UNIVERSITI PUTRA MALAYSIA

THE EFFECT OF SELECTED LOCAL PLANTS USED IN GOATS DIET IN MALAYSIA ON IN VITRO DEGRADABILITY

MUHAMMAD AZROLHARITH BIN RASHID

FPV 2015 67

THE EFFECT OF SELECTED LOCAL PLANTS USED IN GOATS DIET IN MALAYSIA ON *IN VITRO* DEGRADABILITY

MUHAMMAD AZROLHARITH BIN RASHID

A project paper submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia
In partial fulfilment of the requirement for the
DEGREE OF DOCTOR OF VETERINARY MEDICINE
Universiti Putra Malaysia
Serdang, Selangor Darul Ehsan

MARCH, 2015

CERTIFICATION

It is hereby certified that I have read this project paper entitled "The Effect of Selected Local Plants Used in Goats Diet in Malaysia on *In Vitro* Degradability", by Muhammad Azrolharith bin Rashid and in our opinion, it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

DR HASLIZA ABU HASSIM
DVM, MSc (UPM), PhD (UGhent, Belgium)
Senior Lecturer (Animal Nutrition)
Department of Veterinary Preclinical Sciences
Faculty of Veterinary Medicine, Universiti Putra Malaysia
(Supervisor)

PROF. DR MOHAMED ALI RAJION
BSc (Hon), MSc (U.N.E, Australia), PhD (Melbourne, Australia)
Professor (Physiology)
Department of Veterinary Preclinical Sciences
Faculty of Veterinary Medicine, Universiti Putra Malaysia
(Co-Supervisor)

DR MAHDI EBRAHIMI
BSc Animal Science (Tehran University), MSc, PhD (UPM)
Department of Veterinary Preclinical Sciences
Faculty of Veterinary Medicine, Universiti Putra Malaysia
(Co-Supervisor)

ACKNOWLEGDEMENTS

I would like to express my gratefulness to my lovely supervisor, Dr Hasliza Abu Hassim for her support and guidance throughout this project. She is the most gorgeous supervisor who is willing to teach and guide me all the time.

Special thanks also goes to Prof. Dr Mohamed Ali Rajion and Dr Mahdi Ebrahimi as my co-supervisors who had encourage me and assist during laboratory analysis at the Physiology Laboratory, Faculty of Veterinary Medicine, UPM.

Not forgotten, my lab partners, Dr Ahmad Afifi Abdul Ghani and Nur Haizan Abdul Rahman who always give support and help me during my lab work. My special gratitude also for postgraduate friends at Nutrition Laboratory, Faculty of Veterinary Medicine, UPM who are willing to take part in my lab works.

Finally, a special gratitude to those who were directly or indirectly involved in the completion of this project.

DEDICATION

This project is lovely dedicated to:

My parents

Rashid bin Omar & Kalsoom binti Husin

My only big Brother & his wife

Mohd Ikram bin Rashid & Syarifah Syafafwati binti Syed Alawi

My sweet nephew and niece

Nur Imanina Qaireen & Muhammad Ilham Mukhlis

My future wife

Vetman Production

Relatives & Friends

Thank you for loving me unconditionally..

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LIST OF ABBREVIATIONS

BA	*Mallothus spp***. (**Balik Angin)
LD	*Macaranga spp.* (Lebar Daun)
MX	50% Lebar Daun & 50% Balik Angin
MW	20% Lebar Daun, 20% Balik Angin & 60% Napier
N	Napier
NDF	Neutral Detergent Fiber
VFA	Volatile Fatty Acids

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 - Projek Ilmiah Tahun Akhir.

KESAN TUMBUHAN TEMPATAN TERPILIH YANG DIGUNAKAN DALAM DIET KAMBING DI MALAYSIA TERHADAP FERMENTASI RUMEN *IN VITRO*

Oleh

Muhammad Azrolharith bin Rashid

2015

Penyelia: Dr Hasliza Abu Hassim

Pembantu Penyelia: Prof. Dr Mohd Ali Rajion

Dr Mahdi Ebrahimi

Makanan ternakan merupakan salah satu penyumbang kos terbesar dalam pengeluaran kambing yang mencapai kira-kira 70% daripada jumlah kos pengeluaran. Disebabkan oleh kekurangan ruang untuk penanaman rumput dan juga persaingan

makanan antara manusia dan ternakan, beberapa cara alternatif telah digunakan oleh penternak dengan menggunakan tumbuh-tumbuhan tempatan untuk dijadikan sebagai makanan haiwan. Oleh itu, pemilihan bahan makanan ternakan yang bersesuaian dan berkhasiat adalah penting untuk menghasilkan nilai tenaga dan pengeluaran gas yang dapat membantu meningkatkan fermentasi pada rumen kambing. Dalam kajian ini, dua tumbuhan tempatan telah dipilih iaitu *Macaranga spp.* (Lebar Daun) dan *Macrostacyhyus spp.* (Balik Angin) untuk mengkaji pengeluaran gas serta pengeluaran asid lemak meruap yang terdiri daripada asetat, propionat, dan butirat dengan mengaplikasikan teknik inkubasi *in vitro* selama 24 jam, menggunakan cecair rumen daripada kambing yang telah difistulasi. Terdapat 5 kumpulan diet eksperimen yang telah dilabelkan sebagai LD (Lebar Daun), BA (Balik Angin), N (Napier), MX (50% Lebar Daun & 50% Balik Angin), dan MW (20% Lebar Daun, 20% Balik Angin & 60% Napier). Keputusan menunjukkan pengeluaran asid lemak meruap sebanyak 772.46 mM/ML daripada Balik Angin adalah yang tertinggi berbanding dengan kumpulan diet lain. Lebar daun pula menghasilkan kepekatan tertinggi asetat (94.30%) berbanding rawatan lain. Campuran kedua-dua tumbuhan tempatan (MX) menghasilkan kepekatan tertinggi untuk butirat (give the value here) dan propionat (give the value here). Selain itu, Napier menghasilkan gas (give the value here) yang paling tinggi berbanding dengan tumbuhan-tumbuhan tempatan, Walau bagaimanapun kadar pengeluaran gas dan asid lemak meruap antara kumpulan diet tidak memberi terlalu banyak perbezaan ($P>0.05$). Oleh itu, tidak ada perbezaan yang signifikan antara sampel-sampel kumpulan diet tersebut ($P>0.05$). Daripada kajian ini, keterdegradasian rumen *in vitro* tumbuhan tempatan terpilih adalah sama atau kurang daripada sumber serat lain, iaitu Napier yang kebiasaannya digunakan sebagai

makanan kambing,yang jelas menyatakan bahawa kedua-dua tumbuhan tempatan terpilih ini sesuai untuk digunakan sebagai sumber serat lain sebagai makanan kambing.

Kata Kunci: tumbuhan tempatan, fermentasi rumen, asid lemak meruap, penghasilan gas, *Mallothus spp.*, *Macaranga spp.*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial requirement of the VPD 4999 – Final Year Project.

THE EFFECT OF SELECTED LOCAL PLANTS USED IN GOATS DIET IN MALAYSIA IN IN VITRO RUMEN DEGRADABILITY

By

Muhammad Azrolharith bin Rashid

2015

Supervisor: Dr Hasliza Abu Hassim

Co-Supervisor: Prof. Dr Mohd Ali Rajion

Dr Mahdi Ebrahimi

Livestock feeds are considered as one of the largest cost associated with goat production, typically accounting around 70% of total production costs. Due to lack of space for grass planting and animal-human feed competition, farmers have come out with alternatives ways to use local plants as animal feed. Thus, it is important to choose the appropriate and nutritive feedstuffs that can compromise the energy value and essential nutrients in the goats which will improve rumen degradability. In this study,

two of selected local plants which are *Macaranga spp.* (Lebar Daun) and *Mallothus spp.* (Balik Angin) were selected to assess the *in vitro* ruminal fermentation with respects on the gas production and production of volatile fatty acids (VFA) which are acetate, propionate, and butyrate. The *in vitro* incubation was done for 24 hours, using rumen fluid from fistulated goats. There are 5 different experimental designs which are LD (Lebar Daun), BA (Balik Angin), N (Napier), MX (50% Lebar Daun & 50% Balik Angin), and MW (20% Lebar Daun, 20% Balik Angin & 60% Napier). From the results, the production of total VFA 772.46 mM/ml from Balik Angin was the highest compared to other treatment groups. Lebar Daun produced the highest acetate production (94.30%) compared to others. Mixture of both selected local plants produces highest concentration for butyrate and propionate compared to other treatments. However, there is no significant different between the treatments ($P<0.05$). Meanwhile, the production of total gas from selected local plants when compared with the control plant which is Napier grass, did not show significant different. Indeed, there was no significant difference among the treatment samples for gas production ($P<0.05$). From this study, the *in vitro* ruminal degradability of selected local plants are equal or less than other fibre source, which is Napier grass that commonly used in goat's diet in Malaysia. This represent that these two selected local plants can be used as fibre sources for goats feedstuffs without adverse effect of rumen fermentation.

Keywords: local plants, rumen fermentation, volatile fatty acids, gas production, *Mallothus spp.* and *Macaranga spp.*

1.0 INTRODUCTION

Animal nutrition is facing an increasing sustainability dilemma related to directly covering requirements by vegetal sources in diets, particularly when derived from a livestock system depending on crops that can be consumed by humans (Kayouli, 2007). Growing concerns about this problem have prompted researchers to search ways to promote the efficient utilization of non-competitive feed resources such as agricultural by-products and local plants that may supply essential nutrients (e.g. fibres) to the animals (Nguyen, 1998).

There are a variety of options among farmers concerning feeds for livestock production. However, the utilisation of conventional options, such as maize and soy bean, for livestock feeding is not feasible as the maize and soy bean are also widely used for human consumption. Hence, the price of the commodities would be high. As such, there is great interest in the utilisation of unconventional materials as livestock feed.

In this era of globalisation, suitable feed choices have become one of the main factor in diversify the nutrients contents for animal requirement especially for farm animals. Indeed, Diego (1994) has suggested that an ideal nutrition program should be able to support optimum production, minimizes related problems and in the same time is efficient and economical. As to create or produce well balance feed, several ways have been specialized to ensure the good nutrition supplements for the animals. In Malaysia, most of the local plants which subjected as higher plants, wild shrubs, palms, climbers that grown in the wild such as *Mallothus spp.* (Balik Angin), *Acacia*

spp. (Akasia), *Codiaeum spp.* (Puding), *Passiflora spp.* (Daun Letup) and *Macaranga spp.* (Macaranga) are widely being utilized in goat diets as source of roughage.

Although the local plants are abundantly available and use in goats diet, concerns about their role to enhance rumen degradability are of interest. Hence, this study is aim to assess the effect of some selected local plants *Mallothus spp.* (Balik Angin) and *Macaranga spp.* (Lebar Daun) that are being fed to goats on *in vitro* rumen degradability. This study was done in a farm under Ladang Angkat, Fakulti Perubatan Veterinar, Universiti Putra Malaysia. A comparison of rumen degradability parameters (total gas production and volatile fatty acids) of these local plants with other fibre source (Napier) that commonly used in goats diet was done to evaluate its potential to be included in total mixed ration.

8.0 REFERENCES

Akinfemi, A., Adua, M. M., & Adu, O. A. (2012). Evaluation of nutritive values of tropical feed sources and by-products using in vitro gas production technique in ruminant animals. *Animal Science*, *24*(4):348-353.

Ammar, H., López, S., Andrés, S., Ranilla, M. J., Bodas, R., & González, J. S. (2008). In vitro digestibility and fermentation kinetics of some browse plants using sheep or goat ruminal fluid as the source of inoculum. *Animal Feed Science and Technology*, 147: 90-104.

Aufrere, J., & Michalet-Doreau, B. (1988). Comparison of Methods for Predicting Digestibility of Feeds. *Animal Feed Science and Technology*, 20:203-218.

Bergman E. N. (1990). Energy Contributions of Volatile Fatty Acids from the Gastrointestinal Tract in Various Species, *Physiological Review*, 70(2):567-590.

Bogaard, A., Hazeen, M., & Boven, C. (1986). Quantitative Gas Chromatographic Analysis of Volatile Fatty Acids in Spent Culture Media and Body Fluids. *Journal of Clinical Microbiology*, 23(3): 523-530.

Chumpawadee, S., Chantiratikul, A., & Chantiratikul, P. (2007). Chemical Compositions and Nutritional Evaluation of Energy Feeds for Ruminant Using In vitro Gas Production Technique. *Pakistan Journal of Nutrition*, 6(6): 607-612.

Diego, M., & Gimenez, J. (1994). Nutrient Requirements of Sheep and Goats. *Extension Animal Scientist,* ANR Publication 812:1-18.

Drake, D. J., Nader, G., Forero, L. (2002). Feeding Rice Straw to Cattle. Publication 8079, University of California, Division of Agriculture and Natural Resources.

Ellis, J. L., Dijkstra, J., Kebreab, E., Bannink, A., Odongo, N. E., McBride, B. W., & France, J. (2008). Aspects of rumen microbiology central to mechanistic modelling of methane production in cattle. *Journal of Agricultural Science*, 146:213-233.

Ellis, J. L., Dijkstra, J., Kebreab, E., Archibeque, S., & Bannink, A. (2011). Prediction of Methane Production in Beef Cattle within a Mechanistic Digestion Model. In D. Sauvant, J. Van Milgen, P. Faverdin & N. Friggens (Eds.), *Modelling nutrient digestion and utilisation in farm animals*, (pp. 181-188). Netherlands.

Faridah-Hanum, I., & Shamsul, K. (2004). *A Guide to the Common Plants of Ayer Hitam Forest, Selangor, Peninsular Malaysia*. (pp. 47-50). Malaysia: Universiti Putra Malaysia.

Fellner, V. (2009). Reactions in the Rumen – Limits and Potential for Improved Animal Production Efficiency. North Carolina State University ,53-63p.

Getachew G., de Peters E. J.,Robinson P. H. (2004). *In vitro* Gas Production Provides Effective Method for Assessing Ruminant Feeds. *California Agriculture*. 58: 54-58.

Hassim, H.A. (2012). Towards Improved Utilization of Oil Palm Fronds in Ruminants diets, PhD dissertation, Ghent University, Ghent, Belgium, 211p.

Hoai, N. N., Dejaegher, B., Tistaert, C., Hong, V. N., Rivière, C., Chataigné, G., Heyden, Y. V. (2009). Development of HPLC Fingerprints for Mallotus Species Extracts and Evaluation of the Peaks Responsible For Their Antioxidant Activity. *Journal of Pharmaceutical and Biomedical Analysis*, 50(5):753-763.

Infascelli, F., Bovera, F., Moniello, G., & Piccolo, V. (2002). In Vitro Degradability Of Three Forages: Fermentation Kinetics and Gas Production of NDF and Neutral Detergent-Soluble Fraction Of Forages. *Journal of the Science of Food and Agriculture*, 82(2): 222-229.

Kariuki, J. N., Tamminga, S., Gachuiri, C. K., Gitau, G. K., & Muia, J. M. (1999). Performance Of Sahiwal and Friesian Heifers Fed on Napier Grass Supplemented With Graded Levels of Lucerne. *South African Journal Animal Science*, 29(1): 1-10.

Kayouli,C. (2007), Workshop on :Sustainable Livestock Production in the Tropics. The Belgian Platform on Tropical Animal Health and Production, Brussels, November 21, 2007.

Khampa, S., & Wanapat, M. (2007). Manipulation of Rumen Fermentation with Organic Acids Supplementation in Ruminants Raised in the Tropics. *Pakistan Journal of Nutrition*, 6(1):20-27.

Leng, R. A. (1990). Factors Affecting the Utilization of 'Poor-Quality' Forages by Ruminants Particularly Under Tropical Conditions. Nutrition Research Reviews, 3(01):277-303.

Mabjeesh, S. J., Cohen, M., & Arieli, A. (2000). In Vitro Methods for Measuring the Dry Matter Digestibility of Ruminant Feedstuffs: Comparison of Methods and Inoculum Source. *Journal of Dairy Science*, 83(10):2289-2294.

Morrison, D. J., Cooper, K., Waldron, S., Slater, C., Weaver, L. T., & Preston, T. (2004). A streamlined approach to the analysis of volatile fatty acids and its application to the measurement of whole-body flux. *Rapid Communications in Mass Spectrometry*, 18:2593-2600.

Nguyen Hoai, N., Dejaegher, B., Tistaert, C., Nguyen Thi Hong, V., Rivière, C., Chataigné, G., Phan Van, K. (2009). Development of HPLC fingerprints for Mallotus species extracts and evaluation of the peaks responsible for their antioxidant activity. *Journal of Pharmaceutical and Biomedical Analysis*, 50:753-763.

Norliza, S., Zahariah, I., Mohd Suria, A. Y., Shawaluddin, T., Mardhati, M., & Wong, H. K. (2014). In Vitro Digestibility Study of Fractionated Refined, Bleached and Deoderized Palm Stearin Study. *Malaysian Journal of Veterinary Research*, 5(2):1-4.

Nguyen, X.T., (1998). The Need for Improved Utilisation of Rice Straw as Feed For Ruminants In Vietnam: An Overview. *Livestock Research for Rural Development,* 10(2):33-38.

Nur Fadhilah, I., Nor Hidayaty, K., & Zairossani, M. N. (2012). Determination of Fellner Desorption-Gas Chromatography. *Chemical Engineering Transactions,* 30:175-180.

Chumpawadee, S., Sommart, K., Vongpralub, T., & Pattarajinda, V. (2005), Nutritional Evaluation of Non Forage High Fibrous Tropical Feeds for Ruminant Using in vitro Gas Production Technique. *Walailak Journal of Science and Technology*, 2(2): 298-303.

Rasmussen, J. & Harrison, A. (2011). The Benefits on Supplementary Fat in Feed Rations for Ruminants, with Particular Focus on Reducing Levels of Methane Production. ISRN Veterinary Science, 2011(2011):1-10.

Raun, N. S., Burroughs, W., & Woods, W. (1961). Dietary Factors Affecting Volatile Fatty Acid Production in the Rumen, *Retrospective Theses and Dissertations*.

Rymer C. Huntington J.A, Williams B.A., Giben D.I (2005). In vitro cumulative gas production techniques: History, Methodological considerations and Challenges. *Animal Feed Science and Technolo*gy 123-124(1):9-30.

Soliva, C.R. and Hess, H.D. (2007). Measuring methane emission of ruminants by in vitro and in vivo techniques. In H.P.S. Makkar & P.E. Vercoe, (Eds.), *Measuring Methane Production from Ruminants* (pp. 15–31). Netherlands: Springer.

Shinoda, M., Kawashima, T., Pholsen, P., & Chuenpreecha, T. (2009). Evaluation of Quality and Nutritive Value of Napier Grass Silage with Different Growth Stages Either Chopped or Unchopped in Northeast Thailand. Proceeding of FAO Electronic Conference on Tropical Silage, Thailand (pp. 1-6).