UNIVERSITI PUTRA MALAYSIA

ASSESSMENT OF SELECTED LOCAL PLANTS FEED INTAKE AND REPRODUCTIVE PERFORMANCE IN FEMALE GOATS

NORHAZIRAH ABDUL HALIM

FS 2017 5

ASSESSMENT OF SELECTED LOCAL PLANTS FEED INTAKE AND REPRODUCTIVE PERFORMANCE IN FEMALE GOATS

By

NORHAZIRAH ABDUL HALIM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

January 2017

COPYRIGHT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

ASSESSMENT OF SELECTED LOCAL PLANTS FEED INTAKE AND REPRODUCTIVE PERFORMANCE IN FEMALE GOATS

By

NORHAZIRAH ABDUL HALIM

January 2017

Chairman : Mashitah Shikh Maidin, PhD
Faculty : Science

Malaysian goat production could be highly dependent on nutritional management. It is important to assess the effect of goats' nutritional management especially feeding practices on the goat production for maximizing the reproductive efficiency of the goats. Therefore, our study was conducted with aims; 1) to assess the effect of different types of feed on the reproductive performance of female goats under intensive and semi-intensive farm systems in Peninsular Malaysia, and 2) to evaluate the effects of different pre-breeding dietary intake on reproductive performance of female goats. Goat farm surveys and experimental of animals were conducted to achieve the aims. For farm surveys, a set of questionnaires were used to acquire data on feeding practices and goat reproductive performance including abortion and kidding performances from 212 respondents who involved with goat breeding for more than a year in Peninsular Malaysia. The surveys were conducted in about 8 months from January to August 2014. While for the experimental of animals, thirty-two female goats were used and were assigned into four groups: Group 1 was given a maintenance (M) diet of Napier and Guinea grass, Group 2 was given 2M of Napier grass and commercial concentrate, Group 3 was given 2M of Napier grass and Chinese Violet and Group 4 was given 1M of Napier grass and Jackfruit leaves. The treatment diets were given daily for 10 days prior to their mating period (Day -9 until Day 0). Ovulation and pregnancy rates were determined from observation of corpora lutea and fetus scanned on Day 14 and Day 49 respectively after the mating period. Kidding and twinning rates were determined through the kidding performances. Progesterone level was determined from does' blood samples taken every two or three days during the experiment. The result of the survey revealed that the kidding rate of goats were higher in farms where additional feeds were given (1.27 ± 0.06) compared to not given (1.03 ± 0.06) ($p<0.05$). Intake of Chinese Violet, banana leaf and silage have a significant relationship with early abortion ($p<0.05$) while, intakes of Napier grass and silage have a significant relationship with late abortion ($p<0.05$). Additional feed intakes have a significant association with early abortion ($X^2=11.36$, $p<0.05$) and twin kids ($X^2=10.44$, $p<0.05$). Feeding Chinese Violet, concentrate and Napier grass have significant association

with twin kids ($p<0.05$). Meanwhile, the result of animal experimental shows that Group 2 does has highest ovulation rate (1.86 ± 0.34), pregnancy rate (57.2%), twinning rate (66.7%) and litter size (1.7) and lowest overall abortion rate (50.0%). Group 1 had highest progesterone level on Day 0, 9 and 22 ($p<0.05$). Overall, from present study, it showed that commercial concentrate could affect pregnancy rate, kidding rate, twinning rate and litter size of goats. In addition, this feed intake has potential as feed supplementation for female goats where it could increase the kidding rate.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENILAIAN PENGAMBILAN MAKANAN IAITU TUMBUHAN TEMPATAN TERPILIH DAN PRESTASI REPRODUKSI KAMBING BETINA

Oleh

NORHAZIRAH ABDUL HALIM

Januari 2017

Pengerusi : Mashitah Shikh Maidin, PhD
Fakulti : Sains

Pengeluaran kambing Malaysia mungkin adalah amat bergantung kepada pengurusan pemakanannya. Adalah penting untuk menilai kesan pengurusan pemakanan kambing terutamanya amalan pemberian makanan kepada pengeluaran kambing untuk memaksimumkan abiliti pembiakan kambing. Oleh itu, kajian kami dijalankan dengan matlamat; 1) untuk menilai kesan jenis makanan yang berbeza terhadap prestasi pembiakan kambing betina dalam sistem intensif dan semi-intensif di Semenanjung Malaysia, dan 2) untuk menilai kesan pengambilan makanan yang berbeza sebelum mengawan terhadap prestasi pembiakan kambing betina. Kaji selidik ladang kambing dan uji kaji haiwan dijalankan untuk mencapai matlamat ini. Untuk kaji selidik ladang kambing, satu set soal selidik digunakan untuk memperoleh data berkenaan amalan pemberian makanan dan prestasi pembiakan kambing termasuk prestasi keguguran dan kelahiran kambing daripada 212 orang responden yang terbabit dengan pemeliharaan kambing selama lebih daripada setahun di Semenanjung Malaysia. Kaji selidik ini dijalankan selama lebih kurang 8 bulan dari bulan Januari hingga Ogos 2014. Untuk uji kaji haiwan pula, 32 dua ekor kambing betina digunakan dan dibahagikan kepada empat kumpulan: Kumpulan 1 menerima 1 tahap keperluan makanan (M) yang terdiri daripada rumput Napier dan Guinea, Kumpulan 2 menerima 2M rumput Napier dan konsentrat, Kumpulan 3 menerima 2M rumput Napier dan rumput Nyonya and Group 4 menerima 1M rumput Napier dan daun nangka. Diet trsebut diberikan setiap hari selama 10 hari sebelum tempoh mengawan (Hari -9 sehingga Hari 0). Kadar pengovulan dan kebuntingan telah ditentukan berdasarkan pemerhatian korpora lutea dan fetus yang diimbas pada hari ke-14 dan hari ke-49 selepas tempoh mengawan. Kadar kelahiran dan kembar ditentukan melalui prestasi bilangan anak yang dilahirkan. Kadar progesteron ditentukan dengan menggunakan sampel darah yang diambil setiap dua atau tiga hari semasa eksperimen itu. Keputusan kaji selidik ladang kambing menunjukkan bahawa kadar kelahiran kambing lebih tinggi di ladang di mana pemberian makanan tambahan diberikan (1.27 ± 0.06)

berbanding dengan tidak diberi (1.03 ± 0.06) ($p<0.05$). Pengambilan rumput Nyonya, daun pisang dan silaj mempunyai hubungan bererti dengan keguguran peringkat awal ($p<0.05$) manakala, pengambilan rumput Napier dan silaj mempunyai hubungan bereti dengan keguguran peringkat akhir ($p<0.05$). Pengambilan makanan tambahan mempunyai hubungan bererti dengan keguguran peringkat awal ($X^2=11.36$, $p<0.05$) dan anak kembar ($X^2=10.44$, $p<0.05$). Pemberian rumput Nyonya, konsentrat dan rumput Napier mempunyai hubungan bererti dengan anak kembar ($p<0.05$). Sementara itu, keputusan uji kaji haiwan menunjukkan kambing betina dalam Kumpulan 2 mempunyai kadar pengovulan (1.86 ± 0.34), kadar kebuntingan (57.7%), kadar kembar dua (66.7%) dan saiz seperinduk (1.7) yang tertinggi dan kadar keguguran keseluruhan (50.0%) yang terendah. Kambing Kumpulan 1 mempunyai tahap progesteron yang tertinggi pada Hari 0, 9 dan 22 ($p<0.05$). Secara keseluruhannya, kajian ini menunjukkan konsentrat komersial boleh memempengaruhi kadar kebuntingan, kadar kelahiran, kadar kembar dan saiz seperinduk kambing. Tambahan pula, pengambilan makanan ternakan ini mempunyai potensi sebagai makanan tambahan untuk kambing betina di mana ia boleh meningkatkan kadar kelahiran.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my earnest gratitude and appreciation to my project supervisor, Dr. Mashitah Shikh Maidin for her invaluable advices, help, guidance and ideas during preparation and completion of this study and thesis. I am especially grateful for her on-field guidance as I know there were not many supervisors would guide their students like her. I also would like to express my sincere appreciation to Dr. Rosimah Nulit, my co-supervisor for her help and concern about the development of my project.

I am also feel very thankful to Mr. Yap Keng Chee from Faculty of Veterinar, Associate Prof. Dr. Aziz and Mr. Fadzlee from Faculty of Medicine & Health Sciences, Dr. Shamarina and the staffs at Department of Biology, Faculty of Science, Universiti Putra Malaysia for their recommendations, co-operations and helps. My research work could not have completed successfully without them.

For the success of conducting animal experimental, I sincerely would like to thank Mr Zainal Abdul Ghani and Mrs. Fatimah Abdullah for allowing me to conduct the experiment at Boden Goat Farm. I am very grateful to their farm workers, especially Mr. Paniman for their kindness and help. Furthermore, I would like to extend my sincere gratitude to all of my respondents (goat farmers, members of Independent Goat Farmers Association and Kelab Generasi Transformasi Ruminan Malaysia) for the success of conducting goat farm surveys. They are very kind and are willing to share their ideas and relevant information for completing my project.

Special thanks go to my parents, Mr. Abdul Halim Maidin and Mrs. Norlina Othman, and my siblings, especially Norhazimah and Norhanifah for their understanding, help, advices, encouragement and continuous support. Besides, I am very grateful and thankful to my friends, Nurul Husna, Farah Nadira, Melissa Alina, Intan Fazleen and Nur Hafizah for their ideas, help, advices and encouragement during this Master program. They are very helpful and supportive although we are from different background of studies and some are from different faculties.

Last but not least, I would like to acknowledge Higher Ministry of Malaysian Education (MyBrain15), research grant (RUGS/UPM: 9374600) and Graduate Research Fellowship (GRF) scheme for financial support and also everyone who had helped me in any way during the course of my study. The experiences and knowledge that I have learned through this project are indeed very valuable.

I certify that a Thesis Examination Committee has met on 23 January 2017 to conduct the final examination of Norhazirah binti Abdul Halim on her thesis entitled "Assessment of Selected Local Plants Feed Intake and Reproductive Performance in Female Goats" 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 Master of Science.

Members of the Thesis Examination Committee were as follows:

Yap Chee Kong, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Anjas Asmara @ Ab. Hadi bin Samsudin, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Ramli Abdullah, PhD
Professor
Universiti Malaya
Malaysia
(External Examiner)

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

Date: 22 March 2017

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

Mashitah Shikh Maidin, PhD
Senior Lecturer
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Rosimah Nulit, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

_____

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby declare 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.: Norhazirah Binti Abdul Halim (GS35370)

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) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Mashitah Shikh Maidin, PhD

Signature: _____
Name of Member of Supervisory Committee: Rosimah Nulit, PhD

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

%	Percentage
°C	Degree Celsius
ANOVA	Analysis of variance
AOAC	Association of Analytical Communities
BW	Body weight
CIDR	Controlled Internal Drug Releasing device
CL	Corpus luteum (singular) or corpora lutea (plural)
CP	Crude protein
CPM	Counts per minute
DCP	Digestible crude protein
DM	Dry matter
DMI	Dry matter intake
DVS	Department of Veterinary Services (Malaysia)
FSH	Follicle-stimulating hormone
GnRH	Gonadotrophin-releasing hormone
IACUC	Institutional Animal Care and Use Committee
Kg	Kilogram
LH	Luteinizing hormone
M	Maintenance (diet)
MAFF	Ministry of Agriculture, Fisheries and Food
ME	Metabolisable energy
MEm	Metabolisable energy for maintenance
MHz	Megahertz
min	Minute
ng/ml	Nanogram per millilitre
NRC	National Research Council
QC	Quality control
RIA	Radioimmunoassay
Rpm	Revolutions per minute
SD	Standard deviation
SE	Standard error
SEM	Standard error of mean
TC	Total count
TDN	Total digestible nutrient
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Introduction

About 10,000 years ago, the smallest domesticated ruminants; goats or scientifically known as *Capra hircus* has served mankind earlier and longer than cattle and sheep. They are reared for the production of meat, milk and wool, particularly in arid, semi-tropical or mountainous countries (Peters et al., 1999). The common goat breeds reared are Alpine, Nigerian Dwarf, Anglo Nubian, Toggenburg, Saanen, Boer, Kiko, Pygmy and Angora. Boer goat is one of the most desirable goat breed for meat production. It has gained worldwide recognition for excellent body conformation, fast growing rate and good carcass quality (Lu, 2002). Comparing it with the indigenous goat of Malaysia, Katjang, is smaller in size but more hardy, well-adapted, and nimble (Alimon, 1990; Devendra, 2007). The physical, characteristics as well as the importance of goat promote the prominence of goat as livestock where it is an important source of food security.

Many researchers have reviewed in general the importance of goats such as the goat meat and milk in numerous parts of the world (Devendra, 2007; Tsegaye, 2009; Devendra & Liang, 2012). In Malaysia, goat meat (chevon) is highly desired for many purposes compared to milk. Other than listed as a favourite menu on the table, it is also important for certain customs, religions and festive occasions. For example, it is slaughtered for Aqiqah and Qurban occasions for Muslims. Goat meat is a source of high quality animal protein with less fat and lower cholesterol than beef, lamb and pork (USDA, 2002). Meanwhile, in milk production, there is a slow but significant increase in the demand for goat milk generally due to the increase in society affluence and the traditional beliefs on the added health benefits of goat milk. Since there is a demand for goat milk but the local dairy goats are not available, dairy goat breeds such as Saanen, Alpine, Toggenberg, Anglo Nubian, Jamnapari, and Shami goats have been imported into Malaysia (DVS, 2013). Depending on the breed and farm management, daily goats could yield milk about 1 to 5 litres/head. Goat milk is generally sold for a high price of about RM 20/liter compared to cow's milk which is about RM 2.20/liter (Sithambaram & Hassan Nizam, 2014). Other than for meat and milk, goat is also useful in production of cheeses, soaps, cosmetic products, decoration, instrument and soil fertilizer (Lebbie, 2004; Devendra, 2007).

In Malaysia, the self-sufficiency of chevon and mutton (the meat of goat and sheep) were only about 13% which is far lower than the local's demand (DVS, 2014). Thus, Malaysian government have to import more goats for local needs. It is very crucial to study on the factors affecting the production of local goat. Since, it has been reported that the intake of nutrition from feed could affect the production of goats (Mellado et al., 2004; 2006), it would be beneficial to focus on feed intake of goat. Low quality and unbalanced nutrient contents of feed resources could lower small ruminant

production but a wide range of alternative feed sources such as fodder shrubs and some natural compounds in plants (e.g. tannins and saponins) were proven to be efficient in improving sheep and goat performances and or reducing feeding cost (Salem, 2010).

1.2 Problem statement and significance of study

As mentioned earlier, low quality and unbalanced nutrient contents of feed could lower the production of goats through poor reproductive performance (Salem, 2010) and the self-sufficiency of chevon in Malaysia was very low (DVS, 2014). However, the study on local feed intake that could affect the reproductive performance of goats particularly in Malaysia is very little. Reviews have shown that the general area of nutrition and reproduction in goats requires more attention, particularly in nutritional adaptation to management, feed intake and reproductive performance. In Malaysia, goat farmers give many types of feed to their goats but, the type of feed that is not detrimental to reproduction and could improve the reproductive performance of goats is unknown or unclear. There are massive findings in literatures about sheep and nutrition, but there are little in goats.

Female goats have to be fed with better diet to improve their reproductive performances such as ovulation, embryonic growth and foetal development. Meanwhile, deficiencies in nutrition during the initial stage of reproduction could severely disturb the reproductive performance. Most of studies regarding these were done on sheep but, apparently, as their reproductive processes are very similar, we would expect the same will occur in goats. However, at a detailed level, there are differences that may alter the outcomes of nutritional manipulation. Therefore, it is crucial to study on the effects of nutrition or the different types of feed intake and feeding practiced by the goat farmers on reproductive performance of goats in Malaysia. Our study on these aspects of the reproductive performance could provide some contribution and at the same time help in formulating better nutritional management strategies for goat farmers and improve the goat production in our country.

1.3 Objective of study

The objectives of our study are:

1) To assess the effect of different types of feed on the reproductive performance of female goats under intensive and semi-intensive farm systems in Peninsular Malaysia, and
2) To evaluate the effects of different pre-breeding dietary intake on reproductive performance of female goats.

The study was divided into two main parts; i) goat farm survey and ii) experimental of animal. The goat farm survey was conducted from January to August 2014, while the experimental of animal was conducted from February to June 2015.

REFERENCES

Abecia, J.A., Lozano, J.M., Forcada, F., and Zaragaza, L. (1997). Effect of level of dietary energy and protein on embryo survival and progesterone production on day eight of pregnancy in Rasa Aragonesa ewes. *Animal Reproduction Science, 48*: 209-218.

Abecia, J.A., Sosa, C., Forcada, F., and Meikle, A. (2006). The effect of undernutrition on the establishment of pregnancy in the ewe. *Reproduction and Nutrition Development, 46*: 367-378.

Acero-Camelo, A., Valencia, E., Rodriguez, A., and Randel, P.F. (2008). Effects of flushing with two energy levels on goat reproductive performance. *Livestock Research for Rural Development, 20*(9).
Retrieved from http://www.lrrd.org/lrrd20/9/acer20136.htm

Adamiak, S.J., Mackie, K., Watt, R.G., Webb, R., and Sinclair, K.D. (2005). Impact of nutrition on oocyte quality: cumulative effects of body composition and diet leading to hyperinsulinemia in cattle. *Biological Reproduction, 73*: 918-926.

Ademosun, A.A. (1988). Appropriate management systems for the West African Dwarf goat in the humid tropics. In: Smith, O.B. and Bosman, H.G. (eds.), *Goat production in the humid tropics, proceedings of a workshop at the University of Ife, Nigeria, 20-24 July 1987* (pp. 21-28). Centre for Agricultural Publishing and Documentation (Pudoc), Wageningen, The Netherlands.

Ahmed, A.B.M. (2008). *Effect of dietary protein energy levels on performance of debilitated Nubian goats* (Thesis of Ph.D). Department of Animal Nutrition, Faculty of Animal Production, University of Khartoum, Sudan.

Ajayi, D.A., Adeneye, J.A., and Ajayi, F.T. (2005). Intake and nutrient utilization of West African dwarf goats fed mango (*Mangifera indica*), Ficus (*Ficus thionningii*), Gliricidia (*Gliricidia sepium*) foliages and concentrates as supplements to basal diet of Guinea Grass (*Panicum maximum*). *World Journal of Agricultural Sciences 1*(2): 184-189.

Ajayi, I.A. (2008). Short communication: Comparative study of the chemical composition and mineral element content of *Artocarpus heterophyllus* and *Treculia Africana* seeds and seed oils. *Bioresource Technology, 99*: 5125-5129.

Alimon, A.R. (1990). *Perternakan kambing*. Kuala Lumpur, Malaysia: Dewan Bahasa dan Pustaka.

Aregheore, E.M. (2003). Effect of grazing mixed pasture dominated by guinea grass (*Panicum maximum*) and crop residues based concentrate supplementation on nutrient intake and performance of growing goats. *Journal of Animal and Veterinary Advances, 2*(5): 279-284.

Aregheore, E.M., and Rokomatu, I. (2004). Effects of season and sex on voluntary dry matter intake, digestibility and performance of the Fiji Fantastic sheep fed native guinea grass (*Panicum maximum*) diet. *Journal of Animal and Feed Sciences, 13*(4): 575-587.

Ashworth, C.J. (1995). Maternal and conceptus factors affecting histotrophic nutrition and survival of embryos. *Livestock Production Science* 44: 99-105.

Ashworth, C.J., Toma, L.M., and Hunter, M.G. (2009). Nutritional effects on oocyte and embryo development in mammals: implications for reproductive efficiency and environmental sustainability. *Philosophical Transaction of The Royal Society B, 364*: 3351-3361.

Aziz, J.A. (2007). Wealth creation through livestock production. In: *Proceedings of the 19th Veterinary Association Malaysia Congress* (pp. 1-3). Malaysia.

Baumont, R., Prache, S., Meuret, M., and Morand-Fehr, P. (2000). A review: How forage characteristics influence behaviour and intake in small ruminants. *Livestock Production Science, 64*: 15-28.

Bamikole, M.A. (2003). Macro-minerals bioavailability study in goats fed forages of nitrogen-fertilized Guinea grass and Guinea grass-Verano stylo mixture. *Livestock Research for Rural Development, 15*(12).
Retrieved from http://www.lrrd.org/lrrd15/12/bami1512.htm

Ben Salem, H., Makkar, H.P.S., and Nefzaoui, A. (2001). Towards better utilisation of non-conventional feed sources by sheep and goats in some African and Asian countries. In: *Proceedings of the Ninth seminar of the FOACIHEAM Sub-network on sheep & goat nutrition* (pp. 177-187). Mammamet, Tunisia.

Berhanu, T. (2012). *Feeding strategy on growth and reproductive performance of Woyto-guji goat* (Thesis of PhD), Kasetsart University, Thailand.

Berhanu, T., Thiengtham, J., Tudsri, S., Abebe, G., and Prasanpanich, S. (2013). Supplementation of meal concentrate on growth and subsequent reproductive performances of Woyto-Guji goats. *Kasetsart Journal of Natural Science, 47*: 74-84.

Blache, D., Maloney, S.K., and Revell, D.K. (2008). Use and limitations of alternative feed resources to sustain and improve reproductive performance in sheep and goats. *Animal Feed Science and Technology, 147*: 140-157.

Blache, D., and Martin, G.B. (2009). Focus feeding to improve reproductive performance in male and female sheep and goats: how it works and strategies for using it. In: Papachristou, T.G., Parissi, Z.M., Ben Salem, H., and Morand-Fehr, P. (Eds.), *Nutritional and foraging ecology of sheep and goats. Zaragoza: CIHEAM / FAO / NAGREF* (pp. 351-364) (*Options Méditerranéennes: Série A. Séminaires Méditerranéens*; n. 85).

Bosu, W.T., Serna Garibay, J.A., and Barker, C.A. (1979). Peripheral plasma levels of progesterone in pregnant goats and in pregnant goats treated with prostaglandin F2a. *Theriogenology, 11*(2): 131-48.

Brown, D., Salim, M., Chavalimu, E., and Fitzhugh, H. (1988). Intake, selection, apparent digestibility and chemical composition of *Pennisetum purpureum* and *Cajanus cajan* foliage as utilized by lactating goats. *Small Ruminant Research, 1*: 59-65.

Casey, N.H., and Van Niekerk, W.A. (1988). The Boer goat. I. Origin, adaptability, performance testing, reproduction and milk production. *Small Ruminant Research, 1*: 291-302.

Chandra, R., Chatlod, L.R., Kumar, S., Toppo, S., Haque, N., and Rahman, H. (2012). Nutritional evaluation of NB-21 hybrid Napier grass for goats. *Indian Journal of Small Ruminant, 18*(2): 261-263.

Ching, J., and Saad, M.Z. (2010). Reproductive Performance of Boer Goats Imported from Australia. *5th Proceedings of the Seminar in Veterinary Sciences, 5-8 January 2010* (pp. 113).
Retrieved from http://psasir.upm.edu.my/31423/1/Proceedings-56.pdf

Cognie, Y. (1990). *Current Technologies for Synchronization and Artificial Insemination of Sheep*. Reproductive Physiology of Merino Sheep-Concepts and Consequences, The University of Western Australia, Perth.

Cook, B.G., Pengelly, B.C., Brown, S.D., Donnelly, J.L., Eagles, D.A., Franco, M.A., Hanson, J., Mullen, B.F., Partridge, I.J., Peters, M., Schultze-Kraft, R. (2005). *Tropical Forages*. CSIRO, DP I & F (Qld), CIAT and ILRI, Brisbane, Australia. Retrieved from http://www.tropicalforages.info/

Crocker, K.P., Johns, M.A., and Johnson, T.J. (1985). Reproductive performance of Merino ewes supplemented with sweet lupin seed in southern Western Australia. *Australian Journal of Experimental Agriculture, 25*: 21-26.

Das, A., and Ghosh, S.K. (2007). Effect of partial replacement of concentrates with jackfruit (*Artocarpus heterophyllus*) leaves on growth performance of kids grazing on native pasture of Tripura, India. *Small Ruminant Research, 67*: 36-44.

Dawson, L.J. (1999). Pregnancy diagnosis in goats. In*: Proceeding 14th Annual Goat Field Day*, (pp. 97-103). Langston University, Langston, Oklahoma.

De Santiago-Miramontes, M.A., Rivas-Munoz, R., Munoz-Gutierrez, M., Malpaux, B., Scaramuzzi, R.J., and Delgadillo, J.A. (2008). The ovulation rate in anoestrous female goats managed under grazing conditions and exposed to the male effect is increased by nutritional supplementation. *Animal Reproduction Science, 105*: 409-416.

DVS (2013). *Malaysian livestock breeding policy*. Department of Veterinary Services, 2013.
Retrieved in June 2013 from http://www.dvs.gov.my/documents/10157

DVS (2014). *Livestock statistics*. Department of Veterinary Services, 2014.
Retrieved in August 2014 from http://www.dvs.gov.my/statistik

Devendra, C. (1979). *Malaysian feeding-stuffs*. Malaysian Agricultural Research and Development Institute (MARDI), Serdang, Selangor, Malaysia.

Devendra, C. (1989). Ruminant production systems in the developing countries: Resource utilisation. *Feeding Strategies for Improved Productivity of Ruminant Livestock in Developing Countries IAEA* (pp. 5-30). *Vienna, Austria.*

Devendra, C. (1995). Composition and nutritive value of browse legumes. J. D'mello, C. Devendra (Eds.), *Tropical Animal Nutrition* (pp. 49-66). CAB International, UK.

Devendra, C. (1999). Goats: challenges for increased productivity and improved livelihoods. *Outlook Agriculture, 28*: 215-226.
Retrieved from http://ilri.org/infoserv/Webpub/fulldocs/Outlk2840/Goats.htm

Devendra, C. (2007). Perspectives on Animal Production Systems in Asia. *Livestock Science, 106*: 1-18.

Devendra, C., and Liang, J.B. (2012). Conference summary of dairy goats in Asia: current status, multifunctional contribution to food security and potential improvements. *Small Ruminant Research, 108*: 1-11.

Downing, J.A., and Scaramuzzi, R.J. (1991). Nutrient effects on ovulation rate, ovarian function and the secretion of gonadotropic and metabolic hormones in sheep. *Journal of Reproduction Fertility Supplement, 43*: 209-227.

El-Hag, F.M., Fadlalla, B., and Elmadih, M.A. (1998). Effect of strategic supplementary feeding on ewe productivity under range conditions in North Kordofan, Sudan. *Small Ruminant Research, 30*: 67-71.

Eng, P.K. (1989). Forage development and research in Malaysia. In: Halim, R.A. (ed.), *Proceedings of First Meeting of the Regional Working Group on Grazing and Feed Resources of Southeast Asia: Grasslands and Forage Production in South East Asia, 27 February - 3 March 1989* (pp. 20-29). Selangor: UPM, MARDI and DVS.

Fatet, A., Pellicer-Rubio, M.T., and Leboeuf, B. (2011). Reproductive cycle of goats. *Animal Reproduction Science, 124*: 211-219.

Ferguson, E.M., Ashworth, C.J., Edwards, S.A., Hawkins, N., Hepburn, N., and Hunter, M.G. (2003). Effect of different nutritional regimens before ovulation on plasma concentrations of metabolic and reproductive hormones and oocyte maturation in gilts. *Reproduction, 126*: 61-71.

Ferguson, E.M., Slevin, J., Hunter, M.G., Edwards, S.A., and Ashworth, C.J. (2007). Beneficial effects of a high fibre diet on oocyte maturity and embryo survival in gilts. *Reproduction, 133*: 433-439.

Fitz-Rodriguez, G., De Santiago-Miramontes, M.A., Scaramuzzi, R.J., Malpaux, B., and Delgadillo, J.A. (2009). Nutritional supplementation improves ovulation and pregnancy rates in female goats managed under natural grazing conditions and exposed to the male effect. *Animal Reproduction Science, 116*: 85-94.

Frutos, P., Hervas, G., Giraldez, F.J., and Mantecon, A.R. (2004). Review: Tannins and ruminant nutrition. *Spanish Journal of Agricultural Research, 2*(2): 191-202.

Gasparotto, S.W. (2015). Minerals and vitamins in goats: Deficiency and toxicity. Retrieved from http://www.tennesseemeatgoats.com/vitaminmineral06.html

Geertruida, A., Posthuma-Trumpie, van Amerongen, A., Korf, J., and van Berkel, W.J.H. (2009). Review: Perspectives for on-site monitoring of progesterone. *Trends in Biotechnology, 27*(11): 652-660.

Gimenez, D., and Rodning, S. (2007). Reproductive management of sheep and goats. In: *Alabama Cooperative Extension System, ANR-1316* (pp. 1-12). Retrieved from http://www.aces.edu/pubs/docs/A/ANR-1316/ANR-1316.pdf

Gnatek, G.G., Smith, L.D., Duby, R.T., and Godkin, J.D. (1989). Maternal recognition of pregnancy in the goat: Effects of conceptus removal on estrus intervals and characterization of conceptus protein production during early pregnancy. *Biological reproduction, 41*: 655-663.

Gohl, B. (1981). *Tropical feeds: Feed information summaries and nutritive values*. Rome, Italy: Animal production and health series no.12 (Food and Agriculture Organization of the United Nations).

Goncalves, C.A., Dutra, S., and Rodrigues Filho, J.A. (2003). Milk production in *Panicum maximum* cv. Tobiata pasture with concentrate supplementation in northeast Para, Brazil. *Pasturas Tropicales, 25*: 2.

Goncalves, C.A., Rodrigues F.J.A., Camarao, A.P., and Azevedo, G.P.C. (2005). Evaluation of *Panicum maximum* cv. Tobiata pasture to milk production of under two levels of concentrate supplementation in the Northeast of the State of Para. *Documentos - Embrapa Amazonia Oriental, 39*: 35.

Gutierrez, C.G., Ferraro, S., Martinez, V., Saharrea, A., Cortez, C., Lassala, A., Basurto, H., and Hernandez, J. (2011). Increasing ovulation quota: more than a matter of energy. *Acta Scientiae Veterinariae, 39*(1): 305-316.

Hagerman, A.E., and Butler, L.G. (1991). Tannins and lignins. In: Rosenthal, G.A., Berenbaum, M.R. (Eds.), *Herbivores: their interactions with secondary plant metabolites, Vol I: The chemical participants* (pp. 355-388). Academic Press, NY (USA).

Haruna, S., Kuroiwa, T., Lu, W., Zabuli, J., Tanaka, T., and Kamomae, H. (2009). The effects of short-term nutritional stimulus before and after the luteolysis on metabolic status, reproductive hormones and ovarian activity in goats. *Journal of Reproduction and Development, 55*(1): 39-44.

Hassan, A.W., Sauhal, A.N., Mohd Nazril, M., and Khaidzir, A.A. (2004). Pasture preferences of Timor deer. In: Halim, R.A., Hamid, N.R.A., and Nasir, S.M. (Eds.), *Forages and Feed Resources in Commercial Livestock Production Systems: Proceedings of the 8th Meeting of The Regional Working Group on Grazing and Feed Resources for Southeast Asia held on 22-28 September 2003* (pp. 183-185). Kuala Lumpur, Malaysia.

Heuze, V., Tran, G., Giger-Reverdin, S., and Lebas, F. (2014). Elephant grass (*Pennisetum purpureum*). *Feedipedia*, a programme by INRA, CIRAD, AFZ and FAO.
Retrieved in July 2014 from http://www.feedipedia.org/node/395

Ibrahim, M.N.M., Zemmelink G., and Tamminga. S. (1998). Release of mineral elements from tropical feeds during degradation in rumen. *Asian-Australian Journal of Animal Science, 11*: 530-537.

Ibrahim, T., Sanchez, M.D., Darussamin, A., and Pond, K.R. (1990). Evaluation of selected and introduced forage species in North Sumatra. *SR-CRSP Annual Research Report 1989-1990* (pp. 82-87). Sungai Putih, Indonesia.

Ince, D. (2010). Reproduction performance of Saanen goats raised under extensive conditions. *African Journal of Biotechnology, 9*(48): 8253-8256.

Joshi, A., Vema, P.K., Kumar, S., Maurya, V.P., Gulyani, R., and Mittal, I.P. (2005). Survey on reproductive status and management of Marwari goats in farmer flock of arid region of Rajanstan. *Indian Journal of Animal Production Management, 21*(1-4): 113-115.

Karikari, P.K. and Blasu, E.Y. (2009). Influence of nutritional flushing prior to mating on the performance of west African Dwarf goats mated in the rainy season. *Livestock Research for Rural Development, 21*(7).
Retrieved from http://www.lrrd.org/lrrd21/7/kari21103.htm

Kinne, M. (2002). Special problems during pregnancy.
Retrieved in June 2015 from http://kinne.net/ob3.htm

Lebbie, S.H.B. (2004). Goats under household conditions. *Small Ruminant Research, 51*(2): 131-136.

Legesse, G., Abebe, G., and Goetsch, A.L. (2006). Performance and harvest measures of Somali and Arsi-Bale goats managed under three feeding systems in Ethiopia. *Journal of Applied Animal* Research, *30*: 5-12.

Long, N.M., Tuersunjiang, N., George, L.A., Lemley, C.O., Ma, Y., Murdoch, W.J., Nathanielsz, P.W., and Ford, S.P. (2013). Maternal nutrient restriction in the ewe from early to midgestation programs reduced steroidogenic enzyme expression and tended to reduce progesterone content of corpora lutea, as well as circulating progesterone in non-pregnant aged female offspring. *Reproductive Biology and Endocrinology*, *11*: 34-44.

Lozano, J.M., Lonergan, P., Boland, M.P., and O'Callaghan, D. (2003). Influence of nutrition on the effectiveness of superovulation programs in ewes: effect on oocyte quality and post-fertilization development. *Reproduction, 125*: 543-553.

Lu, C.D. (2002). Boer goat production: Progress and perspective. Retrieved from http://hilo.hawaii.edu/uhh/vcaa/documents/boergoatproduction-progressandperspective2002.pdf

Luginbuhl, J.M. (2015). Nutritional feeding management of meat goats. *NC Cooperative Extension Resources.* Retrieved from http://content.ces.ncsu.edu/nutritional-feeding-management-of-meat-goats

MAFF (1975). *Food Standards Committee Report on Novel Protein Foods*. Ministry of Agriculture, Fisheries and Food. FSC/REP/62, HMSO, London.

Martin, G.B, Rodger, J., and Blache, D. (2004). Nutritional and environmental effects on reproduction in small ruminants. *Reproduction, Fertility and Development, 16*: 491-501.

Mcdougall, S. (2010). Effects of treatment of anoestrous dairy cows with gonadotropin-releasing hormone, prostaglandin, and progesterone. *Journal of Dairy Science, 93:* 1944-1959.

Meikle, A., Tasende, C., Rodriguez, M., and Garofalo, E.G. (1997). Effects of estradiol and progesterone on the reproductive tract and on uterine sex steroid receptors in female lambs. *Theriogenology*, *48*(7): 1105-1113.

Mellado, M., Valdez, R., Garcia, J.E., Lopez, R., and Rodriguez, A. (2006). Factors affecting the reproductive performance of goats under intensive conditions in a hot arid environment. *Small Ruminant Research*, 63: 110-118.

Mellado, M., Valdez, R., Lara, L.M., and Garcia, J.E. (2004). Risk factors involved in conception, abortion, and kidding rates of goats under extensive conditions. *Small Ruminant Research* 55: 191-198.

Melissa A.Y. (2016). *Critical success factor in small ruminant farming* (M.Sc. Thesis). Universiti Putra Malaysia, Malaysia.

Merkel, R.C., Pond, K.R., Burns, J.C., and Fisher, D.S. (1999). Intake, digestibility and nitrogen utilization of three tropical tree legumes as sole feeds compared to *Asystasia intrusa* and *Brachiaria brizantha*. *Animal Feed Science and Technology, 82*: 91-106.

Metawi, H.R. (2011). Economic sustainability of goat production under different production systems in Egypt. In: Bernues, A., Boutonnet, J.P. Casasus, I., Chentouf, M., Gabina, D., Joy, M., Lopez-Francos, A., Morand-Fehr, P., Pacheco. F. (Eds), *Economic, social and environmental sustainability in sheep and goat production systems. Zaragoza: CIHEAM/FAO/CITA-DGA* (pp. 185-190).

Meza-Herrera, C.A., Hallford, D.M., Ortiz, J.A., Cuevas, R.A., Sanchez, J.M., Salinas, H., Mellado, M., and Gonzalez-Bulnes, A. (2008). Body condition and protein supplementation positively affect periovulatory ovarian activity by non LH-mediated pathways in goats. *Animal Reproduction Science, 106*: 412-420.

Min, B.R., Mcnabb, W.C., Barry, T.N., Kemp, P.D., Waghorn, G.C., and Mcdonald,, M.F. (1999). The effect of condensed tannins in *Lotus corniculatus* upon reproductive efficiency and wool production in sheep during late summer and autumn. *Journal of Agricultural Science, 132*: 323-334.

Mitchell, T.D. (1986). *Condition scoring goats*. Agfact. A7.2.3. Agriculture New South Wales: Sydney.

Mokhtar, S.N., and Wong, C.C. (1988). A preliminary assessment on the feed values of *Asystasia intrusa* when fed to adult rams. In: *Proceedings 12th Annual Conference, Malaysian Society of Animal Production, MSAP: Maximising Livestock Productivity held on 29-30 March 1988 in Selangor, Malaysia* (pp. 101-105). Kuala Lumpur: Universiti Malaya.

Mohd Najib, M.A. (1995). *Proc. 4th Meeting of Regional Working Group on Grazing and Feed Resources of Southeast Asia,* 20-24 March 1995 (pp. 129-134). Nha Trang, Vietnam.

Muhammad, S., Tegegne, F., and Ekanem, E. (2004). Factors contributing to success of small farm operations in Tennessee. *Journal of Extension 42*(4). Retrieved from https://joe.org/joe/2004august/rb7.php

Mui, N.T., Ledin, I., Uden, P., and Dinh Van, B., (2002). The foliage of Flemingia (*Flemingia macrophylla*) or Jackfruit (*Artocarpus heterophyllus*) as a substitute for a rice bran-soya bean concentrate in the diet of lactating goats. *Asian-Australasian Journal of Animal Science, 15*: 45-54. Retrieved from http://www.ajas.info/upload/pdf/15_9.pdf

Njaa, B.L. (2012). *Kirkbride's Diagnosis of Abortion and Neonatal Loss in Animals*. United Kingdom, UK: John Wiley & Sons.

NRC (1981). *Nutrient Requirements of Goats: Angora, Dairy, and Meat Goats in Temperate and Tropical Countries.* National Research Council. Washington, DC: The National Academies Press.

Nsubuga, H.S.K. (1996). Keynote address - Small ruminants: Goats and sheep in Uganda. In: Lebbie, S.H.B. and Kagwini, E. (Eds), *Small Ruminant Research and Development in Africa. Proceedings of the Third Biennial Conference of the African Small Ruminant Research Network*, UICC, Kampala, Uganda, 5-9 December 1994 (pp. 326). ILRI (International Livestock Research Institute) Nairobi, Kenya.

Ojiako, A.O., Chikezie, P.C., and Zedech, U.C. (2013). Serum lipid profile of hyperlipidemic rabbits (*Lepus townsendii*) treated with leaf extracts of *Hibiscus rosesinesis, Emilia coccinea, Acanthus montanus* and *Asystasia gangetica*. *Journal of Medicinal Plants Research, 7*(43): 3226-3231.

Pallant, J. (2005). *SPSS survival manual: A step by step guide to data analysis using SPSS*. Sydney: Allen & Unwin.

Parr, R.A., Davis, I.F., Fairclough, R.J., and Miles, M.A. (1987). Overfeeding during early pregnancy reduces peripheral progesterone concentration and pregnancy rate in sheep. *Journal of Reproduction and Fertility, 80*: 317-320.

Parr, R.A., Davis, I.F., Miles, M.A., and Squires, T.J. (1993). Feed intake affects metabolic clearance rate of progesterone in sheep. *Research in Veterinary Science, 55*: 306-310.

Parr, R.A. (1992). Nutrition-progesterone interaction during early pregnancy in sheep. *Reproduction and Fertility Development, 4*: 297-300.

Parr, R.A., and Williams, A.H. (1982). Nutrition of the ewe and embryo growth during early pregnancy. *Australian Journal of Biological Science, 35*: 271-276.

Patel, A.K., Mathur, B.K., and Kaushish S.K. (2005). Kidding performance of arid goat breeds under different management systems. *Indian Journal of Small Ruminant, 11*(2): 140-144.

Peters, J., Helmer, D., von den Driesch, A., and Sana-Segui, M. (1999). Early animal husbandry in the Northern Levant. *Paleorient, 25*(2): 27-48.

Pennington, J.A. Moore, B.J., Wall, C.W., and Jones S.M. (1914). *Nutrition of Meat Goats.* University of Arkansas, United states: Cooperative Extension Service.

Rahman, M.M., Abdullah, R.B., Wan Khadijah, W.E., Nakagawa, T., and Akashi, R. (2013). Feed intake, digestibility and growth performance of goats offered Napier grass supplemented with molasses protected palm kernel cake and soya waste. *Asian Journal of Animal and Veterinary Advances, 8*(3): 527-534.

Ramirez-Restrepo, C.A., Barry, T.N., Lopez-Villalobos, N., Kemp, P.D., and Harvey, T.G. (2005). Use of *Lotus corniculatus* containing condensed tannins to increase reproductive efficiency in ewes under commercial dry land farming conditions. *Animal Feed Science Technology, 121*: 23-43.

Rashid, M. (2008). Goats and their nutrition. *Manitoba goat association.* Retrieved from http://www.gov.mb.ca/agriculture/livestock/production/goat/pubs/goats-and-their-nutrition.pdf

Relling, E.A., Van Niekerk, W.A., Coertze, R.J., and Rethman, N.F.G. (2001). An evaluation of *Panicum maximum* cv. Gatton: The influence of stage of maturity on diet selection, intake and rumen fermentation in sheep. *South African Journal of Animal Science, 31*: 85-91.

Robinson, J.J., Ashworth, C.J., Rooke, J.A., Mitchell, L.M., and McEvoy, T.G. (2006). Nutrition and fertility in ruminant livestock. *Animal Feed Science and Technology, 126*: 259-276.

Robinson, J.J., Rooke, J.A., and McEvoy, T.G. (2002). Nutrition for conception and pregnancy. In Freer, M., and Dove, H. (Eds.), *Sheep nutrition* (pp. 189-211). Wallingford, UK: CAB International.

Robinson, T.J., Mooew, N.W., Holst, P.J., and Smith, J.F. (1967). The evaluation of several progesterone administred in intravaginal sponges for the synchronization of oestrous in the entire cycle Merino ewe. In: Robinson, T.J. (Ed), *Control of the Ovarian Cycle in the Sheep*. White and Bull Pty Ltd (pp. 76-91).

Rondina, D., Freitas, V.J.F., Spinaci, M., and Galeati, G. (2005). Effect of nutrition on plasma progesterone levels, metabolic parameters and small follicles development in un-stimulated goats reared under constant photoperiod regimen. *Reproduction in Domestic Animals, 40*: 548-552.

Rubianes, E., and Menchaca, A. (2003). The pattern and manipulation of ovarian follicular growth in goats. *Animal Reproduction Science, 78*: 271-287.

Safari, J., Kifaro, G.C., Mushi, D.E., Mtenga, L.A., Adnoy, T., and Eik, L.O. (2012). Influence of flushing and season of kidding on reproductive characteristics of Small East African goats (does) and growth performance of their kids in a semiarid area of Tanzania. *African Journal of Agricultural Research, 7*(35): 4948-4955.

Safari, J., Mushi, D.E., Mtega, L.A., Kifaro, G.C., and Eik, L.O. (2009). Effects on concentrate supplementation on carcass and meat quality attributes of feedlod finished Small East African goats. *Livestock Science, 125*: 266-274.

Sahare, M. G., Sawaimul, A. D., Ali, S. Z., and Kolte, B. R. (2009). Kidding Percentage and Twinning Ability in Osmanabadi goat in Vidarbha Climatic Condition. *Veterinary World, 2*(2): 60-61.

Salem, H.B. (2010). Nutritional management to improve sheep and goat performances in semiarid regions. *Revista Brasileira de Zootecnia, 39*: 337-347.

Sanchez, M.D., and Ibrahim, T.H. (1991). Forage Species for Rubber Plantations in Indonesia. In Shelton, H.M. and Stur, W.W. (Eds.), *Forages for Plantation Crops, Proceedings of a workshop, Australian Centre for International Agriculture Research (ACIAR) Proceedings 32th* (p. 168, pp. 54-57), *27-29 June 1990.* Sanur Beach, Bali, Indonesia.

Scaramuzzi, R.J., Adams, N.R., Baird, D.T., Campbell, B.K., Downing, J.A., Findlay, J.K., Henderson, K.M., Martin, G.B., McNatty, K.P., McNelly, A.S., and Tsonis, C.G. (1993). A model for follicle selection and the determination of ovulation rate in the ewe. *Reproduction and Fertilization Development, 5*: 459-478.

Scaramuzzi, R.J., and Radford, H.M. (1983). Factors regulating ovulation rate in the ewe. *Journal of Reproduction Fertility, 69*: 353-367.

Scaramuzzi, R.J., Campbell, B.K., Downing, J.A., Kendall, N.R., Khalid, M., Munoz-Gutierrez, M., and Somchit, A., (2006). A review on the effects of supplementary nutrition in the ewe on the concentration of reproductive and metabolic hormones and the mechanisms that regulate folliculogenesis and ovulation rate. *Reproductive Nutritional Development, 46*: 339-354.

Schoenian, S.G., and Burfening, P.J. (1990). Ovulation rate, lambing rate, litter size and embryo survival of Rambouillet sheep selected for high and low reproductive rate. *Journal of Animal Science, 68*(8): 2263-2270.

Shahrom, M.S. and Zamri-Saad, M. (2012). A retrospective study on post-arrival mortality rate of Australian Boer goats in a breeder farm in Malaysia. *Pertanika Journal of Tropical Agricultural Science, 35*(4): 737-742

Sherwood, L., Klandorf, H., and Yancey, P.H. (2012). *Animal physiology: From genes to organisms*. Belmont, USA: Cengage Learning.

Shikh Maidin, M. (2011). *Nutritional control of reproduction in female goats* (Thesis of PhD). University of Western Australia, Australia.

Shikh Maidin, M., Blackberry, M.A., Milton, J.T.B., Hawken, P.A.R., and Martin, G.B. (2014). Nutritional supplements, leptin, insulin and progesterone in female Australian Cashmere goats. *APCBEE Procedia, 8*: 299-304.

Shikh Maidin, M., Chadwick, A., Khaiseb, P.C., Hawken, P.A., and Martin, G.B. (2008). 242. Reproductive performance of Australian Cashmere goats supplemented with lupin grain. *Reproduction, Fertility and Development (Supplement), 20*: 42-42.

Simoes, J., Potes, J., Azevedo, J., Almeida, J.C., Fontes, P., Baril, G., and Mascarenhas, R. (2005). Morphometry of ovarian structures by transrectal ultrasonography in Serrana goats. *Animal Reproduction Science, 85*: 263-273.

Sithambaram, S., and Hassan Nizam Q.D. (2014). Country Report - Malaysia. In: *AADGN Country Reports 2013/14*. pp. 57-65. Institute of Tropical Agriculture, Universiti Putra Malaysia.
Retrieved from www.aadgn.upm.edu.my/aadgn/file/AADGN_Country_Report_2013_14.pdf

Sivaraj, S., Agamuthu, P., Adam, A., Hamzah, I., and Mukherjee, T.K. (1991). Comparative performance of sheep and goats in oil palm (*Elaeis quineensis*) plantations: preliminary report. In: Saithanoo, S., Norton, B.W. (Eds.), *Goat Production in the Asian Humid Tropics* (pp. 176-181). Prince of Songkla University and the University of Queensland.

Snijders, S.E.M., Dillon, P., O'Callaghan, D., and Boland, M.P. (2000). Effect of genetic merit, milk yield, body condition and lactation number on in vitro oocyte development in dairy cows. *Theriogenology, 53*:981-989.

Spearow, J.L. (1996). Regulation of ovulation rate. In: Jeffrey Chang R. (Ed.), *Polycystic Ovary Syndrome; Serono Symposia USA* (pp. 1-20). Abstract viewed at http://link.springer.com/chapter/10.1007%2F978-1-4613-8483-0_1

Stanisz, M., Ludwiczak, A., Pietrzak, M., and Slosarz, P. (2015). The quality of meat and edible by-products from kids with different inheritance of Boer goat. *Small Ruminant Research, 125:* 81-87.

Suparjo, N.M. (1998). Digestibilities and nutritive values of *Asystasia* in rabbits. *Proc. 20 MSAP: Local Feedstuff Utilization: Potential and Realities on 27-28 July 1998 in Putrajaya, Malaysia* (pp. 101-102). Serdang: MSAP.

Suparjo, N.M., and Shokri, A.O. (2005). Effect of planting material and distance on establishment yield of *Asystasia intrusa. Journal of Tropical Agriculture and Feed Science, 33*(1): 115-121.

Suparjo, N.M., Shokri, A.O., Abu Bakar, C., Halim, R.A., and Jalaludin, S. (1997). Yield response of *Asystasia* to light intensity and cutting interval. *Proc. 19 MSAP: Harmonising Livestock Production with the Environment, 8-10 Sep. 1997, Johor Bahru* (pp. 166-170). Serdang: MSAP.

Suparjo, N.M., Zainol, A.A. and Shokri, A.O. (1991). Optimum light requirement of *Asystasia intrusa*. In *Proceeding 14 MSAP Annual Conference: Recent Innovations in the Animal and Animal Products Industry, 8-9 May 1991, Genting Highlands, Pahang* (pp. 217-221). Serdang: MSAP.

Tajuddin, I., and Chong, D.T. (1991). Sheep grazing to manage weeds in rubber plantations. In: Iniguez, L.C., Sanchez, M.D. (Eds), *Proc. Workshop on Integrated Tree Cropping and Small Ruminant Production System* on 9-14 Sept. 1990, Medan, North Sumatra, Indonesia, (p. 128-35. Davis, California: Small Ruminant - Collaborative Research Support Program (SR-CRSP) 1991.

Tanaka, T., Fujiwara, K., Kamomae, H., Kim, S., and Kaneda, Y. (2004). Ovarian and hormonal responses to progesterone-releasing controlled internal drug releasing treatment in dietary restricted goats. *Animal Reproduction Science, 84*: 135-46.

Teleni, E., King, W.R., Rowe, J.B., and McDowell, G.H. (1989). Lupins and energy-yielding nutrients in ewes. I. Glucose and acetate biokinetics and metabolic hormones in sheep fed a supplement of lupin grain. *Australian Journal of Agricultural Research, 40*: 913-924.

Tsegaye T. (2009). *Characterization of goat production systems and on-farm evaluation of the growth performance of grazing goats supplemented with different protein sources in Metema Woreda, Amhara Region, Ethiopia* (M.Sc. Thesis). Haramaya University, Ethiopia.

Tuen, A.A. (1994). Chemical composition and rumen degradability of forages and browse for goats and sheep in Sarawak. In: Djajanegara, A., Sukmawati, A. (Eds.), *Sustainable Animal Production and the Environment: Proc. 7th AAAP Animal Science Congress, vol. 2. Ikatan Saijana Ilmu-ilmu Peternakan Indonesia, Jakarta, Indonesia* (pp. 503-504).

Tuwei, P.K., Kang Ara, J.N.N, Stewart, J.L., Poole, J., Ngugi, F.K., and Mueller-Harvey, I. (2003). Factors affecting biomass production and nutritive value of *Calliandra calothyrsus* leaf as fodder for ruminants. *Journal of Agricultural Science, 141*: 113-127.

USDA (2002). *Nutritive value of foods.* Home and Garden Bulletin, no. 72. United States Department of Agriculture.
Retrieved in June 2013 from http://pubsearch.arsnet.usda.gov

USDA (2011). *Small-scale U.S. goat operations.* USDA-APHIS-VS, CEAH. Fort Collins, CO. No. 602.0611.
Retrieved in June 2013 from https://www.aphis.usda.gov

Viengsavanh P., and Ledin, I. (2002). Performance of growing goats fed *Panicum maximum* and leaves of *Gliricidia sepium*. *Asian-Australian Journal of Animal Science, 15*(11): 1585-1590.

Vinoles, C., Forsberg, M., Martin, G.B., Cajarville, C., Repetto, J., and Meikle, A. (2005). Short-term nutritional supplementation of ewes in low body condition affects follicle development due to an increase in glucose and metabolic hormones. *Reproduction, 129*: 299-309.

Vinoles, C., Meikle, A., and Forsberg, M., (2004). Accuracy of evaluation of ovarian structures by transrectal ultrasonography in ewes. *Animal Reproduction Science, 74:* 539-545.

Vinoles, C., Paganoni, B.L., Glover, K.M.M, Milton, J.T.B., Blache, D., Blackberry, M.A., and Martin, G.B. (2010).The use of a 'first-wave' model to study the effect

of nutrition on ovarian follicular dynamics and ovulation rate in sheep. *Reproduction, 140*: 865-874.

Vinoles, C., Glover, K.M.M, Paganoni, B.L., Milton, J.T.B., and Martin, G.B. (2012). Embryo losses in sheep during short-term nutritional supplementation. *Reproduction, Fertility and Development, 24:* 1040-1047.

Wan Zahari, M., Nordin, M.S.Y., Najib, M.A., Suparjo, N.M., Abu Bakar, C., Aminah, A., and Chantiratikul, A. (2006). Laboratory and Field Evaluation of Potential Feed Resources in Malaysia. *IAEA-TECDOC-1495. Improving Animal Productivity by Supplementary Feeding of Multinutrient Blocks, Controlling Internal Parasites and Enhancing Utilization of Alternate Feed Resources. RCA project with technical support of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture,* December 2006 (pp. 197-210).

Wilkins, J.F. (1997). Method of stimulating ovulation rate in merino ewes may affect conception but not embryo survival. *Animal Reproduction Science, 47*: 31-42.

Zarazaga, L.A., Guzman, J.L., Domínguez, C., Pqrez, M.C., and Prieto, R. (2005). Effect of plane of nutrition on seasonality of reproduction in Spanish Payoya goats. *Animal Reproduction Science, 87*: 253-267.