for their sacrifices and all round support to see me finish well. To my parents, Engr. and Mrs. I. A. Adeleke, thanks a lot for believing in me to have given me the best gift on earth. My lovely and unending appreciation and thanks goes to my jewel of inestimable value, my wife, Mrs. Ola-Fadunsin Olufunmilayo Josephine for her unconditional love, patience, sacrifices, understanding, moral support, prayers and holding the home-front throughout the study. Similar appreciation goes to my great and wonderful children, Ola-Fadunsin Mishael Oluwatoyin, Ola-Fadunsin Michael Oluwamayowa and Ola-Fadunsin Esther Oluwapelumi for their endurance and prayers during this study.

Finally, I appreciate all my brethren (Pastors, Ministers and Members) of The Redeemed Christian Church of God Malaysia Province 1 and very one too numerous to mention that has made this study a success.

May the Almighty God bless you all.

I certify that a Thesis Examination Committee has met on 8 February 2017 to conduct the final examination of Ola-Fadunsin Shola David on his thesis entitled "Diversity and Epidemiology of Bovine Haemoparasites and their Potential Arthropod Vectors in Peninsular Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Thesis Examination Committee were as follows:

**Abdul Aziz bin Saharee, PhD**
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Chairman)

**Mohd Zamri bin Saad, PhD**
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Internal Examiner)

**Saleha binti Abdul Aziz, PhD**
Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Internal Examiner)

**Simon A. Reid, PhD**
Professor
University of Queensland
Australia
(External Examiner)

**NOR AINI AB. SHUKOR, PhD**
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 28 April 2017

This thesis was submitted to the School of graduate studies of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

**Reuben Sharma, PhD**
Senior Lecturer
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Chairman)

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

**Rehana Abdullah Sani, PhD**
Professor
Faculty of Veterinary Medicine
Universiti Malaysia Kelantan
(Member)

_____
**ROBIAH BINTI YUNUS, 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 other 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: Ola-Fadunsin Shola David, GS36691

**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: Dr. Reuben Sharma

Signature: _____

Name of Member of Supervisory Committee: Associate Professor Dr. Faez Jesse Firdaus Abdullah

Signature: _____

Name of Member of Supervisory Committee: Professor Dr. Rehana Abdullah Sani

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| % | Percent |
| µl | Microliters |
| 1× | one times |
| 10× | ten times |
| 16SrRNA | 16S ribosomal RNA |
| 2× | Two times |
| A | Alanine |
| a | Adenosine |
| AFLP | Amplified Fragment Length Polymorphism |
| AMA-1 | Apical Membrane Antigen- 1 |
| ANOVA | Analysis of Variance |
| bp | base pair |
| C | Cysteine |
| $ddH_2O$ | double distilled water |
| DK | Dengkil |
| DNA | Deoxyribonucleic acid |
| dNTP | deoxynucleatide triphosphate |
| DVS | Department of Veterinary Services |
| E | East |
| EDTA | Ethylenediaminatetraacetic acid |
| ELISA | Enzyme linked Immunosorbent Assay |
| FAO | Food and Agriculture Organization |
| G | Gauge |
| G | Guanine |
| g | Gram |
| GIS | Geographical Information System |
| GPS | Global positioning system |

| | |
|---|---|
| h | Hour |
| kb | Kilobase |
| KK | Kedah-Kelantan |
| km | Kilometer |
| LID | Local Indian Dairy |
| LSD | Least Significant Difference |
| M | Molar |
| m | Metre |
| mg | Milligram |
| $MgCl_2$ | magnesium chloride |
| min | Minute |
| ml | Milliliters |
| mM | Millimolar |
| mm | Millimeters |
| MPSP | Major Piroplasm Surface Protein |
| MSP4 | Major Surface Protein-4 |
| N | North |
| N | Number |
| NCBI | National Center for Biotechnology Information |
| ℃ | degree Celsius |
| OIE | World Organization for Animal Health |
| PCR | Polymerase Chain Reaction |
| rbcs | red blood cells |
| RNA | ribonucleic acid |
| RoTat 1.2 | Rode Trypanozoon Antigen Type 1.2 |
| sec | Seconds |
| spp | Species |
| SPSS | Statistical Package for Social Sciences |
| T | Thymine |

| | |
|---|---|
| TAE | tris-acetic-EDTA |
| UV | Ultraviolet |
| V | Voltage |
| VESA 1α | Variant Erythrocyte Surface Antigen 1 |
| W | Watt |

# CHAPTER 1

# INTRODUCTION

Parasitism is a major cause of economic losses in many cattle producing countries of the world. Heavy parasite burdens are known to cause mortality, reduction in weight gain, low fertility, and sub-optimal production in ruminants (Perry and Randolph, 1999; Sissay *et al*., 2007; Alembrhan and Haylegebriel, 2013). Ruminants are susceptible to a large number of parasites represented by the major classes of helminths, arthropods and protozoa (Hunter-Cevera and Belt, 1996). Among the various economically important bovine diseases, vector-borne haemoparasite infections such as anaplasmosis, babesiosis, trypanosomiosis, theileriosis and mycoplasmosis are recognized as a major cause of severe clinical illnesses in cattle (Haque *et al*., 2012; Singh *et al*., 2012). These parasites threaten an estimated 250 million cattle and act as a major constraint on livestock production and improvement in many developing countries (Durrani and Kamal, 2008; Singh *et al*., 2012; Huseyin *et al*., 2013). The estimated annual global costs associated with arthropod and arthropod-borne diseases in cattle is between US$ 13.9 to 18.7 billion (de Castro, 1997). Haemoparasite infections may be silent and only evident when the host is undergoing a clinical response to infection. While low-grade parasitaemia may be readily observed in blood smears from apparently healthy animals, heavy infection may inflict losses to the cattle industry due to the increase in mortality, reduced growth rate and production, lowered working efficiency and abortions (Levine, 1985; Kamio *et al*., 1990; Fadraga *et al*., 1991; Sajid *et al*., 2007; Yitayew and Samuel 2015).

In Malaysia, ruminant livestock farming is an important component of its agricultural sector. The Malaysian government, in its effort to be self-sufficient in beef production, has embarked on various strategies to promote economic livestock production. The cattle population in the entire country as of 2011 was estimated to be a little below one million heads, with the vast majority of the cattle farms concentrated in Peninsular Malaysia (West Malaysia) (DVS, 2011). Over three decades ago, the Department of Veterinary Services Malaysia (DVS, 1986) stressed the importance of disease surveillance and identified blood parasite infections as a major parasitic condition affecting cattle in the country. The spread of these organisms are often difficult to control as they are effectively transmitted by biting arthropods, which are abundant in the tropical climate of Malaysia which favour its survival and multiplication throughout the year (Saharee and Fatimah, 1993).

Amin-Babjee (1978), Sani *et al*. (1995), Sharifat (2001) and Chin (2007) documented that anaplasmosis, babesiosis, mycoplasmosis, theileriosis and trypanosomiasis are the major haemoparasitic diseases that affect cattle in Malaysia. These diseases are known to cause substantial losses to the cattle industry in the country (Hassan, 1977). Monitoring of a local cattle farm over a seven year duration revealed a death rate of 66% due to haemoparasite infections (Amin-Babjee, 1993). A recent study (Premaalatha *et al*., 2013) on the seroprevalence of *Anaplasma marginale* in Malaysia recorded a high prevalence rate of 78.5%. Rahman *et al*. (2010) employed an Indirect Immunofluourescent Antibody assay (IFAT) to determine the prevalence of bovine

babesiosis and documented prevalence rates of 17.0% for *Babesia bovis*, 16.0% for *B. bigemina* and 9.0% for both *B. bovis* and *B. bigemina*. A subsequent seroprevalence study (Rahman *et al*., 2012) on *Trypanosoma evansi* and *A. marginale* recorded prevalence rates of 14.7% and 77.6%, respectively. Earlier work by Hassan (1977) on cattle and buffaloes in Peninsular Malaysia recorded that the most common blood parasites in these livestock were *Babesia* and *A. marginale*. Kamio *et al*. (1990) screened blood samples of 322 cattle in seven states of Peninsular Malaysia and made an interesting observation that all the cattle harboured *Theileria*. With the present body of evidence, it is apparent that bovine haemoparasites are prevalent in the country and could pose a substantial risk to profitable livestock production. However, it is often the case that most silent infections go undetected by conventional microscopy, and serological data only reveals that the animals were exposed to the parasites but does not readily provide information on active infection. Low grade parasitaemia, in the absence of clinical disease, is of concern as this could lead to gradual but significant loss in productivity. Apart from a single study on the molecular prevalence of *Anaplasma* (Tay *et al*., 2014) among cattle in one location in the country, there remains a paucity of information on the molecular prevalence of local bovine haemoparasites. It is therefore timely that a molecular study be conducted to detect these haemoparasites infecting cattle in the country, and to determine the diversity of their potential arthropod vectors.

Biting flies have been known to be efficient mechanical vector for several pathogens like *Anaplasma* and *Trypanosoma*, and have a direct influence on the epidemiology of vector-borne diseases (Torr *et al.*, 2006 and Martins *et al*., 2008). They also cause nuisance and restlessness to livestock and inflict severe bites that cause blood loss, and may result in reduced weight gain and sub-optimal milk production (Taylor *et al*., 2012). In Malaysia, biting flies such as *Stomoxys*, *Haematopota*, *Chrysops* and *Tabanus* have been implicated as vectors of bovine anaplasmosis and bovine trypanosomiasis (Surra) (Nurulaini *et al.*, 2007; Rahman *et al.*, 2012). Ticks are cosmopolitan in distribution and are capable of transmitting a wide range of pathogens including viruses, bacteria and protozoa, highlighting their importance as vectors of disease for livestock (Ryan, 2006). Tick-borne parasitic diseases occur throughout the world, especially in tropical and subtropical areas (Monique and Henri, 2002). These arthropods have been implicated to cause major losses to the cattle industry as a result of disease transmission, damage to the skin through their attachment, restlessness and the nuisance caused (Jongejan and Uilenberg, 1994). In Malaysia, cattle ticks have been incriminated as vectors for a variety of bovine diseases, including theleriosis, babesiosis and anapalsmosis (Kamio *et al.*, 1990; Rahman *et al.*, 2010; Rahman *et al.*, 2012).

In spite of the major concern and economic drawbacks caused by bovine haemoparasites, there remains a dearth of current published information on the prevalence and zoogeographical distribution of these pathogens and their arthropod vectors in Malaysia. In addition, more advanced molecular diagnostic techniques have not been employed to determine the presence of these haemopathogens locally. It has been well established that molecular detection techniques like the Polymerase Chain Reaction (PCR) and subsequent DNA sequencing of target genes are highly effective means of detecting and genotyping blood parasites (Zahler *et al.*, 2000; Dantrakool *et*

*al*., 2004). The present study was therefore undertaken to investigate the molecular epidemiology of bovine haemoparasites in Peninsular Malaysia, and to determine the diversity and spatio-temporal distribution of their known and potential vectors. It constitutes the first comprehensive attempt to employ molecular techniques to determine the prevalence and epidemiology of these bovine pathogens over a widespread area of the country, and the first systematic investigation on the occurrence and diversity of biting fly vectors that may be responsible for transmission. It is envisaged that the data obtained will afford a more accurate representation of local bovine haemoparasite-vector occurrence, which in turn may facilitate targeted control and prevention measures to be instituted. The present study was undertaken with the following hypotheses and specific objectives:

**Hypothesis**

1. Bovine haemoparasites (*Anaplasma*, *Babesia*, *Mycoplasma*, *Theileria* and *Trypanosoma*) are present in Peninsular Malaysia with no defined pattern of distribution.
2. Numerous risk factors at the farm and animal levels are associated with bovine haemoparasite infection in Peninsular Malaysia.
3. The dynamics of arthropod vectors of these parasites may be influenced by environmental variables.
4. Various trapping methods will have different level of efficacy in the collection of biting flies that may be vectors of these haemoparasites.

**Objectives**

1. To determine the diversity, prevalence, spatial distribution, and occurrence of co-infection of bovine haemoparasites in Peninsular Malaysia by PCR detection.
2. To ascertain the risk factors for infection with these haemoparasites among local cattle at the farm and animal levels.
3. To investigate the species diversity and spatial distribution patterns of haematophagous arthropods that may be potential vectors for bovine haemoparasites in the country.
4. To determine the seasonal dynamics and temporal activity patterns of haematophagous diptera, and the efficacy of various trapping methods on selected cattle farms in the country.

## REFERENCES


Abas Mazni, O. and Zainal-Abidin, A. H. (1985). The infectivity and virulence of *Trypanosoma evansi* in Local Indian Dairy x Kedah Kelantan cattle. Malaysian Agricultural Research and Development Institute Bulletin 13: 291-301.

Abas Mazni, O., Zainal-Abidin, A. H. and Ramakrishnan, P. (1987). Observations on the the prevalence of *Trypanosoma evansi* infection in the swamp buffaloes at Bukit Ridan, Pahang Darul Makmur, West Malaysia. Tropical Veterinary 5: 127-132.

Abdulla, I., Arshad, F. M., Bala, B. K., Bach N. L. and Mohammadi, S. (2016). Management of Beef Cattle Production in Malaysia: A Step Forward to Sustainability. American Journal of Applied Sciences 13 (9): 976-983.

Abou El-Naga, T. R., Barghash, S. M., Mohammed, A. H., Ashour, A. A. and Salama, M. S. (2012). Evaluation of (Rotat 1.2-PCR) Assays for Identifying Egyptian *Trypanosoma evansi* DNA. Acta Parasitologica Globalis 3(1): 01-06.

Adkins, T. R., Ezell, W. B., Sheppard, D. C. and Askey, M. M. (1972). A modified canopy trap for collecting Tabanidae (Diptera). Journal of Medical Entomology 19: 183-185.

Adler, S. and Ellenbogen, V. A. (1934). A note on two new blood parasites of cattle, *Eperythrozoon* and *Bartonella*. Journal of Comparative Pathology and Therapeutics 47: 219-221.

Adrian, S. A. V. M. (2008). Investigation of Trypanosomiasis at a deer farm in Lenggong, Perak, DVM Thesis, Universiti Putra Malaysia.

Ahmed, A. B., Okiwelu, S. N. and Samdi, S. M. (2005). Species diversity, abundance and seasonal occurrence of some biting flies in Southern Kaduna, Nigeria. African Journal of Biomedical Research 8: 113-118.

Ahmed, J. S. (2002). The role of cytokines in immunity and immunopathogenesis of pirolasmoses, Parasitology Research 88: 48-50.

Ahmed, J. S., Glass, E. J., Salih, D. A. and Seitzer, U. (2008). Innate immunity to tropical theileriosis, a review. Innate Immunity 14: 5-12.

Akinpelu, A. I. (2008). Prevalence and Intensity of Blood Parasites in Wild Pigeons and Doves (Family: Columbidae) from Shasha Forest Reserve, Ile-Ife, Nigeria. Asian Journal of Animal and Veterinary Advances 3: 109-114.

Aktas, M., Altay, K. and Dumanli, N. (2006). A molecular survey of bovine *Theileria* parasites among apparently healthy cattle and with a note on the distribution of ticks in eastern Turkey. Veterinary Parasitology 138: 179–185.

Alembrhan, A. and Haylegebriel, T. (2013). Major causes of organ condemnation and economic loss in cattle slaughtered at Adigrat municipal abattoir, northern Ethiopia Veterinary World 6(10): 734-738.

Ali-Hussain, H., Nabil, A. S. and Jabbar, S. A. (2012). Pathological and molecular diagnostic study of theileriosis in cattle in Sulaimaniyah province, Iraq. Proceeding of the Eleventh Veterinary Scientific Conference. 306-314.

Al-Khedery, B. and Allred, D. R. (2006). Antigenic variation in *Babesia bovis* occurs through segmental gene conversion of the ves multigene family, within a bidirectional locus of active transcription. Molecular Microbiology 59: 402–414.

Allred, D. R., Carlton, J. M., Satcher, R. L., Long, J. A., Brown, W. C., Patterson, P. E., O'Connor, R. M. and Stroup, S. E. (2000).The ves multigene family of *B. bovis* encodes components of rapid antigenic variation at the infected erythrocyte surface. Molecular Cell 5: 153–162.

Allsopp, M. T., Cavalier-Smith, T., de Waal, D. T., and Allsopp, B. A. (1994). Phylogeny and evolution of the piroplasms, Parasitology 108: 147-152.

Almería, S., Delgado-Neira, Y., Adelantado, C., Huguet, M., Vinent, J. and Nicolàs, A. (2009). Mediterranean Theileriosis and Other Tick Transmitted Piroplasmoses in Cattle in Minorca (Balearic Islands, Spain): the Effect of Tick Control on Prevalence Levels Analyzed by Reverse Line Blot (Rlb) Macroarrays. Journal of Parasitology 95(3): 598-603.

Al-Qarawi, A. A., Omar, H. M., Abdel-Rahman, H. A., El-Mougy, S. A. and El-Belely, M. S. (2004). Trypanosomiasis-induced infertility in dromedary *(Camelus dromedarius)* bulls: changes in plasma steroids concentration and semen characteristics. Animal Reproduction of Science 84: 73-82.

Altangerel, K., Battsetseg, B., Battur, B., Sivakumar, T., Batmagnai, E., Javkhlan, G., Tuvshintulga, B., Igarashi, I., Matsumoto, K., Inokuma, H. and Yokoyama, N. (2011a). The first epidemiological survey of *Theileria orientalis* infection in Mongolian cattle. Veterinary Parasitology 182: 343–348

Altangerel, K., Sivakumar, T., Inpankaew, T., Jittapalapong, S., Terkawi, M. A., Ueno, A., Xuan, X., Igarashi, I. and Yokoyama, N. (2011b). Molecular Prevalence of Different Genotypes of *Theileria orientalis* Detected from Cattle and Water Buffaloes in Thailand. Journal of Parasitology 97(6): 1075-1079.

Amin-Babjee, S. M. (1978). Common Bovine Parasitic Diseases in Peninsular Malaysia. In the Livestock Industry in Malaysia, ed. C. Samuel, J. Young and A.R. Omar, pp. 71. Ipoh, Malaysia: Rajan & Co.

Amin-Babjee, S. M. (1993). Parasitic diseases of domestic ruminants in Malaysia. In the animal industry in Malaysia, ed. C.T.N.I. Fatimah, A. H. Ramlah and A. R. Bahaman, pp. 179-185. Serdang, Selangor: Faculty of Veterinary Medicine and Animal Science, Universiti Pertanian Malaysia.

Ananda, K. J., Placid, E. and Puttalakshmamma, G. C. (2009). Prevalence of hemoprotozoan diseases in crossbred cattle in Bangalore north. Veterinary World 12: 15-16.

Anon. (1979). Proceedings of a workshop on livestock pest management. Kansas State University, Manhattan, Kansas, pp.322.

Aparna, M., Ravindran, R., Vimalkumar, M. B., Lakshmanan, B., Rameshkumar, P., Kumar, K. G., Promod, K., Ajithkumar, S., Ravishankar, C., Devada, K., Subramanian, H., George, A.J and Ghosh, S. (2011). Molecular characterization of *Theileria orientalis* causing fatal infection in crossbred adult bovines of South India. Parasitology international 60: 524–529.

Arunachalam, K., Bino Sundar, S. T. and Sangaran, A. (2014). Report on the infestation of *Haemaphysalis* specie tick in man. International Journal of Agricultural Sciences and Veterinary Medicine 2(4): 109-110.

Arunasalam, V., Chandrawathani, P. and Sivanandan, S. (1995). An outbreak of *Trypanosoma evansi* infection in pigs. Jurnal Veterinar Malaysia 7: 71-73.

Atif, F. A., Khan, M. S., Iqbal, H. J., Arshad, G. M., Ashraf, E. and Ullah, S. (2012). Prevalence of *Anaplasma marginale*, *Babesia bigemina* and *Theileria annulata* infections among cattle in Sargodha District, Pakistan. African Journal of Agricultural Research 7(22): 3302-3307.

Atif, F. A., Khan, M. S., Muhammad, F. and Ahmad, B. (2013). Sero-epidemiological study of *Anaplasma marginale* among cattle. The Journal of Animal and Plant Sciences 23(3): 740-744.

Aubry, P. and Geale, D. W. (2011). A review of bovine anaplasmosis. Transboundary and Emerging Diseases 58: 1-30.

Ayling, R. D., Bisgaard-Frantzen, S., Adler, A., Blowey, R. W., Barlow, A. M., Millar, M. F. and van der Burgt, G. M. (2012). Detection of 'Candidatus Mycoplasma haemobos', Mycoplasma wenyonii and Anaplasma phagocytophilum from cattle in England. Veterinary Record 170(21): 543-549.

Baetselier, P. D., Namangala, B., Noël, W., Brys, L., Pays, E. and Beschin, A. (2001). Alternative versus classical macrophage activation during experimental African trypanosomosis. International Journal for Parasitology 31: 575-587.

Baharudin, O., Amran, A., Ismail, G., Jeffrey, J., Abdullah, M. A. and Hamimah, I. (1984). Studies on the medically important flies in Malaysia *Stomoxys Pulla* Austen (Diptera: Muscidae): a new record from Malaysia. Bangi: Penerbit Universiti Kebangsaan Malaysia.

Baldacchino, F., Muenworn, V., Desquesnes, M., Desoli, F., Charoenviriyaphap, T., Duvallet, G. (2013). Transmission of pathogens by Stomoxys flies (Diptera, Muscidae): a review. Parasite 20: 20–26.

Baral, T. N., De Baetselier, P., Brombacher, F. and Magez, S. (2007). Control of *Trypanosoma evansi* infection is IgM mediated and does not require a type I inflammatory response. Journal of Infectious Diseases 195: 1513-1520.

Barbet, A. F. (2009). Persistence mechanisms in tick-borne diseases. Onderstepoort Journal of Veterinary Research 76: 53–58.

Barker, S. C. and Murrell, A. (2004). Systematics and evolution of ticks with a list of valid genus and species names. Parasitology 129(7): 15-36.

Barnard, D. R. (2003). Control of fly-borne diseases. Pesticide Outlook 14: 222-228.

Barros, A. T. M. (2001). Seasonality and relative abundance of Tabanidae (Diptera) captured on horses in the Pantanal, Brazil. Mem. Inst. Oswaldo Cruz, Rio de Janeiro. 96: 917-923.

Barros, T. and Foil, L. (1999). Seasonal occurrence and relative abundance of Tabanidae (Diptera) from the Pantanal Region, Brazil. Memoirs of Entomology International 14: 387-396.

Baticados, W. N., Fernandez, C. P. and Baticados, A. M. (2011). Molecular detection of *Trypanosa evansi* in cattle from Quirino Province, Philippines. Veterinarski Arhiv 81 (5); 635-646.

Bauer, N., Balzer, H. J., Thüre, S. and Moritz, A. (2008). Prevalence of feline haemotropic mycoplasmas in convenience samples of cats in Germany. Journal of Feline Medicine and Surgery 10: 252–258.

Bawm, S., Soe, T. T. and Htun, L. L. (2015). Seasonal abundance of horse flies (Diptera: Tabanidae) and stable fly (Diptera: Muscidae) collected by Nzi trap within Taw Area, Myanmar. Journal of Environmental and Applied Research 03 (1): 01-06.

Bell-Sakyi, L., Koney, E. B. M., Dogbey, O. and Walker, A. R. (2004). Incidence and prevalence of tick-borne haemoparasites in domestic ruminants in Ghana. Veterinary Parasitology 124(1-2): 25-42.

Beresford, D. V. and Sutcliffe, J. F. (2008). Stable fly (*Stomoxys calcitrans*: Diptera, Muscidae) trap response to changes in effective trap height caused by growing vegetation. Journal of Vector Ecology 33: 40–45.

Beresford, D. V. and Sutcliffe, J. F. (2006). Studies on the effectiveness of Coroplast sticky traps for sampling stable flies (Diptera: Muscidae), including a comparison to Alsynite. Journal of Economic Entomology 93: 1025-1035.

Berry, I. L. and Campbell, J. B. (1985). Time and weather effects on daily feeding pattern of stable flies (Diptera: Muscidae). Environmental Entomology 14: 336-342.

Bhoora, R., Franssen, L., Oosthuizen, M. C., Guthrie, A. J., Zweygarth, E., Penzhorn, B. L., Jongejan, F. and Collins, N. E. (2009). Sequence heterogeneity in the 18S rRNA gene within *Theileria equi* and *Babesia caballi* from horses in South Africa. Veterinary Parasitology 159(2): 112-20.

Bilgic, H. B., Karagenc, T., Simuunza, M., Shiels, B., Tait, A., Eren, H. and Weir, W. (2013). Development of a multiplex PCR assay for simultaneous detection of *Theileria annulata*, *Babesia bovis* and *Anaplasma marginale* in cattle. Experimental Parasitology 133: 222–229.

Binnington, K. C., Young, A. S. and Obenchain, F. D. (1983). Morphology of normal and *Theileria parva* infected salivary glands of *Rhipicephalus appendiculatus.* Journal of Parasitology 69: 421-424.

Birkenheuer, A. J., Breitschwerdt, E. B., Alleman, A. R. and Pitulle, C. (2002). Differentiation of Haemobartonella canis and Mycoplasma haemofelis on the basis of comparative analysis of gene sequence, American Journal of Veterinary Research 63: 1385– 1388.

Bishop, R., Musoke, A., Morzaria, S., Gardner, M. and Nene, V. (2004). Theileria: intracellular protozoan parasites of wild and domestic ruminants transmitted by ixodid ticks. Parasitology 129: 271–283.

Bishop, R., Musoke, A., Skilton, R., Morzaria, S., Garder, M. and Nene, V. (2008). Theileria: life cycle stages associated with the ixodid tick vector. In: Alan S. Bowman, Patricia A. Nuttall (eds.), Ticks: Biology, Disease and Control. Cambridge University Press. pp. 308-324.

Bitome Essono, P. Y., Dechaume-Moncharmont, F. X., Mavoungou, J., Obiang Mba, R., Duvallet, G. and Bretagnolle, F. (2015). Distribution and abundance of hematophagous flies (Glossinidae, Stomoxys, and Tabanidae) in two national parks of Gabon. Parasite 22 (23): 1-11.

Blears, M. J., Pokorny, N. J., Carreno, R. A., Chen, S., De Grandis, S. A., Lee, H. and Trevors, J. T. (2000). DNA fingerprinting of Cryptosporidium parvumn isolates using amplified fragment length polymorphism (AFLP). Journal of Parasitology 86(4): 838-41.

Blood, D. C., Radostits, O. M. and Henderson, J. A. (1983). Veterinary Medicine - A textbook of the Diseases of Cattle, Sheep, Goats and Horses. Sixth Edition - Bailliere Tindall London.

Blumenthal, U.J., Fleisher, J.M., Esrey, S.A., Peasey, A. (2001). Epidemiology: a tool for the assessment of risk. In: Fewtrell, L., Bartram, J. (Eds.). Water Quality: Guidelines, Standards and Health. IWA, London, UK, pp. 135–160.

Bock, R. E., de Vos, A. J., Kingston, T. G. and McLellan, D. J. (1997). Effect of breed of cattle on innate resistance to infection with *Babesia bovis*, *B. bigemina* and *Anaplasma marginale*, Australia Veterinary Journal 75: 337-340.

Bock, R. E., Kingston, T. G. and de Vos, A. J. (1999a). Effect of breed of cattle on transmission rate and innate resistance to infection with *Babesia bovis* and *B bigemina* transmitted by *Boophilus microplus*, Australian Veterterinary Journal 77 (7): 461-464.

Bock, R. E., Kingston, T. G., and de Vos, A. J. (1999b). Effect of breed of cattle on innat resistance to infection with *Anaplasma marginale* transmitted by *Boophilus microplus*, Australian Veterterinary Journal 77: 748-751.

Bock, R., Jackson, L., De Vos, A. and Jorgensen, W. (2004). Babesiosis of cattle. Parasitology. 129, S247–S269.

Bogema, D. R., Deutscher, A. T., Fell, S., Collins, D., Eamens, G. J. and Jenkins, C. (2015). Development and Validation of a Quantitative PCR Assay Using Multiplexed Hydrolysis Probes for Detection and Quantification of *Theileria orientalis* Isolates and Differentiation of Clinically Relevant Subtypes. Journal of Clinical Microbiology 53(3): 941-950.

Borst, P., Fase-Fowler, F. and Gibson, W.C. (1987). Kinetoplast DNA of *Trypanosoma evansi*. Molecular and Biochemical Parasitology 23: 31-38.

Bowie, M. V., de la Fuente, J., Kocan, K. M., Blouin, E. F., Barbet, A .F. (2002). Conservation of major surface protein 1 genes of *Anaplasma marginale* during cyclic transmission between ticks and cattle. Gene 282: 95-102.

Bradley, A. M. and Peterson, N. G. (2005). Relationship between Rainfall and Stable Fly (Diptera: Muscidae) Abundance on California Dairies. Journal of Medical Entomology 42 (4): 705-708.

Bram, R.A. (1983). Tick-borne livestock diseases and their vectors. 1. The global problem. Wld. Anim. Rev., (FAO), 36:1-5.

Brayton, K. A., Lau, A. O., Herndon, DR, Hannick, L., Kappmeyer, L. S., Berens, S. J., Bidwell, S. L., Brown, Y. C., Crabtree, J., Fadrosh, D., Feldblum, T., Forberger, H. A., Haas, B. J., Howell, J. M., Khouri, H., Koo, H., Mann, D. J., Norimine, J., Paulsen, I. T., Radune, D., Ren, Q., Smith Jr., R. K., Suarez, C. E., White. O., Wortman, J. R. Knowles Jr., D. P., McElwain, T. F. and Nene, V. M. (2007). Genome sequence of *Babesia bovis* and comparative analysis of apicomplexan hemoprotozoa. PLoS Pathogens 3: 1401–1413.

Brightwell, R. Dransfield, R. D., Kyorku. C., Golder, T.K., Tarimo, S. A. and Mungai, D. (1987). A new trap for *Glossina pallidipes*. Tropical Pest Management 33(2): 151-159.

Brightwell, R., Dransfield, R. D. and Kyorku. C. (1991). Development of a low-cost tsetse trap and odour baits for *Glossina pallidipes* and *Glossina longipennisin* Kenya. Medical and Veterinary Entomology 5: 153-164.

Brown, C. D. G., Hunter, A. G. and Luckins, A. G. (1990) Bovine babesiosis. In: Sewell MMH, Brocklesby DW (eds.). Handbook on Animal Diseases in the Tropics, Chapter: Diseases caused by protozoa. Bailli ère Tindall, 161-170.

Brown, C. G. (1990). Control of tropical theileriosis (Theileria annulata infection) of cattle. Parassitologia 32(1): 23-31.

Brown, W. C. and Palmer, G. H. (1999). Designing blood-stage vaccines against *Babesia bovis* and *B. bigemina*. Parasitology Today 15: 275-281.

Brown, W. C., Norimine, J., Knowles, D. P. and Goff, W. L., (2006). Immune control of *Babesia bovis* infection. Veterinary Parasitology 138: 75–87.

Bruce, W. N. and Decker G. C. (1958). The relationship of stable fly abundance to milk production in dairy cattle. Journal of Economic Entomology 51: 269-274.

Brun, R., Hecker, H. and Lun, Z. R. (1998). *Trypanosoma evansi* and *T. equiperdum*: distribution, biology, treatment and phylogenetic relationship (a review). Veterinary Parasitology. 79: 95-107.

Burger, J. F. and Chainey, J. E. (2000). Revision of the Oriental and Australasian species of *Chrysops* (Diptera: Tabanidae). Invertebrate Taxonomy 14: 607–654.

Burger, J. F. and Thompson, F. C. (1981). The *Tabanus striatus* complex (Diptera: Tabanidae): A revision of some oriental horse fly vectors of surra. Proceedings of the Entomological Society of Washington 83(2): 339-358.

Burton, J. J. S. (1978). Tabanini of Thailand above the Isthmus of Kra (Diptera: Tabanidae). Entomological Reprint Specialists, Los Angeles.

Campbell, J. B., White, R. G., Wright, J. E., Crookshank, R. and Clanton, D. C. (1977). Effects of stable flies (Diptera: *Muscidae*) on weight gains and feed-efficiency of calves on growing or finishing rations. Journal of Economic Entomology 70: 592-594.

Carelli, G., Decaro, N., Lorusso, A., Elia, G., Lorusso, E., Mari, V., Ceci, L. and Buonavoglia, C. (2007). Detection and quantification of *Anaplasma marginale* DNA in blood samples of cattle by real-time PCR. Veterinary Microbiology 124: 107–114.

Carnes, J., Anupama, A., Balmer, O., Jackson, A., Lewis, M., Brown, R., Cestari, I., Desquesnes, M., Gendrin, C., Hertz-Fowler, C., Imamura, H., Ivens, A., Koreny, L., Lai, D-H., MacLeod, A., McDermott, S. M., Merritt, C., Monnerat, S., Moon, W., Myler, P., Phan, I., Ramasamy, G., Sivam, D., Lun, Z.-R., Lukes, J., Stuart, K. and Schnaufer, A. (2015). Genome and Phylogenetic Analyses of *Trypanosoma evansi* Reveal Extensive Similarity to *T. brucei* and Multiple Independent Origins for Dyskinetoplasty. PLOS Neglected Tropical Disease (9): 1. 1-21.

Case, R. J., Boucher, Y., Dahllo, I., Holmström, C., Doolittle, W. F. and Kjelleberg, S. (2007). Use of 16SrRNA and rpoB Genes as Molecular Markers for Microbial Ecology Studies. Applied and environmental Microbiology 73 (1): 278–288.

Catangui, M. A., Campbell, J. B. Thomas, G. D. and Boxler, D. J. (1997). Calculating economic injury levels for stable flies (Diptera: *Muscidae*) on feeder heifers. Journal of Economic Entomology 90: 6-10.

Centro Panamericano de Zoonosis. (1976*). Diagnóstico de situação sanitária na sub-área de São Gonçalodo Sapucaí-MG. In: Curso de Planificacion en Salud Animal, 6th, Buenos Aires. Relatório dos Participantes, s. n. t., mimeograph.*

Challier, A., Eyraud, M., Lafaye, A. and Laveissière, C. (1977) Amélioration du rendement du piège biconique pour glossines (Diptera, Glossinidae): par l'emploi d'un cône inférieur bleu. Cahiers ORSTOM, séries Entomologie médicale et Parasitologie 15: 283-286.

Chandrawathani, P. (2000). Status of Babesiosis in Malaysia. In: Proceedings of the Third Obihiro International Symposium on Protozoan Diseases. August 31–September 2, 2000. National Research Center for Protozoan Diseases, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido, Japan.

Chandrawathani, P., Luckins A. G., Jamnah, O., Adnam, M., Zaini C. M. and Cheah, T. S. (1998). Serological prevalence bovine trypanosomiasis in Peninsular Malaysia. In: Proceeding of the 10th Veterinary Association Malaysia Scientific Congress, Shah Alam.

Chandrawathani, P., Tak, T. K., Adnan, M., Erwanas, A. I., Premaalatha, B., Low, K. N., Moo, K. S., Soon, X. Q., Yvonne, A. L. and Ramlan, M. (2014). Significant blood protozoan infections, their host range and trend of infection in domestic animals of Malaysia diagnosed by the department of Veterinary Services and Veterinary Research Institute (VRI) from 1931 to 2010- A historical preview. Malaysian Journal of Veterinary Research 5(2): 47-61.

Chandrawathani, P., Tsuji, N., Kawazu, S., Ishikawa, M. and Fujisaki, K. (1994). Seroepidemiology studies of bovine babesiosis caused by *Babesia ovata*, *B. bigemina* and *B. bovis* in Peninsular Malaysia. Journal of Veterinary Medical Science 56(5): 929-932.

Chandrawathani, P., Tsuji, N., Kawazu, S.I. and Fujisaki, K. (1993). The serological prevalence of *Babesia ovata*, *Babesia bigemina* and *Babesia bovis* in Malaysia. In: Proceeding of the 5th Veterinary Association Malaysia Scientific Congress, Air Keroh, Malaka. 1-3 October 1993, pp: 47-48.

Changbunjong, T., Weluwanarak, T., Ratanakorn, P. and Maneeon, P. (2012). Distribution and abundance of Stomoxyini flies (Diptera: Muscidae) in Thailand. The Southeast Asian Journal of Tropical Medicine and Public Health 43: 1400-1410.

Charlwood, J. D. and Lopes, J. (1980).The age structure and biting behavior of *Stomoxys calcitrans* (Diptera: Muscidae) from Manaus, Brazil. Bulletin of Entomological Research 70: 549-556.

Chauvin, A., Moreau, E., Bonnet, S., Plantard, O. and Malandrin, L. (2009). Babesia and its hosts: adaptation to long-lasting interactions as a way to achieve efficient transmission. Veterinary Research 40, 37.

Cheah, T. S., Sani, R. A., Chandrawathani, P., Bahri, S. and Dahlan, I. (1999). Epidemiology of Trypanosoma evansi infection in crossbred dairy cattle in Malaysia. Tropical Animal Health and Production 31(1): 25-31.

Chin, H. C., Ahmad, N. W., Kian, C. W., Kurahashi, H., Jeffery, J., Kiang, H. S. and Omar. B. (2010). A Study of Cow Dung Diptera in Sentul Timur, Kuala Lumpur, Malaysia. The Journal of Tropical Medicine and Parasitology. 33 (2):53-61.

Chin, P. L. (2007). Prevalence of blood parasites in UPM cattle, DVM Thesis, Universiti Putra Malaysia.

Claes, F., Radwanska, M., Urakawa, T., Majiwa, P. A. O., Goddeeris, B. and Büscher, P. (2004). Variable Surface Glycoprotein RoTat 1.2 PCR as a specific diagnostic tool for the detection of *Trypanosoma evansi* infections. Kinetoplastid Biology and Disease 3(3): 1-6.

Claes, F., Verloo, D., De Waal, D. T., Majiwa, P. A. O., Baltz, T., Goddeeris, B. M. and Büscher, P. (2003). The expression of RoTat 1.2 variable surface glycoprotein (VSG) in *Trypanosoma evansi* and *T. equiperdum*. Veterinary Parasitology 116: 209–216.

Clarridge, J. E. (2004). Impact of 16S rRNA Gene Sequence Analysis for Identification of Bacteria on Clinical Microbiology and Infectious Diseases. Clinical Microbiology Reviews 17 (4): 840–862.

Collinet-Adler, S., Babji, S., Francis, M., Kattula, D., Premkumar, P. S., Sarkar, R., Mohan, V. R., Ward, H., Kang, G., Balraj, V. and Naumova, E. N. (2015). Environmental factors associated with high fly densities and diarrhea in Vellore, India. *Applied and Environmental Microbiology* 81(17): 6053-6058.

Colwell, D. D. (2014). Life history parameters of the cattle long-nosed sucking louse, Linognathus vituli. Medical and Veterinary Entomology 28(4): 432-437.

Costa, V. M., Ribeiro, M. F., Duarte, A. L., Mangueira, J. M., Pessoa, A. F., Azevedo, S. S., Barros, A.T., Riet-Correa, F. and Labruna, M. B. (2013). Seroprevalence and risk factors for cattle anaplasmosis, babesiosis, and trypanosomiasis in a Brazilian semiarid region. Brazilian Journal of Veterinary Parasitology 22(2): 207-213.

Cox, F. E. G. (2001). Concomitant infections, parasites and immune responses. Parasitology. 122: 23-38.

Cresencio, R. O., Roeder, P. L., Tongson, M. T., Gonzales, A. T., Jacobo, L. V., De la Peña, R. C. and Abuso, O. T. (1994). Incident of disease in carabaos and cattle with *Trypanosoma evansi* involvement. In: Annual Convention of the Veterinary Practitioners Association of the Philippines. Manila, Philippines.

Criado-Fornelio, A., Martinez-Marcos, A., Buling-Saraña, A. and Barba-Carretero, J.C. (2003). Presence of Mycoplasma haemofelis, Mycoplasma haemominutum and piroplasmids in cats from southern Europe: a molecular study, Veterinary Microbiology 93: 307–317.

Cruz-Vazquez, C., Mendoza, I. V., Parra, M. R., Garca-Vazquez, Z. (2004). Influence of temperature, humidity and rainfall on field population trend of *Stomoxys calcitrans* (Diptera: Muscidae) in a semiarid climate in Mexico. Parasitologia Latinoamericana 59: 99-103.

Cynthia, M. K. and Scott, L. (2005). Merck Veterinary Manual. MERCK AND CO., INC. WHITEHOUSE STATION, N.J., USA.

D´avila, A. M. R. and Silva, R. A. M. S. (2000). "Animal trypanosomiasis in South America: Current status, partnership, and information technology," Annals of the New York Academy of Sciences 916: 199–212.

Dalgliesh, R. J. (1993). Babesiosis. In Immunology and Molecular Biology of Parasite Infections (ed. Warren, S. K.), pp. 352–383. Oxford, Blackwell.

Dalgliesh, R. J., Stewart, N. P., (1983). The use of tick transmission by *Boophilus microplus* to isolate pure strains of *Babesia bovis*, *Babesia bigemina* and *Anaplasma marginale* from cattle with mixed infections. Veterinary Parasitology 13, 317-323.

Damayanti, R., Graydon, R. J. and Ladds, P. W. (1994). The pathology of experimental *Trypanosoma evansi* infection in the Indonesian buffalo (*Bubalus bubalis*). Journal of Comparative Pathology 110: 237-252.

Dantrakool A, Somboon P, Hashimoto T, Saito-Ito A (2004). Identification of a new type of *Babesia* species in wild rats (*Bandicota indica*) in Chiang Mai Province, Thailand. Journal of Clinical Microbiology 42: 850-854.

Dargantes, A. P. (2010). Epidemiology, control and potential insect vectors of *Trypanosoma evansi* (surra) in village livestock in southern Philippines. Ph.D. Thesis. Murdoch University, Australia.

Dargantes, A. P., Campbell, R. S., Copeman, D. B. and Reid, S. A. (2005). Experimental *Trypanosoma evansi* infection in the goat. II. Pathology. Journal of Comparative Pathology 133: 267-276.

Dawit, L., Addis, M. and Gari, G. (2012). Distribution, Seasonality and Relative Abundance of Stomoxys Flies in Selected Districts of Central Ethiopia. World Applied Sciences Journal 19 (7): 998-1002.

De Castro, J. J. (1997). Sustainable tick and tickborne disease control in livestock improvement in developing countries, Veterinary Parasitology 71, 77-97.

De Eschaide, S. T., Bono, M. F., Lugaresi, C., Aguirre, N., Mangold, A., Moretta, R., Farber, M and Mondillo, C. (2005). Detection of antibodies against *Anaplasma marginale* in milk using a recombinant MSP5 indirect ELISA. Veterinary Microbiology 106: 287–292.

De La Fuente, J., van den Bussche, R. A., Garcia-Garcia, J. C., Rodriguez, S. D., Garcia, M. A., Guglielmone, A. A., Mangold, A. J., Friche Passos, L. M., Barbosa Ribeiro, M. F., Blouin, E. F., Kocan, K. M. (2002). Phylogeography of New World isolates of *Anaplasma marginale* based on major surface protein sequences. Veterinary Microbiology 88: 275-285.

De Villa, R. M. C. N., Eduardo, S. I. and Dennig, H. K. (1991). Clinico-pathologic and hematologic observations in goats experimentally infected with *Trypanosoma evansi* (Manila strain). Philippine Journal of Veterinary and Animal Sciences 17: 131-142.

Del Fabbro, s., Gollino, S., Zuliani, M., and Nazzi, F. (2015). Investigating the relationship between environmental factors and tick abundance in a small, highly heterogeneous region. Journal of Vector Ecology 40(1):107-116.

Dela Fosse, A., Thebaud, E., Desquesnes, M., and Michaux (2006). Epidemiology of *Trypanosoma vivax* infection in cattle in the tsetse free area of Lake Chad. Preventive Veterinary Medicine 74: 108-119.

Delafosse, A. and Doutoum, A. A. (2004). Prevalence of *Trypanosoma evansi* infection and associated risk factors in camels in eastern Chad. Veterinary Parasitology 119:155–164.

Department of Veterinary Service. Accessed on the 19 May 2015, from http://agrolink.moa.my/jph/dvs/statistics/

DVS. (1986). Department of Veterinary Service. Animal Health Services in Malaysia; DVS Ministry of Agriculture: Kuala Lumpur.

DVS. (1999). Department of Veterinary Service. Animal Health Services in Malaysia; DVS Ministry of Agriculture: Kuala Lumpur.

DVS. (2011). Department of Veterinary Service. Animal Health Services in Malaysia; DVS Ministry of Agriculture: Kuala Lumpur.

Desquesnes, M. (2004). "Livestock trypanosomoses and their vectors in LatinAmerica," CIRAD-EMVT publication, OIE, Paris, France. http://www.oie.int/doc/ged/D9818.PDF.

Desquesnes, M., Biteau-Coroller, F., Bouyer, J., Dia, M. L. and Foil, L. (2009). "Development of a mathematical model for mechanical transmission of trypanosomes and other pathogens of cattle transmitted by tabanids." International Journal for Parasitology 39: (3) 333–346.

Desquesnes, M., Bossard, G., Patrel, D., Herder, S., Patout, O., Lepetitcolin, E., Thevenon, S., Berthier, D., Pavlovic, D., Brugidou, R., Jacquiet, P., Schelcher, F., Faye, B., Touratier, L. and Cuny, G. (2008). First outbreak of *Trypanosoma evansi* in camels in metropolitan France. Veterinary Record 162: 750-752.

Desquesnes, M., Dargantes, A., Lai, D-H., Lun, Z.-R., Holzmuller, P. and Jittapalapong, S. (2013b). Trypanosoma evansi and Surra: A Review and Perspectives on Transmission, Epidemiology and Control, Impact, and Zoonotic Aspects. BioMed Research International Volume 2013, Article ID 321237, 20 pages.

Desquesnes, M., Holzmuller, P., Lai, D-H., Dargantes, A., Lun, Z.-R. and Jittaplapong, S. (2013a) "*Trypanosoma evansi* and Surra: a review and perspectives on origin, history, distribution, taxonomy, morphology, hosts, and pathogenic effects," BioMed Research International Volume 2013, Article ID 194176, 22 pages.

Dia, M. L., Elsen, P., Cuisance, D., Diop, C., Thiam, A. and Chollet, J. Y. (1998). Abundance and seasonal variations of tabanids in Southern Trarza (Mauritania). Annals of the New York Academy of Sciences 849: 456-460.

Dirie, M. F., Wallbanks, K. R., Aden, A. A., Bornstein, S. and Ibrahim, M. D. (1989). Camel trypanosomiasis and its vectors in Somalia. Veterinary Parasitology 32 (4):285-291.

Dobbelaere, D. A. E. and Mckeever, D. J. (2002). Theileria. Kluwer Academic Publishers, Boston.

Dolan, T. T. (1989). Theileriasis: a comprehensive review. Scientific and Technical Review of the Office International des Epizooties. 8 (1): 11-36.

Donahue, C. G., Carruthers, V. B., Gilk, S. D. and Ward, G. E. (2000). The Toxoplasma homolog of Plasmodium apical membrane antigen-1 (AMA-1) is a microneme protein secreted in response to elevated intracellular calcium levels. Molecular and Biochemical Parasitology 111: 15-30.

Dos Santos, A. P., dos Santos, R. P., Biondo, A. W., Dora, J. M., Goldani, L. Z., de Oliveira, S. T., de Sá Guimarães, A. M., Timenetsky, J., de Morais, H. A., González, F. H. and Messick, J. B. (2008). Hemoplasma infection in HIV-positive patient, Brazil. Emerging Infectious Diseases 14: 1922–1924.

Dransfield, R. D., Brightwell, R., Chaudhury, M. F., Golder, T. K. and Tarimo, S. A. R. (1986). The use of odour attractants for sampling *Glossina pallidipes* Austen (Diptera: Glossinidae) at Nguruman, south-western Kenya. Bulletin of entomological Research. 76: 607-619.

Drummond, R. O. (1983). Tick-borne livestock diseases and their vectors. Chemical control of ticks. Wild Animals Review (FAO) 36:28-33.

Dumler, J. S., Barbet, A. F., Bekker, C. P., Dasch, G. A., Palmer, G. H., Ray, S. C., Rikihisa, Y., and Rurangirwa, F. R. (2001). Reorganization of genera in the families Rickettsiaceae and Anaplasmataceae in the order Rickettsiales: unification of some species of *Ehrlichia* with *Anaplasma*, *Cowdria* with *Ehrlichia* and *Ehrlichia* with *Neorickettsia*, descriptions of six new species combinations and designation of *Ehrlichia* equi and 'HE agent' as subjective synonyms of *Ehrlichia phagocytophila*. International Journal of Systematic and Evolutionary Microbiology 51: 2145-2165.

Dunbar, S. A. (2006). Applications of Luminex xMAP technology for rapid, high-throughput multiplexed nucleic acid detection. Clinica Chimica *Acta* 363(1-2): 71-82.

Durrani, A. Z. and Kamal, N. (2008). Identification of ticks and detection of blood protozoa in Friesian cattle by polmerase chain reacton test and estimation of blood parameters in district Kasur, Pakistan. Tropical Animal Health and Production 40: 441–447

Dutta, S. and Bharucha, E. (2015). Environmental Health Monitoring: A Risk Factor Approach towards Health. The International Journal of Humanities and Social Studies 3 (8): 178-185.

Dzikowski, R and Deitsch, K. (2006). Antigenic variation by protozoan parasites: insights from *Babesia bovis*. Molecular Microbiology 59: 364–376.

Egri, A., Blahó, M., Sándor, A., Kriska, G., Gyurkovszky, M., Farkas, R. and Horváth, G. (2012). New kind of polarotaxis governed by degree of polarization: attraction of tabanid flies to differently polarizing host animals and water surfaces. Naturwissenschaften 99: 407–416.

Egri, A., Blahó, M., Száz, D., Kriska, G., Majer, J., Herczeg, T., Gyurkovszky, M., Farkas, R. and Horváth, G. (2013). A horizontally polarizing liquid trap enhances the tabanid-capturing efficiency of the classic canopy trap.Bulletin of Entomological Research 103(6): 665-674.

El-Ashkera, M., Hotzelb, H., Gwidab, M., El-Beskawyd, M., Silaghi, C. and Tomasob, H. (2015). Molecular biological identification of Babesia, Theileria, and Anaplasma species in cattle in Egypt using PCR assays, gene sequence analysis and a novel DNA microarray. Veterinary Parasitology 207: 329–334.

Ellie, O., Abakar, M. and Abubakar, L. (1999).The role of trypanolysin in the development of trypanosomes in tsetse. International Scientific Council for Trypanosomiasis Research and Control 120: 417-421.

Ellis, J. T., Morrison, D. A. and Reichel, M. P. (2003). Genomics and its impact on parasitology and the potential for development of new parasite control methods. DNA and Cell Biology 32: 395-403.

Elsify, A., Sivakumar, T., Nayel, M., Salama, A., Elkhtam, A., Rizk, M., Mosaab, O., Sultan, K., Elsayed, S., Igarashi, I. and Yokoyama, N. (2015). An epidemiological survey of bovine Babesia and Theileria parasites in cattle, buffaloes, and sheep in Egypt. Parasitology International 64: 79–85.

Emden, F. I. van. (1965). Fauna of India and the Adjacent Countries: Diptera Muscidae, Volume 7, Part 1. Manager of Publications, Govterment of India. ZSI, Calcutta.

Enwezor, F. N. C., Umoh, J. U., Esievo, K. A. N., Halid, I., Zaria, L. T. and Anere, J. I. (2009). Survey of bovine trypanosomosis in Kachia Grazing Reserve, Kaduna State, Nigeria. Veterinary Parasitology 159(2): 121-125.

Epstein, H. (1969). Domestic animals of China. Commonwealth Agriculture Bureaux. Farnham Royal, Bucks, United Kindgom. 166pp.

Ewings, A. (1981). Transmission of *Anaplasma marginale* by arthropods. *In* Proceedings of the Seventh National Anaplasmosis Conference. 395 -423. Mississippi State University.

Eygelaar, D., Jori, F., Mokopasetso, M., Sibeko, K. P., Collins, N. E., Vorster, I., Troskie, M. and Oosthuizen, M. C. (2015). Tick-borne haemoparasites in African buffalo (Syncerus caffer) from two wildlife areas in Northern Botswana. Parasites and Vectors 8 (26): 2-11.

Fadraga, M., Cordoves and T. Puentes, (1991). Circulation of antibodies to haemoparasites in cattle (Bos Taurus) of high genetic value in Cuba. Rev. Cub-de-Cien. Vetrinarias 22: 249-255.

Fadzil, M. and Ragavan, K. (1986). Bovine Theileriosis in Malaysia. Kajian Veterinar 18 (1): 65-68.

Fairclough, R. (1962). In Proc. 9th Meeting of the International Scientific Council for Trypanosomiasis Research; Commision for Technical Cooperation in Africa, Lagos, CCTA Pub.No. 88: Conakrt, Guinera. pp 81-86.

Fandamu, P., Duchateau, L., Speybroeck, N., Marcotty, T., Mbao, V., Mtambo, J., Mulumba, M., and Berkvens, D. (2005). *Theileria parva* seroprevalence in traditionally kept cattle in southern Zambia and El Nino, International Journal of Parasitology 35: 391-396.

Fatimah, I. K., Ragavan, K., Sheikh-Omar, A.R., Chulan, U. and Bashir Ahmad, F. (1984). Prenatal and Postnatal Babesiosis in calves. Kajian Veterinaire 16(2): 62-65.

Fawcett, D. W., Buscher, G. and Doxsey, S. (1982a). Salivary gland of the tick vector of East Coast fever. IV. Cell type selectivity and host cell responses to *Theileria parva.* Tissue and Cell 14 (2): 397-414.

Fawcett, D. W., Doxsey, S., Stagg, D. A. and Young A. S. (1982b). - The entry of sporozoites of *Theileria parva* into bovine lymphocytes *in vitro.* Electron microscopic observation. European Journal of Cell Biology 27: 10-21.

Fawcett, D. W., Young, A. S. and Leitch, B. L. (1985). - Sporogony in *Theileria* (Apicomplexa: Piroplasmida). A comparative ultrastructural study. Journal of submicroscopic cytology and pathology 17: 299-314.

F èvre, E. M., Bronsvoort, B. M., Hamilton, K. A. and Cleaveland, S. (2006). Animal movements and the spread of infectious diseases. Trends in Microbiology 14: 125-131.

Florin-Christensen, M., Suarez, C. E., Rodriguez, A. E., Flores, D. A. and Schnittger, L. (2014). Vaccines against bovine babesiosis: where we are now and possible roads ahead. Parasitology 141: 1563–1592.

Foil, L. D (1989). Tabanids as vectors of disease agents. Parasitology Today 5: 88-96.

Foil, L. D and J.A. Hogsette J. A. (1994). Biology and control of tabanids, stable flies and horn flies. Scientific and Technical Review of the Office International des Epizooties 13 (4): 1125-1158.

Food and Agriculture Organization (FAO). (1994). http://www.fao.org/ag/AGA/AGAH/PD/pages/ tick01.ht

Food and Agriculture Organization (FAO). (1998). http://www.fao.org/ag/AGA/AGAH/PD/pages/ tick01.ht

Fraser, H. and Symond, S. L. (1909). Surra in the Federated Malay States Report. Journal of Comparative Pathology 22: 185-192.

Freeborn, S. B., Regan, W. M. and Folger, A. H. (1928). The relation of flies and fly spray to milk production. Journal of Economic Entomology 18: 779-790.

French, F.E, and Kline, D.L. (1989). l-Octen-3-ol, an effective attractant for Tabanidae (Diptera). Journal of Medical Entomology 26(5): 459-461.

French, F.E. and Hagan, D.V. (1995) Two-tier box trap catches *Chrysops atlanticus* and *Chrysops fuliginosus* (Diptera: Tabanidae) near a Georgia salt marsh. Journal of Medical Entomology 32: 197-200.

Friedhoff, K. T. (1988). Transmission of Babesia. In: Ristic, M. (Ed.), Babesiosis of Domestic Animals and Man. CRC Press, Boca Raton, pp. 23–52.

Fujisaki, K., Kawazu, S. and Kamio, T. (1994). The taxonomy of the bovine *Theileria* spp. Parasitology Today 10: 31–33.

Fujusaki, K., Kamio, T., Kawazu, S., Shimizu, S. and Shimura, K. (1993). Theileria sergenti: experimental transmission by the long-nosed cattle louse, Linognathus vituli. Annals of Tropical Medicine and Parasitology 87: 217-218.

Futse, J. E., Ueti, M. W., Knowles, D. P., Jr., and Palmer, G. H. (2003). Transmission of *Anaplasma marginale* by *Boophilus microplus*: retention of vector competence in the absence of vector-pathogen interaction, Journal of Clinical Microbiology 41: 3829-3834.

Gachohi, J. M., Ngumi, P. N., Kitala, P. M. and Skilton, R. A. (2010). Estimating seroprevalence and variation to four tick-borne infections and determination of associated risk factos in cattle under traditional mixed farming system in Mbeere District, Kenya. Preventive Veterinary Medicine 95: 208-223.

Gachohi, J., Skilton, R., Hansen, F., Ngumi, P. and Kitala, P. (2012). Epidemiology of East Coast fever (*Theileria parva* infection) in Kenya: past, present and the future. Parasites and Vectors 5: 194.

Gaffar, F. R., Yatsuda, A. P., Franssen, F. F. and de Vries, E. (2004). Erythrocyte invasion by *Babesia bovis* merozoites is inhibited by polyclonal antisera directed against peptides derived from a homologue of Plasmodium falciparum apical membrane antigen 1. Infection and Immunity 72: 2947-2955.

Gardiner, P., R. and Mahmoud, M. M. (1990). In Salivarian trypanosomes Causing Disease in Livestock Outside Sub-Saharan Africa Parasitic Protozoa, J. R. Baker, Ed., vol. 3, pp. 1–68, Academic Press, New York, NY, USA.

Gasser, R. B. (2006). Molecular tools – advances, opportunities and prospects. Veterinary Parasitology 136(2):69-89.

Ge, N. L., Kocan, K. M., Blouin, E. F., and Murphy, G. L. (1996). Developmental studies of *Anaplasma marginale* (Rickettsiales: Anaplasmataceae) in male *Dermacentor andersoni* (Acari: Ixodidae) infected as adults by using nonradioactive in situ hybridization and microscopy, Journal Medical Entomology 33: 911-920.

Genova, S. G., Streeter, R. N., Velguth, K. E., Snider, T. A., Kocan, K. M. and Simpson, K. M. (2011). Severe anemia associated with Mycoplasma wenyonii infection in a mature cow. Canadian Veterinary Journal 52: 1018–1021.

Gerry, A. C., Peterson, N. G. and Mullens, B. A. (2007). Predicting and controlling stable flies on California dairies. ANR Publication 8258. University of California Agriculture and Natural Resources Communication Services, Oakland. ANR Publication 8258:1-11.

Ghaemi, P., Hoghooghi-Rad, N., Shayan, P. and Eckert, B. (2012). Detection of *Theileria orientalis* in Iran by semi-nested PCR. Parasitology Research 110(2): 527-531.

Gibson, G. and Torr, S. J. (1999). Visual and olfactory response of haematophagous Diptera to host stimuli. Medical and Veterinary Entomology 13: 2-23.

Gilles, J., David, J. and Duvallet, G. (2005). Effects of Temperature on the Rate of Increase of *Stomoxys calcitrans* and *Stomoxys niger niger* (Diptera: Muscidae) from La Re ́union Island. Journal of Medical Entomology 42(6): 959-965.

Gilles, J., David, J. F., Duvallet, G., Rocque, S. De La, Tillard, E. (2007). Efficiency of traps for *Stomoxys calcitrans* and *Stomoxys niger niger* on Reunion Island. Medical and Veterinary Entomology 21: 65–69.

Girotto, A., Zangirólamo, A. F., Bogado, A. L. G., Souza, A. S. L., Ferreira da Silva, G. C., Garcia, J. L., Vilas Boas, L. A., Biondo, A. W. and Vidotto, O. (2012). Molecular detection and occurrence of '*Candidatus* Mycoplasma haemobos' in dairy cattle of Southern Brazil. Brazilian Journal of Veterinary Parasitology 21(3): 342-344.

Githeko, A. K., Lindsay, S. W., Confalonieri, U. E. and Patz, J. A. (2007). Climate change and vector-borne diseases: A regional analysis. Bulletin of the World Health Organization, 2000, 78(9): 1136-1147.

Granger, C. A. (1970). Trap design and colour as factors in trapping salt marsh greenhead fly (Diptera: Tabanidae). Journal of Economic Entomology 63: 1670-1673.

Green, C. H. (1994). Bait methods for tsetse fly control. Advances in Parasitology 34: 229–291.

Greenfield, B. P. J. (2011). Environmental parameters affecting tick (*Ixodes ricinus*) distribution during the summer season in Richmond Park, London. Bioscience Horizons. pp 1-9.

Grody, W. W., Nakamura, R. M., Strom, C. M., Kiechle, F. L. (2010). Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory. (eds). Academic Press, Inc.; Boston, MA.

Gruvel, J. (1980). General comments on the significance of mechanical transmission of trypanosomes among cattle. Insect Science and its Application. 1:55-57.

Gubbels, M. J., Hong, Y., Weide, M. V. D., Bai, Q., Nijman, I. J., Guangyuan, L. and Jongejan, F. (2000). Molecular characterization of the *Theileria buffeli/orientalis* group. International Journal of Parasitology 30: 943–952.

Guerrero, F. D., Andreotti, R., Bendele, K. G., Cunha, R. C., Miller, R. J., Yeater, K. and Pérez de León, A. A. (2014). *Rhipicephalus* (*Boophilus*) *microplus* aquaporin as an effective vaccine antigen to protect against cattle tick infestations. Parasites and Vectors 7: 475-486.

Guglielmone, A. A. (1995). Epidemiology of babesiosis and anaplasmosis in South and Central America, Veterinary Parasitology 57: 109-119.

Guimaraes, A. M., Carvalho, A. O., Daher, D. O. and Hirsch, C. (2011). Seroprevalence and risk factors for *Babesia bovis* in dairy cattle from region southern Minas Gerais state, Brazil. Ci ência e Agrotecnologia 35 (4): 826-832.

Guo, Y. J., Greene, G. L. and Butine, M. D. (1998). Population profile of stable flies (Diptera: Muscidae) caught on alsynite traps in various feedlot habitats. Journal of Economic Entomology 91: 159–164.

Guy, R. A., Xiao, C. and Horgen, P. A. (2004). Real-time PCR assay for detection and genotype differentiation of Giardia lamblia in stool specimens. Journal of Clinical Microbiology 42(7): 3317-3320.

Hafez, M. and Gamal-Eddin, F. M. (1959). On the feeding habitats of *Stomoxys calcitrans* (L.) and *Stomoxys sitiens* (Rond.) with special reference to their biting cycle in nature. Bulletin of the Entomological Society of Egypt 43: 291-301.

Hall, M. J. R., Farkas R. and Chainey J. E. (1998). Use of odour-baited sticky boards to trap tabanid flies and investigate repellents. Medical and Veterinary Entomology 12: 241-245.

Hamsho, A., Tesfamarym, G., Megersa, G. and Megersa, M. (2015). A Cross-Sectional Study of Bovine Babesiosis in Teltele District, Borena Zone, Southern Ethiopia. Journal of Veterinary Science and Technology 6: 230.

Hanec, W. and Bracken, G. K. (1964). Seasonal and geographical distribution of Tabanidae (Diptera) in Manitoba, based on females captured in traps. Canadian Entomologist 96: 1362-1369.

Haque, M., Jyoti, Singh, H. and Rath, S. S. (2012). PCR-based detection of cryptic *Trypanosoma evansi* infection in cattle. Indian Veterinary Journal 89(3): 19-21.

Harmsen, D. and Karch, H. (2004). 16S rDNA for diagnosing pathogens: a living tree. American Society for Microbiology News 70:19–24.

Haron, A. W., Abdullah, F. F. J., Abba, Y., Mohammed, K., Adamu, L., Tijjani, A., Sadiq, M. A., Ahmed, S. S. and Lila, M. A. M. (2014). Detection of *Theileria* Species and Hematological Profiles of Infected Cattle from Selected Farms in Selangor, Malaysia. Alexandria Journal of Veterinary Sciences 44: 9-14.

Hassan, M. A. (1977). Common diseases of cattle and buffaloes in Peninsular Malaysia. Bulletin of Ministry of Agriculture Malaysia 146: 90-102.

Hayes, R. O., Doane, O. W., Jr., Sakolsky, G. and Berrick, S. (1993). Evaluation of attractants in traps for greenhead fly (Diptera: Tabanidae) collections on a Cape Cod, Massachusetts, salt marsh. Journal of the American Mosquito Control Association 9: 436-440.

Hehl, A. B., Lekutis, C., Grigg, M. E., Bradley, P. J., Dubremetz, J. F., Ortega-Barria, E. and Boothroyd, J. C. (2000). *Toxoplasma gondii* homologue of Plasmodium apical membrane antigen 1 is involved in invasion of host cells. Infection and Immunity 68: 7078-7086.

Herczeg, T., Száz, D., Blahó, M., Barta, A., Gyurkovszky, M., Farkas, R. and Horváth, G. (2015). The effect of weather variables on the flight activity of horseflies (Diptera: Tabanidae) in the continental climate of Hungary. Parasitology Research 114:1087–1097.

Hilali, M., Abdel-Gawad, A., Nassar, A. and Abdel-Wahab, A. (2006). Hematological and biochemical changes in water buffalo calves (*Bubalus bubalis*) infected with *Trypanosoma evansi*. Veterinary Parasitology 139: 237-243.

Hoare, C. A. (1972). The Trypanosomes of Mammals. A Zoological Monograph, Blackwell Scientific Publications, Oxford, UK.

Hoelzle, K., Hofmann-Lehmann, R., Hoelzle, L.E. (2010). 'Candidatus Mycoplasma haemobos', a new bovine haemotrophic Mycoplasma species? Veterinary Microbiology 144: 525–526.

Hoelzle, K., Winkler, M., Kramer, M. M., Wittenbrink, M. M., Dieckmann, S. M., Hoelzle, L. E. (2011). Detection of '*Candidatus Mycoplasma haemobos'* in cattle with anaemia. The Veterinary Journal 187: 408–410.

Hoelzle, L. E., Hoelzle K., Helbling, M., Aupperle, H., Schoon, H. A., Ritzmann, M., Heinritzi, K., Felder, K. M., Wittenbrink, M. M. (2007). MSG1, a surface-localized protein of *Mycoplasma suis* is involved in the adhension to erythrocytes. Microbes and infection 9: 466-474.

Hofmann-Lehmann, R., Meli, M. L., Dreher, U. M., Gönczi, E., Deplazes, P., Braun, U., Engels, M., Schüpbach, J., Jörger, K., Thoma, R., Griot, C., Stärk, K. D., Willi, B., Schmidt, J., Kocan, K. M. and Lutz, H. (2004). Concurrent infections with vectorborne pathogens associated with fatal hemolytic anemia in a cattle herd in Switzerland, Journal of Clinical Microbiology 42: 3775–3780.

Horak, I. G., Camicas, J. L. and Keirans, J. E. (2002). The Argasidae, Ixodidae and Nuttalliellidae (Acari: Ixodida): a world list of valid tick names, Experimental and Applied Acarology 28: 27-54.

Hornok, S., Foldvári, G., Elek, V., Naranjo, V., Farkas, R. and de la Fuente, J. (2008). Molecular identification of *Anaplasma marginale* and rickettsial endosymbionts in blood-sucking flies (Diptera: Tabanidae, Muscidae) and hard ticks (Acari: Ixodidae) Veterinary Parasitology 154: 354–359.

Hornok, S., Micsutka, A., Meli, M. L., Lutz, H. and Hofmann-Lehmann, R. (2011). Molecular Investigation of transplacental and vector-borne transmission of bovine haemoplasmas. Veterinary Microbiology 152: 411-414.

Horváth, G., Majer, J., Horváth, L., Szivák, I. and Kriska, G. (2008). Ventral polarization vision in tabanids, horseflies and deerflies (Diptera, Tabanidae) are attracted to horizontally polarized light. Naturwissenschaften 95: 1093–1100.

Howell, D. E., Stiles, G. W., and Moe, L. H. (1941). The fowl tick (*Argas persicus*), a new vector of anaplasmosis, American Journal of Veterinary Research 4: 73-75.

Hribar, L.J., Leprince, D.J. and Foil L.D. (1992). Ammonia as an attractant for adult *Hybomitra lasiophthalma* (Diptera: Tabanidae). Journal of Medical Entomology 29(20): 346-348.

http://agrolink.moa.my/jph/dvs/statistics/ statidx.html. Livestock / Livestock Products Statistics. Accessed on 30 March 2007.

http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.04.16_THEILIERIOSIS.pdf.

Hulley, P. E. (1986). Factors affecting numbers of *Musca domestica* Linnaeus (Diptera: Muscidae) and some other flies breeding in poultry manure. Journal of the Entomological Society of South Africa 49(1): 19-27.

Hunter-Cevera, J. C. and A. Belt (1996) Maintaining cultures for biotechnology and industry, Academic Press.

Inci, A., Iça, A., Yildirim, A., Vatansever, Z., Çakmak, A., Albasan, H., Çam, Y., Atasever, A. and Düzlu, Ö. (2008). Epidemiology of Tropical Theileriosis in the Cappadocia Region. Turkey Journal of Veterinary and Animal Science 32(1): 57-64.

Islam, M. K., Jabbar, A., Campbell, B. E., Cantacessi, C. and Gasser, R. B. (2011). Bovine theileriosis –An emerging problem in south-eastern Australia?. Infection, Genetics and Evolution. 11: 2095–2097.

Itina, V. I., Noutcha, A. M. E. and Okiwelu, S. N. (2013). Spatial and Temporal Distribution of Tabanids (Diptera: Tabanidae) in Akwa Ibom State, Nigeria. Research in Zoology 3(2): 62-65.

Ito, Y. and Matsumura, T. (1987). Faunal composition and seasonal distribution of tabanid flies (Diptera, Tabanidae) at plain and mountain pastures in northern Tochigi, Japan. Japan Agricultural Research Quarterly 21: 198-204.

Ito, Y., Boonchit, S., Sarataphan, N. and Tuntasuvan, D. (1999). Species composition and seasonal abundance of horse flies (Diptera: Tabanidae) on a cattle farm in central Thailand. Journal of Thai Veterinary Medical Association 50: 17-28.

Izzo, M. M., Poe, I., Horadagoda, N., de Vos, A. J.and House, J. K. (2010). Haemolytic anaemia in cattle in NSW associated with *Theileria* infections. Australian Veterinary Journal 88: 45–51.

Jackson, A. P., Otto, T. D., Darby, A., Ramaprasad, A., Xia, D., Echaide, I. E., Farber, M., Gahlot, S., Gamble. J., Gupta, D., Gupta, Y., Jackson, L., Malandrin, L., Malas, T. B., Moussa, E., Nair, M., Reid, A. J., Sanders, M., Sharma, J., Tracey, A., Quail, M. A., Weir, W., Wastling, J. M., Hall, N., Willadsen, P., Lingelbach, K., Shiels, B., Tait, A., Berriman, M., Allred, D. R. and Arnab Pain (2014). The evolutionary dynamics of variant antigen genes in Babesia reveal a history of genomic innovation underlying host–parasite interaction. Nucleic Acids Research 42(11): 7113–7131.

Jalaludin, S. and Halim, R. A. (1998).Development of the Livestock Industry in Malaysia. Regional Workshop on Area-Wide Integration of Crop-Livestock Activities, 18-20 June, 1998, FAO Regional Office, Bangkok Thailand.

James, H. (1979). Entomology in Human and Animal Health, Washington State University, Pullman.

Jaswal, H., Bal, M. S., Singla, L. D., Gupta, K., Brar, A. P. S. (2013). Pathological observations on clinical Anaplasma marginale infection in cattle. Journal of Parasitic Disease.

Joazeiro, A. C., Martins, J., Masuda, A., Seixas, A. and Vaz Júnior, I. S. (2015). A PCR for Differentiate between *Anaplasma marginale* and *A. centrale*. Acta Scientiae Veterinariae. 43: 1270-1276.

Jones, T. C.; Hunt, R. D. and King, N. W. (1997). Veterinary Pathology. 6th edition. Williams and Wilkins, Baltimore, Philadelphia, London. 598-599.

Jongejan, F. and Uilenberg, G. (1994) Ticks and control methods. Revue Scientijque et Technique Ofice International des Epizooties 13(4): 1201- 1226.

Jongejan, F. and Uilenberg, G. (2004). The global importance of ticks. Parasitology 129: 3-14.

Jongejan, F., Perry, B. D., Moorhouse, P. D., Musisi, F. L., Pegram, R. G. and Snacken, M. (1988). Epidemiology of bovine babesiosis and anaplasmosis in Zambia, Tropical Animal Health and Production 20: 234-242.

Jonsson, N. N., Bock, R. E. and Jorgensen, W. K. (2008). Productivity and health effects of anaplasmosis and babesiosis on *Bos indicus* cattle and their crosses, and the effects of differing intensity of tick control in Australia, Veterinary Parasitology 155: 1-9.

Jorgensen, W. K., Bock, R. E., Kingston, T. G., De Vos, A. J. and Waldron, S. J. (1993). Assessment of tetracycline and Babesia culture supernatant as prophylactics for moderating reactions in cattle to live Babesia and Anaplasma vaccines. Australian Veterinary Journal 70: 35–36.

Kaewthamasorn, M. and Wongsamee S. (2006). A preliminary survey of gastrointestinal and haemoparasites of beef cattle in the tropical livestock farming system in Nan Province, northern Thailand. Parasitology Research 99(3): 306-308.

Kakarsulemankhel, J. K. (2011). Re-description of existing and description of new record of tick [Hyalomma (Euhyalomma) schulzed from Pakistan. International Journal of Agriculture and Biology 13: 689-694.

Kakuda, T., Kubota, S., Sugimoto, C., Baek, B. K., Yin, H., Onuma, M. (1998). Analysis of immunodominant piroplasm surface protein genes of benign Theileria parasites distributed in China and Korea by allele-specific polymerase chain reaction. Journal of Veterinary Medical Science 60: 237–239.

Kalluri, S., Gilruth, P., Rogers, D., Szczur, M. (2007). Surveillance of arthropod vector-borne infectious diseases using remote sensing techniques: A review. PLoS Pathogens 3(10): 1316-1371.

Kalume, M. K., Saegerman, C., Mbahikyavolo, D. K., Makumyaviri, A. M., Marcotty, T., Madder, M., Caron, Y., Lempereur, L. and Losson, B. (2013). Identification of hard ticks (Acari: Ixodidae) and seroprevalence to Theileria parva in cattle raised in North Kivu Province, Democratic Republic of Congo. Parasitology Research 112:789–797.

Kamani, J., Sannusi, A., Egwu, O. K., Dogo, G. I., Tanko, T. J., Kemza, S., Tafarki, A. E. and Gbise, D. S. (2010). Prevalence and Significance of Haemoparasitic Infections of Cattle in North- Central, Nigeria. Veterinary World 3(10): 445-448.

Kamio, T., Rajamanickam, C., Kawazu, S.I. and Fujisaki, K. (1990). Epidemiology and pathogenicity of bovine theileriosis in Malaysia. Japan Agricultural Research Quarterly 24: 231-234.

Kamis, A. B., Sharifah Azian, B. S. Y. and Zainal-Abidin, A. H. (1986). Trypanosoma evansi infection in the Gerbil: the influence of gonadectomy and testosterone. Tropical Biomedicine 3: 135-140.

Kamyszek, F. (1977). Role of sucking lice and biting lice in the transmission of dermatomycosis in cattle. Wiad. Parazytol. 23: 129-130.

Kappmeyer, L. S., L. E. Perryman, and Knowles, Jr. D. P. (1993). A *Babesia equi* gene encodes a surface protein with homology to Theileria species. Molecular and Biochemical Parasitology 62:121-124.

Kariuki, D. P., Young, A. S., Morzaria, S. P., Lesan, A. C., Mining, S. K., Omwoyo, P., Wafula, J. L., and Molyneux, D. H. (1995). *Theileria parva* carrier state in naturally infected and artificially immunised cattle. Tropical Animal Health and Production 27: 15-25.

Kaufmann, J. (1996). Parasitic Infections of Domestic Animals: A Diagnostic Manual. Basel and Boston (Massachusetts): Birkhiiuser Verlag. pp 74.

Kawazu, S. I., Chandrawathani, P., Kamio, T., Minami, T., Rajamanickam, C. and Fujisaki, K. (1991). Serological survey of Bovine Theileriosis in Malaysia. Japan Agricultural Research Quarterly. 24: 315-318.

Keawrayup, S., Duvallet, G., Sukonthabhirom, S. and Chareonviriyaphap, T. (2012). Diversity of Stomoxys Spp. (Diptera: Muscidae) and diurnal variations of activity *of Stomoxys indicus* and *Stomoxys calcitrans* in a farm, in Wang Nam Khiao District, Nakhon Ratchasima Province, Thailand. Parasite 19: 259-265.

Khan, M. Q., Zahoor, A., Jahangir, M. and Mirza, M. A. (2004). Prevalence of blood parasites in cattle and buffaloes. Pakistan Veterinary Journal 24(4): 193-195.

Klompen, J. S. H., Black, W. C., Keirans, J. E. and Oliver, J. H.Jr. (1996). Evolution of ticks. Annual Review of Entomology 41(1): 141-161.

Knaus, R. M., Foil, L. D., Issel, C. J. and Leprince, D. J. (1993). Insect blood meal studies using radiosodium 24Na and 22Na. Journal of the American Mosquito Control Association 9: 264-268.

Kocan, K. M., Blouin, E. F., and Barbet, A. F. (2000). Anaplasmosis control. Past, present, and future, Annals New Yolk Academy of Science 916: 501-509.

Kocan, K. M., de la Fuente, J., Blouin, E. F. and Garcia-Garcia, J. C. (2004). *Anaplasma marginale* (*Rickettsiales: Anaplasmataceae*): Recent advances in defining host-pathogen adaptations of a tick-borne rickettsia. Parasitology 129: 285-300.

Kocan, K. M., de la Fuente, J., Blouin, E. F. and Garcia-Garcia, J. C. (2008). Characterization of the tick-pathogen-host interface of the tick-borne rickettsia *Anaplasma marginale*, in Bowman A, Nuttall P (eds): *Ticks: Biology, Disease and Control*, Cambridge, UK, Cambridge University Press, pp 325-343.

Kocan, K. M., de la Fuente, J., Guglielmone, A. A. and Melendez, R. D. (2003). Antigens and alternatives for control of *Anaplasma marginale* infection in cattle, Clinical Microbiology Reviews 16: 698-712.

Kocan, K. M., de la Fuente, J., Step, D. L., Blouin, E.F., Coetzee, J. F., Simpson, K. M.,. Genova, S. G. and Boileau, M. J. (2010). Current Challenges of the Management and Epidemiology of Bovine Anaplasmosis. The Bovine Practitioner 44(2): 93-102.

Kocan, K. M., Goff, W. L., Stiller, D., Claypool, P. L., Edwards, W., Ewing, S. A., Hair, J. A., and Barron, S. J. (1992a). Persistence of *Anaplasma marginale* (Rickettsiales: Anaplasmataceae) in male Dermacentor andersoni (Acari: Ixodidae) transferred successively from infected to susceptible calves, Journal of Medical Entomology 29: 657-668.

Kocan, K. M., Stiller, D., Goff, W. L., Claypool, P. L., Edwards, W., Ewing, S.A., McGuire, T. C., Hair, J. A., and Barron, S. J. (1992b). Development of *Anaplasma marginale* in male *Dermacentor andersoni* transferred from parasitemic to susceptible cattle. American Journal of Veterinary Research 53: 499-507.

Kohls, G. M. (1957). Malaysian parasites. XVIII. Ticks (Ixodoidea) of Borneo and Malaya. Studies from the Institute of Medical Research Malaya 28: 65-94.

Kolbert, C. P. and Persing, D. H. (1999). Ribosomal DNA sequencing as a tool for identification of bacterial pathogens. Current Opinion in Microbiology 2: 299–305.

Konnai, S., Imamura, S., Nakajima, C., Witola, W.H., Yamada, S., Simuunza, M., Nambota, A., Yasuda, J., Ohashi, K., and Onuma, M. (2006). Acquisition and transmission of *Theileria parva* by vector tick, *Rhipicephalus appendiculatus*, Acta Tropica 99: 34-41.

Krčmar, S. (2005). Response of horse flies (Diptera, Tabanidae) to different olfactory attractants. Biologia (Bratislava) 60: 611–613.

Krčmar, S. (2005). Seasonal abundance of horse flies (Diptera: Tabanidae) from two locations in eastern Croatia. Journal of Vector Ecology 30 (2): 316-321.

Krčmar, S., Radolić, V., Lajoš, P. and Lukačević, I. (2014). Efficiency of colored modified box traps for sampling of tabanids. Parasite 21: 67.

Kreier, J. P. and Ristic, M. (1984). Genus III *Haemobartonella*; genus IV *Eperythrozoon*. In Bergey's Manual of Systematic Bacteriology, vol. 1, pp. 724–729. Edited by N. R. Krieg & J. G. Holt. Baltimore: Williams and Wilkins.

Krinsky, W. L. (1976). Animal disease agents transmitted by horse flies and deer flies (Diptera: Tabanidae). Journal of Medical Entomology 13: 225-275.

Kubota, S., Sugimoto, C. and Onuma, M. (1995). A genetic analysis of mixed population in *Theileria sergenti* stocks and isolates using allele-specific polymerase chain reaction. Journal of Veterinary Medical Science 57: 279–282.

Kubota, S., Sugimoto, C., Kakuda, T. and Onuma, M. (1996). Analysis of immunodominant piroplasm surface antigen alleles in mixed populations of *Theileria sergenti* and *T. buffeli*. International Journal of Parasitology 26: 741-747.

Kumar, H., Gupta, M. P., Sidhu, P. K., Mahajan, V., Bal, M. S., Kaur, K., Ashuma, Verma, S. and Singla, L. D. (2012). An outbreak of acute *Trypanosoma evansi* Infection in cross bred cattle in Punjab, India. Journal of Applied Animal Research, 40(3); 256-259.

Kunz, S. E. and Monty J. (1976). Biology and ecology of *Stomoxys nigra* Marquart and *Stomoxys calcitrans* (L.) (Diptera: Muscidae) in Mauritius. Bulletin of Entomological Research 66: 745-755.

Kursat, A., Nazir, D., Patricia, J., Holman, B. and Munir, A. (2004). Detection of *Theileria ovis* in naturally infected sheep by nested PCR. Veterinary Parasitology 127: 99-104.

Kuttler, K. L. (1981). In Babesiosis. Ristic, M.; Keire, J.P., Eds.; Academic Press: New York. pp 25-63.

Kuzoe, F. A. S. and Schofield, C. J. (2004). Strategic Review of traps and targets for tsetse and African trypanosomiasis control. World Health Organization on behalf of the Special Programme for Research and Training in Tropical Diseases.

Lang, P. S. (2001). Studies on incidence and control of Trypanosomiasis in buffalos caused by *Trypanosome avansi* steel 1885 in North Vietnam. Proceedings Buffalo Workshop.

Lau, A. O. T. (2009). An overview of the *Babesia*, *Plasmodium* and *Theileria* genomes: A comparative perspective Molecular and Biochemical Parasitology 164: 1–8.

Lau, A. O., Tibbals, D. L. and McElwain, T. F. (2007). *Babesia bovis*: the development of an expression oligonucleotide microarray. Experimental Parasitology 117: 93–8.

Lee, C. C. and Whitten, L. K. (1982). Parasites of domestic animals encountered in routine diagnostic procedures in the Veterinary faculty, University of Agriculture. Malaysia. Journal of Medical Health Labouratory Technology Malaysia 8: 36-39.

Lee, C. C., Sani, R. A., Amin-Babjee S. M., Jefrey, J. and Krishnasamy, M. (1991). Check list of Arthropods, Protozoa and Helminths of domestic animals in Malaysia. Jurnal Veterinar Malaysia 3(2): 45-57.

Legg, J. (1959). Report to the Government of the Federation of Malaysia on animal health. Problem with special reference to protozoan blood parasites. Rome: FAO.

Legg, L. J. (1958). Notes on tick-borne parasites of Malaysia. Journal Malaya Veterinary Association 2: 76-79.

Legner, E. F. and Dietrick, E. I. (1974). Effectiveness of supervised practices in lowering population densities of synanthropic flies on poultry ranches. Entomophaga 19: 467-478.

Legner, E. F. and Greathead, D. J. (1969). Parasitism of pupae in East African populations of Musca domestica and Stomoxys calcitrans. Annals of the Entomological Society of America 62: 128-133.

Legner, E. F. and Olton, G. S. (1971). Distribution and relative abundance of dipterous pupae and their parasitoids in accumulations of domestic animals manure in the southwest United States. Hilgardia 40: 505-535.

Lessard, P., L'Eplattenier, R., Norval, R. A., Kundert, K., Dolan, T. T., Croze, H., Walker, J. B., Irvin, A. D., and Perry, B. D. (1990). Geographical information systems for studying the epidemiology of cattle diseases caused by *Theileria parva*, Veterinary Record 126: 255-262.

Levine, N. D. (1971). Taxonomy of the piroplasms, Transactions of the American Microscopical Society 90: 2-33.

Levine, N. D. (1985). Veterinary Protozoology. 1st edition. The Iowa State University Press, Ames, Iowa.

L'Hostis, M. and Seegers, H. (2002). Tick-borne parasitic diseases in cattle: current knowledge and prospective risk analysis related to the ongoing evolution in French cattle farming systems. Veterinary Research 33(5):599-611.

Li, S. Q., Yang, W. B., Lun, Z. R., Ma, L. J., Xi, S. M., Chen, Q. L., Song, X. W., Kang, J. and Yang, L. Z. (2008). Immunization with recombinant actin from *Trypanosoma evansi* induces protective immunity against *T. evansi*, *T. equiperdum* and *T. b. brucei* infection. Parasitology Research 104: 429-435.

Liu, B. and Liu, Y. (2005). Fellowship of the rings: the replication of kinetoplast D N A. Trends in Parasitology 21 (8): 363-369.

Löhr, K. F., Pholpark, S., Siriwan, P., Leesirikul, N., Srikitjakarn, L. and Staak, C. (1986). *Trypanosoma evansi* infection in buffaloes in North-East Thailand. II. Abortions. Tropical Animal Health and Production 18: 103-108.

Losos, G. J. (1980) Diseases caused by *Trypanosoma evansi*, a review. Veterinary Research Communications 4: 165-181.

Losos, G. J. and Ikede, B. O. (1972). Review of pathology of diseases in domestic and laboratory animals caused by *Trypanosoma congolense, T. vivax, T. brucei, T. rhodesiense* and *T.* gambiense. Veterinary Pathology. 9: 1-17.

Losos, J. G. (1986). Infectious Tropical Diseases of Domestic Animals. Longman Scientific and Technical. The Bath Press, Avon, pp: 5–70.

Luckins, A. G. (1988). *Trypanosoma evansi* in Asia. Parasitology Today 4: 137-142.

Luckins, A. G. (1992). Diagnostic methods for trypanosomiasis in livestock. World Animal Review 71: 15-20.

Luckins, A. G. (1998) Trypanosomiasis caused by *Trypanosoma evansi* in Indonesia. Journal of Protozoology Research 8: 144-152.

Luckins, A. G. (1999). Epidemiology of surra: unanswered questions. Journal of Protozoology Research 8: 106-119.

Luckins, A. G., Boid, R., Rae, P., Mahmoud, M., Elmalik, K. H. and Gray, A. R. (1979). Serodiagnosis of infection with *Trypanosoma evansi* in camels in Sudan. Tropical Animal Health and Production 11: 1-12.

Luckins, A. G., McIntyre, N. and Rae, P. F. (1991). Multiplication of *Trypanosoma evansi* at the site of infection in skin of rabbits and cattle. Acta Tropica 50: 19-27.

Lun, Z. R. and Desser, S. S. (1995) Is the broad range of hosts and geographical distribution of *Trypanosoma evansi* attributable to the loss of maxicircle kinetoplast DNA? Parasitology Today 11: 131-133.

Lysyk, T. J. (1998). Relationship between temperature and life history parameters of *Stomoxys calcitrans* (Diptera: Muscidae). Journal of Medical Entomology 35: 107-119.

Magona, J. W., Walubengo, J., Olaho-Mukani, W., Jonsson, N. N., Welburn, S. C. and Eisler, M. C. (2008). Clinical features associated with seroconversion to *Anaplasma marginale*, *Babesia bigemina* and *Theileria parva* infections in African cattle under natural tick challenge, Veterinary Parasitology 155: 273-280.

Magpayo, F. R., Shinonaga, S. and Kano R. (1987). Studies on the calypterate muscoid flies in Philippines*1 Report on species belonging to the genus Musca Linnaeus (Diptera, Muscidae). The Japan Society of Medical Entomology and Zoology 38(4)257-269.

Mahama, C. I., Desquesnes, M. I., Losson, R., Dedeken R. and Geerts, S. (2004). A cross-sectional epidemiological survey of bovine trypanosomosis and its vectors in the Savelugu and west Mamprusi districts of northern Ghana. Veterinary Parasitology 122: 1-13.

Mahoney, D. F. and Mirre, G. B. (1979). A note on the transmission of *Babesia bovis* (syn *B. argentina*) by the one-host tick, *Boophilus microplus*. Research in Veterinary Science 26: 253-254.

Mahoney, D. F., Wright, I. G., & Mirre, G. B. (1973). Bovine babesiasis: the persistence of immunity to *Babesia argentina* and *B. bigemina* in calves (Bos taurus) after naturally acquired infection, Annals of Tropical Medicine and Parasitology 67: 197-203.

Mahvi, A. H. and Karyab, H. (2007). Risk Assessment for Microbial Pollution in Drinking Water in Small Community and Relation to Diarrhea Disease. American-Eurasian Journal of Agricultural and Environmental Sciences 2 (4): 404-406.

Makala, L. H., Mangani, P., Fujisaki, K. and Nagasawa, H. (2003). The current status of major tick borne diseases in Zambia. Veterinary Research 34: 27-45.

Makler, M. T., Palmer, C. J. and Ager, A. L. (1998). A review of practical techniques for the diagnosis of malaria. Annals of Tropical Medicine and Parasitology 92: 419–433.

Malaysian Meteorological Department. (2014). Malaysian Meteorological Department 46667, Jalan Sultan, Petaling Jaya, Selangor.

Marcelino, I., Martinho de Almeida, A., Ventosa, M., Pruneau, L., Meyer, D. F., Martinez, D., Lefrançois, T., Vachiéry, N. and Coelho, A. V. (2015). Tick-borne diseases in cattle: Applications of proteomics to develop new generation vaccines. Journal of Proteomics 75: 4232-4250.

Martins, C. F., Madruga, C. R., Koller, W.W., Araújo, F. R., Soares, C. O., Kessler, R. H., Melo, E. S. P., Rios, L. R., Almeida, R. C. F., Lima Jr, M. S. C., Barros, A. T. M. and Marques, L. C. (2008). *Trypanosoma vivax* infection dynamics in a cattle herd maintained in a transition area between Pantanal lowlands and highlands of Mato Grosso do Sul, Brazil. Brazilian Journal of Veterinary Research 28: 51-56.

Masmeatathip, R., Chitapa, K. C. and Gérard, D. (2006b). Morphological Studies of *Stomoxys* spp. (Diptera: Muscidae) in Central Thailand, Journal of natural science 40: 872-881.

Masmeatathip, R., Gilles, J., Ketavan, C. and Duvallet, G. (2006a). First survey of seasonal abundance and daily activity of *Stomoxys* Spp. (Diptera: Muscidae) in kamphaengsaen Campus, Nakornpathom Province, Thailand. Parasite 13: 245-250.

Mason, R. W. and Statham, P. (1991). Susceptibility of sheep and goats to Eperythrozoon ovis infection. Australian Veterinary Journal 68: 116–117.

Matthiessen, J. N., Hall, G. P. And Chewing, V. H. (1986). Seasonal Abundance of *Musca vetustissima* Walker and other cattle dung Fauna in central Australia. Journal of the Australian Entomological Society 25: 141-147.

McFadden, A. M., Rawdon, T. G., Meyer, J., Makin, J., Clough, R.R., Tham, K., Mullner, P. and Geysen. D (2011). An outbreak of haemolytic anaemia associated with infection of *Theileria orientalis* in naive cattle. New Zealand Veterinary Journal 59: 79–85.

McKeever, D.J. (2009). Bovine immunity – a driver for diversity in *Theileria* parasites? Trends in Parasitology 25: 269–276.

Mehlhorn, H. and Schein, E. (1984). The piroplasm: life cycle and sexual stages. Advances in Parasitology 23: 38-103.

Meleney, W.P. (1978). Sucking lice (Order Anoplura). Pp. 7-10 in Surveillance and collection of arthropods of veterinary importance (R. A. Bram, compiler), U.S. Dep. Agric., Agric Handbook No. pp. 518,125.

Messick, J. B. (2004). Hemotropic mycoplasmas (hemoplasmas) a review and new insights into pathogenic potential. Veterinary Clinical Pathology 33(1): 2-13.

Mihok, S. (2002). The development of a multipurpose trap (the Nzi) for tsetse and other biting flies. Bulletin of Entomological Research 92: 385–403.

Mihok, S., Carlson, D. A., Krafsur, E. S. and Foil, L. D. (2006). Performance of the Nzi and other traps for biting flies in North America. Bulletin of Entomological Research 96: 387–397.

Milnes, A. S. and Green, L. E. (1999). Prevalence of lice on dairy cattle in England and the bordering countries of Wales. Research in Veterinary Science, Parasitology 47: 497-510.

Minjaw, B. and McLeod, A. (2003). Tick-borne diseases and poverty: the impact of ticks and tick-borne disease on the livelihoods of small-scale and marginal livestock owners in India and eastern and southern Africa. Research report, Department for International Development Animal Health Programme. Centre of Tropical Veterinary Medicine, Universityof Edinburgh, Scotland. P 116

Mirwan, N. M. A. (2003). Prevalence of bovine Anaplasmosis in Malaysian farms. DVM Thesis, Universiti Putra Malaysia.

Mitzmain, M. B. (1913). The role of *S. calcitrans* in the transmission of *Trypanosoma evansi*. Philippine Journal of Science, Sect.B 7: 475-519.

Mitzmain, M. B. (1914). Collected studies on the insect transmission of *T. evansi*. Tropical Veterinary Bulletin 5: 6-14.

Mohamad, A., Vellayan, S., Radcliffe, R. W., Lowenstine, L. J., Epstein, J., Reid, S. A., Paglia, D. E., Radcliffe, R. M., Roth, T. L., Foose, T. J., and Momin Khan, M. K. (2004). "Trypanosomiasis (surra) in the captive Sumatran Rhinoceros (Dicerorhinus sumatrensis sumatrensisi) in Peninsular Malaysia," in Proceedings of the International Conference of the Association of Institutions for Tropical Veterinary Medicine (AITVM '04), vol. 11, pp. 187–189, Petaling Jaya, Malaysia.

Mohanta, U. K., Anisuzzaman, and Mondal, M. M. H. (2011). Tick and tick borne protozoan diseases of livestock in the selected hilly areas of Bangladesh. International Journal of Agricultural Research, Innovation and Technology 1(1and2): 60-63.

Molad, T., Mazuz, M. L., Fleiderovitz, L., Fish, L., Savitsky, I., Krigel, Y., Leibovitz, B., Molloy, J., Jongejan, F. and Shkap, V. (2006). Molecular and serological detection of *A. central* and *A. marginale*-infected cattle grazing within an endemic area. Veterinary Microbiology 113: 55–62.

Molyneaux, D.H. and Ashford, R.W. (1983). The Biology of Trypanosoma and Leishmania, parasites of Man and Domestic Animals. Taylor & Francis Ltd, London.

Monique, L'H. O. and Henri S.E. (2002). Tick-borne parasitic diseases in cattle: Current knowledge and prospective risk analysis related to the ongoing evolution in French cattle farming systems. Veterinary Research 33: 599–611.

Monis, P. T. and Andrews, R. H. (1998). Molecular epidemiology: assumptions and limitations of commonly applied methods. International Journal of Parasitology 28(6):981-987.

Monty, J. (1972). A review of the stable fly problem in Mauritius. *Revue Agricole et Sucriere* de l'*Ile Maurice* 5: 13-29.

Moon, R. D. and Meyer, H. J. (1985). Non-biting flies. In R E Williams, R D Hall, A B Broce and P J Scholl (eds.). Livestock entomology.New York: John Wiley and Sons: 70–79.

Mooring, M. S., Mazhowu, W. and Scott, C. A. (1994). The effect of rainfall on tick challenge at Kyle Recreational Park, Zimbabwe. Experimental and Applied Acarology 18(9):507-520.

Morel, P. (1989). Tick borne diseases. Aberystwyth, UK: Cambrian Printers.

Morel, P. C. (2000). Maladies à tiques du bétail en Afrique. In: Chartier, C., Itard, J., Morel, P. C. and Troncy, P. M. (eds), Précis de parasitology vétérinaire tropicale. Editions Médicales internationales, Cachan, Editions TEC et DOC III, pp. 452–761.

Morel, P.C. (1980). Tick-borne diseases of livestock in Africa. In Manual of Tropical Veterinary Parasitology. UK: CABI.

Morris, K. R. S. (1963). A study of African Tabanids made by trapping. Acta Tropica 20.

Mosqueda, J., Olvera-Ramírez, A., Aguilar-Tipacamú, G. and Cantó, G.L. (2012). Current Advances in Detection and Treatment of Babesiosis. Current Medicinal Chemistry 19: 1504-1518.

Mtshali, M. S. and Mtshali, P. S. (2013). Molecular diagnosis and phylogenetic analysis of *Babesia bigemina* and *Babesia bovis* hemoparasites from cattle in South Africa. BMC Veterinary Research 9: 154-160.

Muenworn, V., Duvallet, G., Thainchum, K., Tuntakom, S., Akratanakul, P. and Chareonviriyaphap, T. (2010b). Stable Fly (Diptera: Muscidae) Distribution in Thailand. Kasetsart Journal (Natural Science) 44: 44 – 52.

Muenworn, V., Duvallet, G., Thainchum, K., Tuntakom, S., Tanasilchayakul, S., Prabaripai, A., Akratanakul, P., Sukonthabhirom, S. and Chareonviriyaphap, T. (2010a). Geographic distribution of Stomoxyine flies (Diptera: Muscidae) and diurnal activity of *Stomoxys calcitrans* in Thailand. Journal of Medical Entomology. 47: 791-797.

Muhammad, G., Naureen, A., Firyal, S. and Saqib, M. (2008). Tick control strategies in dairy production medicine. Pakistan Veterinary Journal 28: 43-50.

Muhanguzi, D., Matovu, E. and Waiswa, C. (2010). Prevalence and Characterization of Theileria and Babesia Species in Cattle under Different Husbandry Systems in Western Uganda. International Journal of Animal and Veterinary Advances 2(2): 51-58.

Mullens, B. A. and Meyer, J. A. (1987). Seasonal abundance of stable flies (Diptera: Muscidae) on California dairies. Journal of Economic Entomology 80: 1039-1043.

Mullens, B. A., Lii, K. S., Mao, Y., Meyer, J. A., Peterson, N. G. and Szijj, C. E. (2006). Behavioural responses of dairy cattle to the stable fly, *Stomoxys calcitrans*, in an open field environment. Medical and Veterinary Entomology 20: 122.

Mulumba, M., Speybroeck, N., Berkvens, D. L., Geysen, D. M., and Brandt, J. R. (2001). Transmission of *Theileria parva* in the traditional farming sector in the Southern Province of Zambia during 1997-1998, *Trop.Anim Health Prod.*, 33, 117-125.

Murray, M., D'Ieteren, G., Authíe, E. and Wissocq, N. (1998). Trypanotolerance, an option for sustainable livestock production in areas at risk from trypanosomosis. OIE Revue Scientifique et Technique 17(1): 154–175.

Murray, M., Nguyen, H. C., Lambert, P. H. and Gerber, H. (1979). The aneamia of African Trypanosomiasis. Demonstration of heamolytic factor. In 15th meeting of International Scienctific Council for Trypanosomiasis Research and Control (ISCTRC), Gambia.

Mustaffa-Babjee, A. (1994). History, development and prospects of the Animal Industry and Veterinary Services in Malaysia. Department of Veterinary Services Malaysia Publication. ISBN 983-99673-1-2. 953pp.

Mwangi, E. K., Stevenson, P., Gettinby, G., Reid, S. W. J. and Murray, J. (1998). Susceptibility of trypanosomosis of three *Bos indicus* cattle breeds in areas of differing tsetse fly challenge. Veterinary Parasitology79: 1-71.

Nantulya, V. M., Bajyana Songa, E. and Hamers, R. (1986). Apparent exhaustion of the variable antigen repertoires of *Trypanosoma vivax* in infected cattle. Infection and immunity 44: 735-738.

Narum, D. L. and Thomas, A. W. (1994). Differential localization of full-length and processed forms of Pf 83/AMA-1 an apical membrane antigen of *Plasmodium falciparum* merozoites. Molecular and Biochemical Parasitology 67: 59-68.

Ndungu, S. G., Brown, C. G., and Dolan, T. T. (2005). In vivo comparison of susceptibility between *Bos indicus* and *Bos taurus* cattle types to *Theileria parva* infection. Onderstepoort Journal of Veterinary Research 72: 13-22.

Neimark, H. and Kocan, K. M. (1997). The cell wall-less rickettsia *Eperythrozoon wenyonii* is a Mycoplasma. FEMS Microbiology Letters 156: 287–291.

Neimark, H., Johansson, K. E., Rikihisa, Y. and Tully, J. G. (2001). Proposal to transfer some members of the genera *Haemobartonella* and *Eperythrozoon* to the genus *Mycoplasma* with descriptions of 'Candidatus Mycoplasma haemofelis', 'Candidatus Mycoplasma haemomuris', 'Candidatus Mycoplasma haemosuis' and Candidatus Mycoplasma wenyonii'. International Journal of Systematic and Evolutionary Microbiology 51:891–899.

Neimark, H., Johansson, K. E., Rikihisa, Y. and Tully, J. G. (2002). Revision of haemotrophic Mycoplasma species names. International Journal of Systematic and Evolutionary Microbiology 52: 683.

Nelson, W. A., Bell, J. F., Clifford, C. M. and Keirans, I. E. (1977). Interaction of ectoparasites and their hosts. Journal of Medical Entomology 13: 389-428.

Nelson, W. A., Keirans, J. E., Bell, J. F. and Clifford, C. M. (1975). Host-ectoparasite relationships. Journal of Medical Entomology 12: 143-166.

Ng, K. B. Y. and Vanselow, B. (1978). Outbreak of surra in horses and the pathogenesis of the anaemia. KajianVeterinar 10: 88-98.

Nihei, S. S. and De Carvalho, C. J. (2009). The Muscini flies of the world (Diptera, Muscidae): identification key and generic diagnoses. Zootaxa 1976: 1–24.

Nik Him, N. A. I. I., Pong, S. C. Y., Zary, S. Y., Premaalatha, B., Zaini, C. M., Chandrawathani, P., Chin, S. W. and Ramlan M. (2013). Seroprevalence of anaplasmosis (*Anaplasma marginale*) in local cattle in Malaysia. Malaysian Journal of Veterinary Research 4:2. 27-31.

Nishizawa, I., Sato, M., Fujihara, M., Sato, S. and Harasawa R. (2010). Differential detection of hemotropic Mycoplasma species in cattle by melting curve analysis of PCR products. The Journal of Veterinary Medical Science 72: 77–79.

Njiru, Z. K., Constantine, C. C., Guya, S., Crowther, J., Kiragu, J. M., Thompson, R. C. and Davila, A. M. (2005). The use of ITS1 rDNA PCR in detecting pathogenic African trypanosomes. Parasitology Research 95: 186-92.

Njiru, Z. K., Costantine C. C., Ndung'u, J. M., Robertso I., Okaye, S., Thompson, R. C. and Reid, M. A. (2004). Detection of *Trypanosoma evansi* in camels using PCR and CATT/*T.evansi* in Kenya. Veterinary Parasitology 124: 187-199.

Norval, R. A., Lawrence, J. A., Young, A. S., Perry, B. D., Dolan, T. T., and Scott, J. (1991). *Theileria parva*: influence of vector, parasite and host relationships on the epidemiology of theileriosis in southern Africa. Parasitology 102(3): 347-356.

Norval, R. A., Perry, B. D., Young, A. S., Lawrence, J. A., Mukhebi, A. W., Bishop, R., and McKeever, D. J. (1992). The Epidemiology of Theileriosis in Africa. Academic Press. London, UK.

Norval, R. A., Sutherst, R. W., Kurki, J., Gibson, J. D., and Kerr, J. D. (1988). The effect of the brown ear-tick *Rhipicephalus appendiculatus* on the growth of Sanga and European breed cattle, veterinary Parasitology 30: 149-164.

Novacco, M., Meli, M. L., Gentilini, F., Marsilio, F., Ceci, C., Pennisi, M. G., Lombardo, G., Lloret, A., Santos, L., Carrapi ço, T., Willi, B., Wolf, G., Lutz, H. and Hofmann-Lehmann, R. (2010). Prevalence and geographical distribution of canine hemotropic mycoplasma infections in Mediterranean countries and analysis of risk factors for infection. Veterinary Microbiology 142: 276–284.

Nur Mahiza, M. I. (2010). Prevalence of Bovine Haemoparasites and Risk Factors Associated with *Trypanosoma evansi* Infection in Malaysia. Master of Science Thesis, Universiti Putra Malaysia.

Nurulaini, R., Jamnah, O., Adnan, O., Zaini, C. M., Khatijah, S., Rafiah, A. and Chandrawathani, P. (2007). Mortality of domesticated java deer attributed to Surra. Tropical Biomedicine 24: 67-70.

Nurulaini, R., Premaalatha, B., Zaini, C. M., Adnan, M., Chandrawathani, P., Fazly Ann, Z. A., Enie Aryanti, A. and Ramlan, M. (2013). Trypanosomiasis outbreak in deer, cattle, buffaloes and pigs in Perak. Malaysian Journal of Veterinary Research 4(1): 55-58.

O'Connor, R. M. and Allred, D. R. (2000). Selection of *Babesia bovis*-infected erythrocytes for adhesion to endothelial cells coselects for altered variant erythrocyte surface antigen isoforms. Journal of Immunology 164: 2037–2045.

O'Connor, R. M., Lane, T. J., Stroup, S. E. and Allred, D. R. (1997). Characterization of a variant erythrocyte surface antigen (VESA1) expressed by *Babesia bovis* during antigenic variation. Molecular and Biochemical Parasitology 89(2): 259–270.

Ochanda, H., Young, A.S., Mutugi, J.J., Mumo, J. and Omwoyo, P.L. (1988). The effect of temperature on the rate of transmission of *Theileria parva* infection to cattle by its tick vector *Rhipicephalus appendiculatus.* Parasitology 97:239-245.

Office International des Epizooties (2008). Chapter 2.4. 16 theileriosis. OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (6th ed.), vol. 2; 789–804.

Ogden, N. H, Swai, E., Beauchamp, G., Karimuribo, E., Fitzpatrick, J. L., Bryant, M. J., Kambarage, D. and French, N. P. (2005). Risk factors for tick attachment to smallholder dairy cattle in Tanzania. Preventive Veterinary Medicine 67: 157–70.

Oku, E. E., Donald, A. U. and Dada, N. E. (2011). Prevalence and seasonal distribution of daytime biting diptera in Rhoko Forest in Akamkpa, Cross River State Nigeria. International Journal of Zoological Research 7 (3): 279-285.

Oliveira, A. F., Ferreira, R. L. and Rafael, J. A. (2007). Seasonality and diurnal activity of Tabanidae (Diptera: Insecta) of canopy in the Adolpho Ducke Forested Reserve, Manaus, Amazonas State, Brazil. Neotropical Entomology 36: 790-797.

Oliveira-Sequeira, T. C., Oliveira, M. C., Araujo, J. P. Jr. and Amarante, A. F. (2005). PCR-based detection of *Babesia bovis* and *Babesia bigemina* in their natural host *Boophilus microplus* and cattle. International Journal of Parasitology 35(1):105-111.

Onah, D. N., Hopkins, J. and Luckins, A. G. (1996). Haematological changes in sheep experimentally infected with *Trypanosoma evansi*. Parasitology Research 82: 659-663.

Onah, D. N., Hopkins, J. and Luckins, A. G. (1997). Effects of *Trypanosoma evansi* on the output of cells from a lymph node draining the site of *Pasteurella haemolytica* vaccine administration. Journal of Comparative Pathology 117: 73-82.

Ota, N., Mizuno, D., Kuboki, N., Igarashi, I., Nakamura, Y., Yamashina, H., Hanzaike, T., Fujii, K., Onoe, S., Hata, H., Kondo, S., Matsui, S., Koga, M., Matsumoto, K., Inokuma, H. and Yokoyama, N. (2009). Epidemiological survey of *Theileria orientalis* infection in grazing cattle in the eastern part of Hokkaido, Japanese Journal of Veterinary Medical Science 71: 937-944.

Oura, C. A. L., Bishop, R., Wampande, M. E., Lubega, G. W. and Tait, A. (2004). The persistence of component Theileria parva stocks in cattle immunized with the 'Muguga cocktail' live vaccine against East Coast fever in Uganda. Parasitology 129: 27-42.

Pace, N. (1997). A molecular view of microbial diversity and the biosphere. Science 276:734–740.

Palmer, G. H. (1989). Anaplasma vaccines. In Veterinary Protozoan and Hemoparasite Vaccines. I.S. Wright, Ed.: 1-29. CRC Press, Boca Raton, Florida. pp. 1–29.

Pancholi, V. and Chhatwal, G. S. (2003). Housekeeping enzymes as virulence factors for pathogens. International Journal of Medical Microbiology 293: 391-401.

Parida, M., Sannarangaiah, S., Dash, P. K., Rao, P. V. and Morita, K., (2008). Loop mediated isothermal amplification (LAMP): a new generation of innovative gene amplification technique; perspectives in clinical diagnosis of infectious diseases. Reviews in Medical Virology 18(6): 407-21.

Patterson, J. E. H. and Ruckstuhl, K. E. (2013). Parasite infection and host group size: A meta-analytical review. Parasitology 140: 803–813.

Patterson, R. S. (1989). Biology and ecology of *Stomoxys nigra* and *S. calcitrans* on Zanzibar, Tanzania. In Current status of stable fly (Diptera: Muscidae) research (J.J. Petersen & G. L. Greene, eds). Miscellaneous Publications of the Entomological Society of America 74: 2-11.

Payne, R. C., Sukanto, I. P., Bazeley, K. and Jones, T. W. (1993). The effect of *Trypanosoma evansi* infection on the oestrous cycle of Friesian Holstein heifers. Veterinary Parasitology 51: 1-11.

Pegram, R. G. and Chizyuka, H. G. B. (1990). The impact of natural infestation of ticks in Zambia on the productivity of cattle and implications of tick control strategies in Africa. Parasitologia 32: 165-176.

Perera, K. P., Gasser, R. B., Pulford, D. J., Stevenson, M. A., Firestone, S. M., McFadden, A, M. J. and Jabbar, A. (2015). Comparison of the performance of three PCR assays for the detection and differentiation of *Theileria orientalis* genotypes. Parasites and Vectors 8: 192-202.

Perry, B. D and Randolph, T. F. (1999). Improving the assessment of the economic impact of parasitic diseases and of their control in production animals. Veterinary Parasitology 84: 145–168.

Perry, B. D., Randolph, T. F., Mcdermott, J. J., Sones, K. R. and Thornton, P. K. (2002). Investing in animal health research to alleviate poverty. International Livestock Research Institute, Nairobi, Kenya. P 138.

Peter, R. J., van den Bossche, P., Penzhorn, B. L. and Sharp, B. (2005). Tick, fly, and mosquito control-Lessons from the past, solutions for the future. Veterinary Parasitology 132(3-4): 205-215.

Phasuk, J., Prabaripai, A. and Chareonviriyaphap, T. (2013). Seasonality and daily flight activity of stable flies (Diptera: Muscidae) on dairy farms in Saraburi Province, Thailand. Parasite, 20, 17.

Phasuk, J., Tharawoot, T., Beaver, R. A. and Jittapalapong, S. (2011). Seasonal Abundance of Tabanidae (Diptera) on Dairy Farms in Saraburi Province, Thailand. Thai Journal of Agricultural Science 44(3): 175-181.

Philip, C. B. (1960a). Malaysian parasites. XXXV. Descriptions of some Tabanidae (Diptera) from the Far East. Studies from the Institute of Medical Research Malaya 29: 1-32.

Philip, C. B. (1960b). Malaysian Parasites XXXVI. A summary review and records of Tabanidae from Malaya, Borneo, and Thailand. Studies from the Institute of Medical Research Malaya 29: 33-78.

Pipano, E., Markovics, A., Kriegel, Y., Frank, M. and Fish, L. (1987). Use of long-acting oxytetracycline in the immunisation of cattle against *Babesia bovis* and *B. bigemina*. Research in Veterinary Science 43: 64–66.

Pong, S. and Nik Him, N. A. I. I. (2012). Seroprevalence of bovine anaplasmosis caused by *Anaplasma marginale* in Malaysia. Proceedings of The 2nd Annual International Conference Syiah Kuala University 2012 andThe 8th IMT-GT Uninet Biosciences Conference Banda Aceh.374 (2) 1.

Potgieter, F. T. and Els, H. J. (1979). An electron microscopic study of intra-erythrocytic stages of Babesia bovis in the brain capillaries of infected splenectomized calves. Onderstepoort Journal of Veterinary Research 46: 41–49.

Prullage, J. B., Williams, R. E. and Gaafa, S. M. (1993). On the transmissibility of *Eperythrozoon suis* by *Stomoxys calcitrans* and *Aedes aegypti*. Veterinary Parasitology 50: 125-135.

Quan, J. H., Kim, T. Y., Choi, I. U. and Lee, Y. H. (2008). Genotyping of a Korean isolate of Toxoplasma gondii by multilocus PCR-RFLP and microsatellite analysis. Korean Journal of Parasitology 46(2):105-8.

Quinones Mateu, M. E., Finol, H. J., Sucre, L.E. and Torres, S. H. (1994). Muscular changes in Venezuelan wild horses naturally infected with *Trypanosoma evansi*. Journal of Comparative Pathology 110: 79-89.

Radostits, O. M., Blood, D. C. and Gay, C. C. (2000). Veterinary Medicine: A text book of disease of cattle, sheep, pigs, goats and horse. 9th Ed, Baillere Tindall Publication, London, pp: 1172-1173, 1289-1290.

Radostits, O. M., Gay, C. C., Hinchcliff, K. W. and Constable, P. D. (2007). Veterinary Medicine, 10th Edition. Saunders Ltd.

Rahman, W. A., Fong, S., Chandrawathani, P., Nurulaini, R., Zaini, C. M., and Premalaatha, B. (2012). Comparative seroprevalences of bovine trypanosomiasis and anaplasmosis in five states of Malaysia. Tropical Biomedicine. 29(1): 65–70.

Rahman, W. A., Lye, Y. P. and Chandrawathani, P. (2010). The seroprevalence of bovine babesiosis in Malaysia Tropical Biomedicine, 27(2): 301–307.

Raina, A. K., Kumar, R., Rajora, V., Sridhar, S. and Singh, R. P. (1985). Oral transmission of *Trypanosoma evansi* infection in dogs and mice. Veterinary Parasitology 18, 67-69.

Rajamanickam, C. (1968). Some notes on the ticks of domestic animals in West Malaysia and their distribution. A preliminary report. Kajian Veterinaire 1(3): 168-177.

Rajamanickam, C. (1970). Blood protozoa diseases of imported temperate breeds of cattle in West Malaysia. Kajian Veterinaire 2(3): 145-152.

Rajamanickam, C. (1987). Cattle tick fever and its control in Malaysia Department of Veterinary Services Ministry of Agriculture, Malaysia.

Rajput, Z. I. Hu, S. Chen, W. Arijo, A. G. and Xiao, C. (2006). Importance of ticks and their chemical and immunological control in livestock. Journal of Zhejiang University SCIENCE B 7(11): 912-921.

Rajput, Z. I., Song-hua, H., Arijo, A. G., Habib, H. and Khalid, K. (2005). Comparative study of Anaplasma parasites in tick carrying buffaloes and cattle. J Zhejiang Univ Sci, 6B: 1057-1062

Randolph, S.E. and Storey, K. (1999). Impact of microclimate on immature tick-rodent host interactions (Acari: Ixodidae): implications for parasite transmission. Journal of Medical Entomology 36: 741-748.

Reid, S. A. (2002) *Trypanosoma evansi* control and containment in Australasia. Trends in Parasitology 18: 219-224.

Reid, S. A. and Copeman, D. B. (2000). Surveys in Papua New Guinea to detect the presence of *Trypanosoma evansi* infection. Australian Veterinary Journal 78(12): 843–845.

Reid, S. A., Husein, A., Hutchinson, G. W. and Copeman, D. B. (1999). A possible role for Rusa deer (*Cervus timorensis russa*) and wild pigs in the spread of *Trypanosoma evansi* from Indonesia to Papua New Guinea. *Memorias do Instituto Oswaldo Cruz*, 94(2): 195-198.

Reid, S. A., Husein, A., Partoutomo, S. and Copeman, D. B. (2001). The susceptibility of two species of wallaby to infection with *Trypanosoma evansi*. Australian Veterinary Journal. 79: 285-288.

Reinbold, J. B., Coetzee, J. F., Sirigireddy, K. R. and Ganta, R. R. (2010). Detection of *Anaplasma marginale* and *A. phagocytophilum* in Bovine Peripheral Blood Samples by Duplex Real-Time Reverse Transcriptase PCR Assay. Journal of Clinical Microbiology 48(7): 2424–2432.

Remarque, E. J., Faber, B. W., Kocken, C. H. and Thomas, A. W. (2008). Apical membrane antigen 1: a malaria vaccine candidate in review, Trends in Parasitology. 24(2): 74-84.

Ribeiro, M. F. B., Passos, L. M. F. and Guimarães, A. M. (1997). Ultrastructure of *Anaplasma marginale* with an inclusion appendage, isolated in Minas Gerais State, Brazil, 1997. Veterinary Parasitology 70: 123- 128.

Richey, E. J. (1999). Bovine Anaplasmosis, College of Veterinary Medicine, University of Florida.

Richey, E. J. and Palmer, G. H. (1990) Bovine anaplasmosis. Compendium on Continuing Education for the Practising Veterinarian 12:1661–1668.

Riek, R. F. (1982). Epidemiology and transmission of *Theileria* sp. of cattle in Australia. Australia Veterinary Journal 59: 89–92.

Ristic, M. (1960). Anaplasmosis. Advances in Veterinary Science 6: 111-192.

Ristic, M. (1968). Anaplasmosis. *In:* Infectious blood diseases of man and animals, ed. Weinman D, Ristic M, vol. 2, pp. 478-572. Academic Press, New York, NY.

Roberts, R. H. (1976). The comparative efficiency of six trap types for the collection of Tabanidae (Diptera). Mosquito News 36: 530 –535.

Rochiman, S. (2009). Daily dynamic population of Tabanids fly in the teaching farm of Faculty of Veterinary Medicine, Airlangga University, Surabaya - Indonesia. Proceeding of the International Conference on Animal Health and Human Safety: Palm Garden IOI Resort Putrajaya (Malaysia).

Rodriguez, R. I. and Trees, A. J. (1996). In vitro responsiveness of Babesia bovis to imidocarb dipropionate and the selection of a drug-adapted line. Veterinary parasitology 62(1-2): 35-41.

Rodríguez-Vivas, R.I., Mata-Mendez, Y., Pérez-Gutierrez, E., and Wagner, G. (2004). The effect of management factors on the seroprevalence of Anaplasma marginale in Bos indicus cattle in the Mexican tropics. Tropical Animal Health and Production 36(2):135-143.

Rogers, D. J (1978). A comparison of electric-trap and hand-net catches of *Glossina palpalis palpalis* (Robineau-Desvoidy) and *Glossina tachinoides* Westwood (Diptera: Glossinidae) in the Sudan vegetation zone of northern Nigeria. Bulletin of Entomological Research 68: 283-297.

Rowlands, G. J., Mulatu, W., Authie, E., d'leteren, G. D. M., Leak, S. G. A., Nagda, S. M. and Peregrine, A. S. (1993). Epidemiology of bovine trypanosomiasis in the Ghibe valley, Southwest Ethiopia. 2. Factors associated with variations in trypanosome prevalence, incidence of new infections and prevalence of recurrent infections. Acta Tropica 53: 135-150.

Rozendaal, J. A. (1997). Vector control. Methods for use by individuals and communities. World Health Organisation, Geneva.

Rugg, D. (1982). Effectiveness of Williams traps in reducing the numbers of stable flies (Diptera: Muscidae). Journal of Economic Entomology 75: 857– 859.

Ryan, J. (2006). Emerging canine tick-borne diseases in Australia and phylogenetic studies of the canine piroplasmida. PhD Thesis, Murdoch University Australia.

Rymaszewska, A. and Grenda, S. (2008) Bacteria of the genus Anaplasma – characteristics of Anaplasma and their vectors: a review. Journal of Veterinary Medicine 53(11): 573–584.

Saad, F., Khaisroon, M., Khan, K. and Akbar, N. (2015). Prevalence and Molecular Detection of Babesiosis in the Slaughter Animals of Peshawar Khyber Pakhunkhawa Pakistan. *International* Journal of Current Microbiology *and* Applied Sciences 4(8): 1030-1036.

Saharee, A. and Fatimah, C. T. N. I. (1993). Common diseases in ruminants. In: Animal industry in Malaysia. Serdang: Faculty of Veterinary Medicine and Animal Science.

Sajid, M. S., Iqbal, Z., Khan, M. N. and Muhammad, G. (2009). In vitro and in vivo efficacies of Ivermectin and Cypermethrin against the cattle tick Hyalomma anatolicum anatolicum (Acari: Ixodidae). Parasitology Research 105: 1133-1138.

Sajid, M. S., Iqbal, Z., Khan, M. N., Muhammad, G., Iqbal, M. U. (2007). Effect of Hyalomma ticks *(acari*: *ixodidae*) on milk production of dairy buffaloes (*Bos bubalus bubalis*) of Punjab (Pakistan). Italian Journal of Animal Science 6: 939–941.

Sajid, M. S., Siddique, R. M., Khan, S. A., Iqbal, Z. and Khan, M. N. (2014). Prevalence and Risk Factors of Anaplasmosis in Cattle and Buffalo Populations of District Khanewal, Punjab, Pakistan. Global Veterinaria 12 (1): 146-153.

Saleh, M. A., Al-Salahy, M. B. and Sanousi, S. A. (2009). Oxidative stress in blood of camels (*Camelus dromedaries*) naturally infected with *Trypanosoma evansi*. Veterinary Parasitology 162: 192-199.

Salleh, M. B. H. (1984). Prevalence of blood-borne protozoa in UPM cattle. DVM Thesis, Universiti Putra Malaysia.

Sani, R. A., Chandrawathani, P. and Salim, N .B. (1995). Diagnosis of *Trypanosoma evansi* infection in cattle and buffaloes in West Malaysia. In: Proceeding of Seventh National Biotechnology Seminar, Langkawi, Ministry of Science, Technology and Environment.

Sarataphan, N., Nilwarangkoon, S., Tananyutthawongese, C., Kakuda, T., Onuma, M. and Chansiri, K. (1999). Genetic diversity of major piroplasm surface protein genes and their allelic variants of Theileria parasites in Thai cattle. Journal of Veterinary Medical Science 61: 991–994.

Schreck, C. E., Kline, D. L., Williams, D. C. and Tidwell, M. A. (1993). Field evaluations in Malaise and canopy traps of selected targets as attractants for tabanid species (Diptera: Tabanidae). Journal of the American Mosquito Control Association 9: 182-188.

Schuurmans, S. J. H. Jr. (1928). The bloodsucking arthropods of the Dutch East Indian Archipelago. IX. Recent collections of tabanids from Sumatra, Middle East Borneo, Soemba etc. Zoologische Jahrbücher 54: 425-448.

Scott, J. A. (1995). The molecular genetics of resistance: resistance as a response to stress. Florida Entomologist. 78(3):399-414.

Sehgal, R. N. M., Jones, H. I. and Smith, T. B. (2005). Blood Parasites of Some West African Rainforest Birds. Journal of Veterinary Medical Science 67(3): 295–301.

Semakula, L. M., Taylor, R. A. J. and Pitts, C. W. (1989). Flight Behavior of *Musca domestica* and *Stomoxys calcitrans* (Diptera: Muscidae) in a Kansas Dairy Barn. Journal of Medical Entomology. 26: 501-509.

Serin, T. and Hashim, F. A. H. (2010). Status and demand of technology for selected beef cattle producers in Peninsular Malaysia. Economic and Technology Management Review 5: 21– 26.

Shahnawaz, S., Ali, M., Aslam, M. A., Fatima, R., Chaudhry, Z. I., Hassan, M. U., Ali, M. and Iqbal, F. (2011). A study on the prevalence of a tick transmitted pathogen, *Theileria annulata*, and hematological profile in cattle from Southern Punjab (Pakistan). Parasitology Research 109(4): 1155-60.

Sharafeldin, A., Eltayeb, R., Pashenkov, M. and Bakhiet, M. (2000). Chemokines are produced in the brain early during the course of experimental African trypanosomiasis. Journal of Neuroimmunology. 103: 165-170.

Sharifah, S. S. H. (2001). A study on *Trypanosoma evansi* in five dairy farms in Selangor, DVM Thesis, Universiti Putra Malaysia.

Sheriff, D., Clapp, K. H. and Reid, M. A. (1966). *Eperythrozoon ovis* infection in South Australia. Australian Veterinary Journal. 42:169-176.

Shiels, B. R., d'Oliveira, C., McKellar, S., Ben-Miled, L., Kawazu, S. and Hide, G. (1995). Selection of diversity at putative glycosylation sites in the immunodominant merozoite/piroplasm surface antigen of Theileria parasites. Molecular and Biochemical Parasitology 72: 149–162.

Shinonaga, S. and Kano, R. (1977). A new specie of the Genus *Musca* L. from the oriental region. Japanese Journal of Sanitary Zoology 28: 111-113.

Shkap, V., Leibovitz, B., Krigel, Y., Molad, T., Fish, L., Mazuz, M., Fleiderovitz, L. and Savitsky, I. (2008). Concomitant infection of cattle with the vaccine strain *Anaplasma marginale* ss *centrale* and field strains of *A. marginale*. Veterinary Microbiology 130: 277–284.

Silva, J. B. da., Santos, P. N. dos, and Fonseca, A. H. (2014). Molecular and serological detection of *Babesi Bovis* and *Babesia Bigemina* in cattle in the Rio de Janeiro, Brazil. Ciências Agrárias, Londrina 35(6): 3139-3146.

Simking, P., Yatbantoong, N., Saetiew, N., Saengow, S., Yodsri, W., Chaiyarat, R., Wongnarkpet, S. and Jittapalapong, S. (2014). Prevalence and risk factors of Babesia infections in cattle trespassing natural forest areas in Salakpra Wildlife Sanctuary, Kanchanaburi Province. Journal of Tropical Medicine and Parasitology 37(1): 10-9.

Simmonds, S. W. (1944) Observations on the biology of the stable fly in Florida. Journal of Economical Entomology 37: 680-686.

Simuunza, M. C. (2009). Differential diagnosis of tick-borne diseases and population genetic analysis of *babesia bovis* and *babesia bigemina*. Ph.D Thesis, University of Glasgow.

Singh, B. P. and Misra, S. K. (1988). A study on the clinical course of *Trypanosoma evansi* in experimentally infected cow-calves. Indian Veterinary Medical Journal 12: 127-128.

Singh, N. K., Singh, H., Jyoti, Haque, M., Rath, S. S. (2012). Prevalence of parasitic infections in cattle of Ludhiana district, Punjab. Journal of Parasitic Diseases 36(2):256–25.

Sissay, M. M., Uggla, A. and Waller, P. J. (2007). Epidemiology and seasonal dynamics of gastrointestinal nematode infections of sheep in a semi-arid region of eastern Ethiopia. Veterinary Parasitology 143: 311-21.

Sivakumar, T., Altangerel, K., Battsetseg, B., Battur, B., AbouLaila, M., Munkhjargal, T., Yoshinari, T., Yokoyama, N. and Igarashi, I., (2012). Genetic detection of *Babesia bigemina* from Mongolian cattle using apical membrane antigen-1 gene based PCR assay. Veterinary Parasitology 187: 17–22.

Skovgård, H. and Jespersen, J. B. (1999). Activity and relative abundance of hymenopterous parasitoids that attack puparia of *Musca domestica* and *Stomoxys calcitrans* (Diptera: Muscidae) on confined pig and cattle farms in Denmark. Bulletin of Entomological Research 89: 263–269.

Smeenka, I., Kellyb, P. J., Wrayc, K., Musukac, G., Treesd, A. J. and Jongejan, F. (2000). *Babesia bovis* and *B. bigemina* DNA detected in cattle and ticks from Zimbabwe by polymerase chain reaction Journal of the South African Veterinary Association 71(1): 21–24.

Smith, A. R: (1986). Eperythrozoonosis. In: Diseases of swine, ed. Leman AD, Straw B, Glock RD, Mengeling WL, et al., 6th ed., pp. 683-687. Iowa State University Press, Ames, IA.

Smith, J. A., Thrall, M. A., Smith, J. L., Salman, M. D., Ching, S. V. and Collins, J. K., (1990). *Eperythrozoon wenyonii* infection in dairy cattle. Journal America Veterinary Medical Association 196: 1244–1250.

Solo´rzano, J., Gilles, J., Bravo, O., Vargas, C., Gomez-Bonilla, Y., Bingham, G. V. and Taylor, D. B. (2015). Biology and Trapping of Stable Flies (Diptera: Muscidae) Developing in Pineapple Residues (Ananas comosus) in Costa Rica. Journal of Insect Science 15(1): 145-149.

Solorio-Rivera, J. L., Rodr´guez-Vivas, R. I., P´rez-Gutierrez, E. and Wagner, G. (1999). Management factors associated with *Babesia bovis* seroprevalence in cattle from eastern Yucat´n, Mexico. Preventive Veterinary Medicine. 40(3-4): 261-269.

Soulsby, E. J. L. (1982). Helminths, Arthropods and Protozoa of Domesticated Animals, 1st Ed. Bailliere Tindall, London, UK.

Sparagano, O., Loria, G. R., Gubbels, M. J., De Vos, A. P., Caracappa, S., Jongejan, F., (2000). Integrated molecular diagnosis of Theileria and Babesia species of cattle in Italy. Annals of New York Academy of Sciences 916: 533–539.

Spickler, A. R. and Roth, J. A. (2008). Emerging and Exotic Diseases of Animal, 3rd Edition, CFSPH Iowa State University, pp: 132-135

Splitter, E.J. (1951). Eperythrozoonosis in Swine. Iowa State University Veterinarian 13(2): 77-81.

Srivastava, P. S. and Sharma, N. N. (1981). Studies on the occurrence, clinical features and clinicopathological and pathomorphological aspects of theileriasis in calves. Veterinary Research 4: 22-29.

Stagg, D. A., Dolan, T. T., Leitch, B. L. and Young, A. S. (1981). The initial stages of infection of cattle cells with *Theileria parva* sporozoites *in vitro.* Parasitology Research 83: 191-197.

Steelman, C. D. (1976). Effects of external and internal arthropod parasites on domestic livestock production. Annual Review of Entomology 21: 155-178.

Stephen, L. E. (1986). Trypanosomiasis: A veterinary perspective, Oxford: Pergamon Press.

Stone, A. and Philip, C. B. (1974). The Oriental Species of the Tribe Haematopotini (Diptera, Tabanidae). Agricultural Research Service United States Department of Agriculture Washington, D.C.

Straif, S., Maier, W. and Seitz, H. M. (1990). Regurgitation as a potential mechanism of pathogen transmission in the biting fly *Stomoxys calcitrans*. Zeitschrift fur Angewandte Zoologie 77(3-4):357-366.

Su, Q. L., Song, H. Q., Lin, R. Q., Yuan, Z. G., Yang, J. F., Zhao, G. H., Huang , W. Y. and Zhu, X. Q. (2010). The detection of *"Candidatus* Mycoplasma haemobos*"* in cattle and buffalo in China. Tropical Animal Health and Production 42(8): 1805-1808.

Suarez, C.E. and Noh, S. (2011). Emerging perspectives in the research of bovine babesiosis and anaplasmosis. Veterinary parasitology 180(1-2): 109- 125.

Sucharit, S. and Tumrasvin, W. (1981). The survey of flies of medieal and veterinary importanee in Thailand. The Japan Society of Medical Entomology and Zoology. 32(4):281-285.

Sudan, V., Sharma, R. L., Gupta, S. R., Borah, M. K. and Mishra, R. (2012). An occurrence of clinical eperythrozoonosis in a German Shepherd dog and its therapeutic management. Journal of Parasitic Diseases 36(2):181–183.

Sugimoto, C. and Fujisaki, K. (2002). Non-transforming *Theileria* parasites of ruminants S.J. Black, J.R. Seed (Eds.), Theileria, Kluwer Academic Publishers, Massachusetts 94–106.

Suh, S. J., Kim, H. C., Klein, T. A., Chong, S. T., Lee, W. J. and Kwon, Y. J. (2005). Tabanid flies (Diptera: Tabanidae) of the northern part of Gyeonggi Province, Republic of Korea. Entomological Research 35: 195-198.

Sukhumsirichart, W., Khuchareontawon S., Saratapan, N., Viseshakul, N. and Chansiri, K. (2000). Application of PCR-Based for diagnosis of *Trypanosoma evansi* in different animals and vectors Journal of Tropical Medicine and Parasitology 23: 1-6.

Sumba, A. L., Mihok, S. and Oyieke, F. A. (1998). Mechanical transmission of *Trypanosoma evansi* and *T. congolense* by *Stomoxys niger* and *S. taeniatus* in a laboratory mouse model. Medical and Veterinary Entomology 12: 417-422.

Sutherst, R. W. (1971). An experimental investigation into the effects of flooding on the ixodid tick *Boophilus microplus* (Canestrini). Oecologia 6(3):208-222.

Sutton, R. H. (1978). Observations on the pathology of *Eperythrozoon ovis* infection in sheep. New Zealand Veterinary Journal. 26: 224-230.

Swai, E. S., Karimuribo, E. D. Ogden, N. H., French, N. P., Fitzpatrick, J. L., Bryant, M. J. and Kambarage, D. M. (2005). Seroprevalence Estimation and Risk Factors for *A. marginale* on Smallholder Dairy Farms in Tanzania. Tropical Animal Health and Production 37: 599–610.

Swai, E. S., Karimuribo, E. D., French, N. P., Fitzpatrick, J. L., Bryant, M. J., Kambarage, D. M. and Ogden, N. H. (2007). Seroprevalence of *Babesia bigemina* in smallholder dairy cattle in Tanzania and associated risk factors. Journal of the South African Veterinary Association 78(1): 15–20.

Tagawa, M., Matsumoto, K. and Inokuma, H. (2008). Molecular detection of Mycoplasma wenyonii and 'Candidatus Mycoplasma haemobos' in cattle in Hokkaido, Japan, Veterinary Microbiology 132: 177–180.

Tagawa, M., Matsumoto, K., Yokoyama, N. and Inokuma, H. (2010). Comparison of the effect of two hemoplasma species on hematological parameters in cattle, The Journal of Veterinary Medical Science 72: 113–115.

Tagawa, M., Yamakawa, K., Aoki, T., Matsumoto, K., Ishii, M. and Inokuma, H. (2013). Effect of Chronic Hemoplasma Infection on Cattle Productivity. Journal of Veterinary Medical Science 75(10): 1271–1275.

Tagawa, M., Ybanez, A. P., Matsumoto, K., Yokoyama, N, and Inokuma, H. (2012). Prevalence and risk factor analysis of bovine hemoplasma infection by direct PCR in Eastern Hokkaido, Japan. Journal of Veterinary Medical Science 74(9): 1171–1176.

Tay, S. T., Koh, F. X., Kho, K. L. and Ong, B. L. (2014). Molecular survey and sequence analysis of *Anaplasma* spp. in cattle and ticks in a Malaysian farm. Tropical Biomedicine 31(4): 769–776.

Taylor, D. B. and Berkebile, D. (2006). Comparative Efficiency of Six Stable Fly (Diptera: Muscidae) Traps. Journal of Economic Entomology 1415-1419.

Taylor, D. B., Moon, R. D. and Mark, D. R. (2012). Economic impact of stable flies (Diptera: *Muscidae)* on dairy and beef cattle production. Journal of Medical Entomology 49(1): p. 198 - 209.

Taylor, M. A., Coop, R. L., and Wall, R. L. (2007). Veterinary parasitology, 3rd edn. Blackwell, UK, p 341.

Tembue, A. A. M., Silva, F. J. M., Silva, J. B., Santos, T. M., Santos, H. A., Soares, C. O. and Fonseca, A. H. (2011). Risk factors associated with the frequency of antibodies against Babesia bovis and Babesia bigemina in cattle in southern Mozam-bique. Pesquisa Veterinária Brasileira, Rio de Janeiro, 31 (8): 663-666.

Temperley, N. D., Webster, L. M., Adam, A., Keller, L. F. and Johnson, P. C. (2009). Cross-species utility of microsatellite markers in Trichostrongyloid nematodes. Journal of Parasitology. 95(2):487-489.

Thach, H., Dung, P. H. and Thuan, H. T. (1996). Survey of trypanosomiasis and study of prophylactic and therapeutic procedures for dairy Cattle and buffaloes in Southern Vietnam. Khoa - HOC Ky Thuat - Thu Y 3: 50–57.

Thorsteinson, A. J., Bracken, G. K. and Hanec, W. (1965). The orientation behaviour of horse flies and deer flies (Tabanidae, Diptera). III. The use of traps in the study of orientation of tabanids in the field. Entomologia Experimentalis et Applicata 8: 189-192.

Thrusfield, M. (2005). Veterinary Epidemiology, third ed. Blackwell Science, Oxford, England, pp. 53.

Thrusfield, M. (2007). Veterinary Epidemiology, 3 Ed, Blackwell Science, London. 231-232.

Todd, D. H. (1964). The biting fly *Stomoxys calcitrans* (L.) in dairy herds in New Zealand, New Zealand Journal of Agricultural Research 7 (1): 60-79.

Torina, A., Agnone, A., Sireci, G., Mosqueda, J. J., Blanda, V., Albanese, I., La Farina, M., Cerrone, A., Cusumano, F. and Caracappa, S. (2010). Characterization of the apical membrane antigen-1 in Italian strains of *Babesia bigemina*. Transboundary and Emerging Diseases 57(1-2): 52-56.

Torr, S. J., Hargrove, J. W. and Vale, G. A. (2006). The effects of host physiology on the attraction of tsetse (Diptera: Glossinidae) and *Stomoxys* (Diptera: Muscidae) to cattle. Bulletin of Entomological Research 96: 71-84.

Tortoli, E. (2003). Impact of genotypic studies on mycobacterial taxonomy: the new mycobacteria of the 1990s. Clinical Microbiology Reviews 16:319–354.

Touratier, L. (1993). Report of the thirteenth meeting of the OIE ad hoc group on non tsetse-transmitted animal trypanosomoses. Revue Scientifique et Technique 12: 237-272.

Trindade, H. I. da., Silva, G. R. de A., Teixeira, M. C. A., Sousa, M. G., Machado, R. Z., Freitas, F. L. da C. and Almeida, K. de S. (2010). Detection of antibodies against *Babesia bovis* and *Babesia bigemina* in calves from the region of Aragua ína. Revista Brasileira de Parasitologia Veterin ária 19 (3): 169-173.

Tumrasvin, W. and Shinonaga, S. (1977). Studies on medically important flies in Thailand. III. Report of species belonging to the genus Musca Linne, including the taxonomic key (Diptera: Muscidae). Bulletin of Tokyo Medical and Dental University 24(3):209-218.

Tumrasvin, W. and Shinonaga, S. (1978). Studies on medically important flies in Thailand. V. On 32 species belonging to the subfamilies Muscinae and Stomoxyinae including the taxonomic keys (Diptera: Muscidae). Bulletin of Tokyo Medical and Dental University 25(4):201-27.

Uche, U. E. and Jones, T. W. (1992). Pathology of experimental *Trypanosoma evansi* infection in rabbits. Journal of Comparative Pathology 106: 299-309.

Uilenberg, G. (1995). International collaborative research: significance of tick-borne hemoparasitic diseases to world animal health. Veterinary Parasitology 57: 19–41.

Uilenberg, G. (2006). Babesia— A historical overview. Veterinary Parasitology 138: 3-10.

Urakawa, T., Verloo, D., Moens, L., Büscher, P. and Majiwa, P. A. O. (2001). Trypanosoma evansi: cloning and expression in Spodoptera fugiperda insect cells of the diagnostic antigen RoTat 1.2. Experimental Parasitol*ogy* 99:181-189.

Urdaz-Rodriguez, J. H., Fosgate, G. T., Alleman, A. R., Rae, D. O., Donvan, G. A. and Melendez, P. (2009). Seroprevalence estimation and management factors associated with high herd seropositivity for *Anaplasma marginale* in commercial dairy farms of Puerto Rico. Tropical Animal Health and Production. 41: 1439-1448.

Urquhart, G. M., Armour, J., Duncan, J. L., Dum, A. M. and Jennings, F. W. (2003). Veterinary Parasitology. 2nd edition, Blackwell Science Ltd. London. pp. 242-243.

Van der Waaiji, E. H., Hanotte, O., van Arendonk, J. A. M., Kemp, S. J., Kennedy, D., Gibson, J. P. and Teale A. (2003). Population parameters for traits defining trypanotolerance in an F2 cross of N'Dama and Boran cattle. Livestock production Science 84(3): 219-230.

Van Hennekeler, K. (2007). Aspects of the ecology of tabanid flies (Family: Tabanidae) in North Queensland and their potential to transmit *Trypanosoma evansi*. Ph.D. Thesis, James Cook University, Australia. Accessed, 16 June 2015, http://eprints.jcu.edu.au/4826/.

Van Hennekeler, K., Jones, R. E., Skerratt, L. F., Fitzpatrick, L. A., Reid, S. A. and Bellis, G. A. (2008). A comparison of trapping methods for Tabanidae (Diptera) in North Queensland, Australia. Medical and Veterinary Entomology 22: 26-31.

Ventura, R. M., Takata, C. S., Silva, R. A., Nunes, V. L., Takeda, G. F. and Teixeira, M. M. (2000) Molecular and morphological studies of Brazilian *Trypanosoma evansi* stocks: the total absence of kDNA in trypanosomes from both laboratory stocks and naturally infected domestic and wild mammals. Journal of Parasitology. 86: 1289-1298.

Vial, H. J. and Gorenflot, A. (2006). Chemotherapy against babesiosis. Veterinary parasitology. 138(1-2): 147-160.

Wagner, G., Cruz, D., Holman, J. and Wagela, S. (1991). Epidemiology, diagnosis and control alternatives for anaplasmosis. In: H. Seminario Internacional de Parasitologia Animal, Garrapatasy enfermedades ques transmit ten, Morelos, Mexico, pp. 167-171.

Walker, J. G., Klein, E. Y. and Levin, S. A. (2014). Disease at the wildlife-livestock interface: Acaricide use on domestic cattle does not prevent transmission of a tick-borne pathogen with multiple hosts. Veterinary Parasitology 199: 206–214.

Wall, R. and Shearer, D. (2000). Veterinary ectoparasites: biology, pathology and control (2nd ed.). Blackwell Science Ltd., Abingdon, U.K.

Wall, W. J. and Doane, O. W., Jr. (1980). Large scale use of box traps to study and control saltmarsh greenhead flies (Diptera: Tabanidae) on Cape Cod, Massachusetts. Environmental Entomology 9: 371-375.

Waters, A. P., Thomas, A. W., Deans, J. A., Mitchell, G. H., Hudson, D. E., Miller, L. H., Mc Cutchan, T. F. and Cohen, S. (1990). A merozoite receptor protein from *Plasmodium knowlesi* is highly conserved and distributed throughout Plasmodium. Journal of Biological Chemistry 265: 17974-17979.

Watson, D. W., Denning, S. S., Calibeo-Hayes, D. I., Stringham, S. M. and Mowrey, R. A. (2007). Comparison of two fly traps for the capture of horse flies (Diptera: Tabanidae). Journal of Entomological Science 42(2): 123-132.

Weir, W., Karagenc, T., Baird, M., Tait, A. and Shiels, B. R. (2010). Evolution and diversity of secretome genes in the apicomplexan parasite *Theileria annulata* BMC Genomics, 11: 42.

Wieman, G. A., Campbell, J. B., Deshazer, J. A. and Berry, I. L. (1992). Effects of stable flies (Diptera: *Muscidae*) and heat stress on weight gain and feed efficiency of feeder cattle. Journal of Economic Entomology 85: 1835-1842.

Willi, B., Boretti, F. S., Baumgartner, C., Tasker, S., Wenger, B., Cattori, V., Meli, M. L., Reusch, C. E., Lutz, H. and Hofmann-Lehmann, R. (2006). Prevalence, risk factor analysis, and follow-up of infections caused by three feline hemoplasma species in cats in Switzerland. Journal of Clinical Microbiology 44: 961–969.

Willi, B., Filoni, C., Cat ão-Dias, J. L., Cattori, V., Meli, M. L., Vargas, A., Mart ínez, F., Roelke, M. E., Ryser-Degiorgis, M. P, Leutenegger, C. M., Lutz, H. and Hofmann-Lehmann, R. (2007). Worldwide occurrence of feline hemoplasma infections in wild felid species, Journal of Clinical Microbiology, 45: 1159–1166.

Wilson, A. J., Parker, R., and Trueman, K. F. (1980). Susceptibility of *Bos indicus* crossbred and *Bos taurus* cattle to *Anaplasma marginale* infection, Tropical Animal Health and Production 12: 90-94.

Wongyounoi, B., Gumtrontip, S., Sunyasutcharee, B. and Nithiuthai, S. (1990). Studies on Surra in cats. Thai Journal of Veterinary Medicine 20: 349-364.

World Health Organization (2015). World health statistics 2015. ISBN 978 92 4 156488 5.

World Organisation for Animal Health Report (2008). Manual of Diagnostic Tests and Vaccines for Terrestrial Animals <http://www.oie.int/eng/ normes/mmanual/A_summry.htm>.

Wright, I. G., Goodger, B. V., Buffington, G. D., Clark, I. A., Parrodi, F., and Waltisbuhl, D. J. (1989). Immunopathophysiology of babesial infections, Transactions of the Royal Society of Tropical Medicine and Hygiene 83: 11-13.

Yamane, I., Koiwai, M. and Hamaoka, T. (2000). A questionnaire-based national survey of bovine theileriosis in Japan. Proceedings of the 9th International Symposium on Veterinary Epidemiology and Economics.

Yeoman, G. H. (1966). Field vector studies of epizootic East Coast Fever. II. Seasonal studies of *R. appendiculatus* on bovine and non-bovine hosts in East Coast Fever enzootic, epizootic and free areas, Bulletin of epizootic diseases of Africa 14: 113-140.

Yitayew, D. and Samuel, D. (2015). Tick Borne Hemoparasitic Diseases of Ruminants: A Review. Advances in Biological Research 9 (4): 210-224.

Young, A. S., Leitch, B. L., Morzaria, S. P., Irvin, A. D., Omwoyo, P. L. and Castro, J. J. (1987). Development and survival of *Theileria parva parva* in *Rhipicephalus appendiculatus* exposed in the Trans-Mara, Kenya. Parasitology. 94:433-441.

Zahid, I. A., Latif, M. and Baloch, K. B. (2005). Incidence and treatment of Theileriasis and Babesiasis. Pakistan Veterinary Journal 25(3): 137-139.

Zahler, M., Rinder, H., Schein, E. and Gothe, R. (2000). Detection of a new pathogenic *Babesia microti*-like species in dogs. Veterinary Parasitology 89:241-8.

Zaugg, J. L., Stiller, D., Coan, M. E., Lincoln, S. D, (1986). Transmission of *Anaplasma marginale* Theiler by males of *Dermacentor andersoni* Stiles fed on an Idaho field infected, chronic carrier cow. American Journal of Veterinary Research 47:2269-2271.

Zhou, J., Liao, M., Ueda, M., Gong, H., Xuan, X. and Fujisaki, K. (2009). Characterization of an intracellular cystatin homolog from the tick *Haemaphysalis longicornis*. Veterinary Parasitology 160 (1-2): 180-183.

Zhuang, W., Sugimoto, C., Matsuba, T., Niinuma, S., Murata, M. and Onuma, M. (1994). Analyses of antigenic and genetic diversities of *Theileria sergenti* piroplasm surface proteins. Journal of Veterinary Medical Science 56: 469-473.

Zintl, A., Mulcahy, G., Skerrett, H. E., Taylor, S. M. and Gray, J. S. (2003). Babesia divergens, a bovine blood parasite of veterinary and zoonotic importance. Clinical microbiology reviews. 16, (4), 622-636.

Zulfiqar, S., Shahnawaz, S., Ali, M., Bhutta, A. M., Iqbal, S., Hayat, S., Qadir, S., Latif, M., Kiran, N., Saeed, A., Ali, M., Iqbal, F. (2012). Detection of *Babesia bovis* in blood samples and its effect on the hematological and serum biochemical profile in large ruminants from Southern Punjab. Asian Pacific Journal of Tropical Biomedicine 2(2): 104-108.

Zumpt, F. (1973). The Stomoxyinae biting flies of the World. Taxonomy, Biology, Economic importance and control measures. Ed. Gustav Fischer Verlag, Stuttgart, Germany. pp: 137-175.

Zwart, D. (1985). Haemoparasitic diseases of bovines. Scientific and Technical Review of the Office International des Epizooties 4 (3): 447-458.