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EVALUATION OF FOUR HERBAL PLANTS AND EFFECTS OF A SELECTED HERBAL PLANT Andrographis paniculata (Burm.f.) Wall. ex Nees AS DIETARY SUPPLEMENT IN DAIRY GOATS

SITI FATIMAH BINTI HAMZAH

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By

SITI FATIMAH BINTI HAMZAH

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

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August 2016

Chairman : Assoc. Prof. Halimatun Yaakub, PhD
Faculty : Agriculture

Many herbal plants are known to contain one or more chemical compounds that can influence milk production and quality in dairy animals. A study was conducted to examine the potential use of local herbal plant as a natural feed supplement that able to improve digestibility, increase milk production and subsequently improve profitability of dairy farm. The general objectives of this study was to evaluate four local herbal plants based on nutrient composition, antioxidant content, fatty acids profile and *in vitro* digestibility and to evaluate the effects of selected herbal plants on nutrient digestibility, milk yield and composition of Saanen and Jamnapari goats.

Two experiments were conducted in this study. In the first experiment, the nutritive values of *Andrographis paniculata*, *Orthosiphon stamineus*, *Boreria latifolia* and *Euphorbia hirta* were evaluated. *Andrographis paniculata* has high value of dry matter (34.56%), ash (14.93%), crude protein (18.13%), gross energy (16.68%), calcium (11.92 mg/L) and low content of ADF (18.80%), and ADL (7.17%). This plant also has high alkaloid (8.50%), saponin (18.73%), and flavonoid (1.25%). *Andrographis paniculata* has high *in vitro* DMD and contribute the highest USFA (73.47 g/100g FAME). In addition, the content of linolenic acid (n-3 FA; 36.89g/100g FAME) of *Andrographis paniculata* was higher than linoleic acid (n-6 FA; 28.93 g/100g FAME).

In a subsequent experiment, a feeding trial was conducted using 2 x 2 factorial designs to determine the effect of selected herbal plant (*Andrographis paniculata*) supplementation on milk yield and its composition in different breed of lactating goats. Thirty-two lactating dairy goats in 4th month of lactation (16 Jamnapari and

16 Saanen) were used. Each breed was randomly allotted into two groups of eight which were control group (unsupplemented) and supplemented group.
The diets were formulated in accordance with dairy goat requirements NRC 1981. Feed intake and faecal output and milk yield were recorded and analysed.There was no interaction between dietary treatment group and breed on weight gain, feed intake, nutrient digestibility and milk production (FCM 3.5%). However, there was a significant effect ($p<0.05$) within dietary treatment group factor and breed factor of parameters measured.

Milk production (FCM 3.5%) and milk efficiency of the supplemented group was higher than the control group in both breeds. Goats of Saanen breed had higher milk production and milk efficiency compared to Jamnapari breed. For milk composition, there was interaction between dietary treatment and breed for all milk components except for lactose, phosphorus and calcium contents. Jamnapari goats in the control group had the higher percentage of fat, protein, solid, solid non-fat and total solid than the other groups. Milk from supplemented group in both breed were higher in antioxidant content and low saturated fatty acid compared to the control group. It was concluded that the supplementation of *Andrographis paniculata* at 1.5% DM intake was able to increase milk production (FCM 3.5%), milk antioxidant content and decrease saturated fatty acid in milk of both Jamnapari and Saanen goat.

Abstrak tesis ini di kemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

EVALUASI EMPAT TUMBUHAN HERBA DAN KESAN PENAMBAHAN TUMBUHAN HERBA TERPILIH *Andrographis paniculata* (Burm.f.) Wall. ex Nees SEBAGAI DIET TAMBAHAN DALAM KAMBING TENUSU

Oleh

SITI FATIMAH HAMZAH

Ogos 2016

Pengerusi : Prof. Madya Halimatun Yaakub, PhD
Fakulti : Pertanian

Tumbuhan herba adalah diketahui mengandungi satu atau banyak molekul kimia yang dapat mempengaruhi pengeluaran dan kualiti susu dalam ternakan tenusu. Satu kajian telah dijalankan untuk mengkaji potensi kegunaan tumbuhan herba tempatan ini sebagai penambah makanan semulajadi yang mampu meningkatkan pencernaan, dan kecekapan pengeluaran susu dan seterusnya membawa kepada keuntungan kepada industri ternakan. Objektif umum kajian ini adalah untuk menilai empat tumbuhan herba berdasarkan komposisi nutrient, kandungan antioksida, profile asid lemak dan pencernaan tumbuhan ini secara '*in vitro'* dan seterusnya mengkaji kesan penambahan tumbuhan herba terpilih keatas pencernaan, produksi dan komposisi susu kambing Saanen dan Jamnapari.

Dua ujikaji telah dijalankan didalam kajian ini. Ujikaji pertama adalah penilaian nutrisi terhadap empat tumbuhan tempatan seperti *Andrographis paniculata*, *Orthosiphon stamineus*, *Boreria latifolia*, dan *Euphorbia hirta*. *Andrographis paniculata* mempunyai peratusan jisim kering (34.56%), peratusan abu (14.93%), protin kasar (18.13%), tenaga kasar (16.68%) dan kalsium (11.92 mg/L) yang tinggi selain mempunyai kandungan ADF (18.80%), dan ADL (7.17%) yang rendah. Tumbuhan herba ini juga mempunyai kandungan alkaloid (8.50%), saponin (18.73%), dan flavonoid (1.25%) yang tinggi. *Andrographis paniculata* mempunyai nilai percernaan secara *in vitro* dan profil asid lemak tidak tepu yang tinggi (73.47 g/100g FAME). Tambahan lagi, kandungan asid Linolenic-nya (n-3 FA; 36.89g/100g FAME) lebih tinggi daripada kandungan asid Linoleic (n-6 FA; 28.93 g/100g FAME).

Di dalam ujikaji yang berikutnya, satu kajian makanan telah dijalankan dengan mengunakan reka bentuk faktoran 2 x 2 untuk menentukan kesan tambahan tumbuhan herba terpilih (*Andrographis paniculata*) terhadap hasil pengeluaran susu dan komposisinya di dalam baka kambing yang berbeza. Sebanyak tiga puluh dua ekor kambing tenusu didalam laktasi bulan ke-4 (16 ekor kambing Jamnapari dan Saanen) telah dipilih. Setiap baka dibahagikan secara rawak di dalam dua kumpulan yang mempunyai lapan individu iaitu kumpulan kawalan (tanpa penambahan *Andrographis paniculata*) dan kumpulan penambah. Pengambilan makanan, pengeluaran tinja dan penghasilkan susu direkodkan dan dianalisa.

Tiada interaksi direkodkan diantara faktor kumpulan penambah dan faktor baka terhadap berat, pengambilan makanan, pencernaan nutrient dan penghasilan susu (FCM 3.5%) bagi kambing yang diuji. Walaubagaimanapun, terdapat kesan yang ketara ($p<0.05$) didalam faktor kumpulan penambah dan faktor baka bagi parameter yang diukur.

Hasil pengeluaran susu pada kadar lemak 3.5% dan kecekapan pengeluaran susu kumpulan penambah adalah lebih tinggi daripada kumpulan kawalan didalam kedua-dua baka kambing. Kambing Saanen mempunyai jumlah pengeluaran susu dan kecekapan pengeluaran susu yang lebih tinggi berbanding kambing Jamnapari. Selain itu, kesan interaksi diantara kumpulan rawatan dan baka dapat dilihat didalam semua komposisi susu kecuali pada kandungan laktosa, fosforus dan kalsium. Kumpulan kawalan baka Jamnapari juga mempunyai peratusan lemak, protein, pepejal, pepejal bukan lemak dan jumlah pepejal yang paling tinggi berbanding kumpuln-kumpulan lain. Kajian semasa juga menunjukkan susu daripada kumpulan penambah, baka Jamnapari mempunyai kandungan antioksidan yang lebih tinggi dan lemak tepu yang rendah berbanding kumpulan kawalan daripada baka yang sama. Kesimpulannya, pengunaannya herba *Andrographis paniculata* pada 1.5% didalam catuan makanan mampu meningkatkan pengeluaran susu, kandungan antioksida dan mengurangkan kandungan asid lemak tepu didalam susu kedua-dua baka iaitu Jamnapari dan Saanen.

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I certify that a Thesis Examination Committee has met on 23 August 2016 to conduct the final examination of Siti Fatimah binti Hamzah on her thesis entitled "Evaluation of Four Herbal Plants and Effects of a Selected Herbal Plant *Andrographis paniculata* (Burm.f.) Wall. ex Nees as Dietary Supplement in Dairy 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:

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Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Dahlan bin Ismail, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Aminah Abdullah, PhD
Professor
Universiti Kebangsaan Malaysia
Malaysia
(External Examiner)

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

Date: 28 September 2017

This thesis submitted to the senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the supervisory committee were as follows:

Halimatun binti Yaakub, PhD
Associate Professor
Faculty of Agriculture
University Putra Malaysia
(Chairman)

Anjas Asmara @ Ab. Hadi bin Samsudin, PhD
Associate Professor
Faculty of Agriculture
University Putra Malaysia
(Member)

ROBIAH BINTI YUNUS, PhD
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Signature: _____
Name of
Chairman of
Supervisory
Committee: Assoc Prof. Halimatun Yaakub

Signature:_____
Name of
Member of
Supervisory
Committee:Assoc Prof. Dr Anjas Asmara @ Ab. Hadi bin Samsudin

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LIST OF ABBREVIATIONS

DPPH	2, 2-diphenyl-1-picryhydrazy
g	gram
mL	mililimeter
nm	nanometer
µmL	micrometer
min	minutes
GE	Gross Energy
CP	Crude Protein
EE	Extrac ether
DM	Dry matter
BW	Body weight
MET	Methanol extraction
WAT	Water extraction
N	Normality
M	Molar
ADF	Acid detergent fiber
NDF	Neutral detergent fiber
ADL	Acid detergent lignin
FCM	Fat corrected milk
FAME	Fatty acid ethyl ester
SFA	Saturated Fatty acid
USFA	Unsaturated Fatty acid
PUFA	Polysaturated Fatty acids
FA	Fatty acid
VFA	Volatile fatty acid
HCN	Hydrogen cyanide
NH_4OH	ammonium hydroxide
KI	potassium Iodide
DMD	Dry matter digestibility
IVGP	*In vitro* Gas Production
IVD	*in vitro* digestibility
GAE	Gallic acid equivalent
H_2SO_4	Suphuric acid

HCL	Hydrochloric acid
SNF	Solid non fat

CHAPTER 1

INTRODUCTION

Almost over five millennia, natural products such as herbal plants have been used therapeutically in humans to provide proactive support to various physiological systems and to cure various diseases (Greathead, 2003; Embuscado, 2015; Darwish *et al*., 2016). Although there were reports of herbal plants being used to treat diseases in domestic animals hundreds of years ago, the potential use of herbal plant in dairy animal is still limited. The uses of herbal plants are not limited as alternative treatment in animals, but also to improve the quality of animal products such as eggs, meat and milk. Nowadays, consumers are aware of the benefits of drinking goat's milk and it increases the demand for goat's milk worldwide. Currently, the interests in natural antioxidant have increased. Herbal plants are known as sources of natural antioxidants have a greater application potential for consumers safety, acceptability, stability and palatability (Embuscado, 2015).

Preliminary and *in vitro* studies of the chemical composition of herbal plants such as crude protein (CP), ether extract, neutral detergent fiber (NDF), acid detergent fiber (ADF) and phytochemical substances will be able to contribute information before being applied *in vivo* for cost and time saving. This preliminary studies also one of practical techniques. These parameter including information about antioxidant properties, rumen fermentation (*in vitro* technique) and digestibility can be used as intermediary for nutritive value of herbal plant.

Generally, medicinal properties of the herbal plants were depending on the secondary metabolites that present in those herbs. Thus, it is necessary to determine that parameter of each herbal plant.

Herbal plants such as *Andrographis paniculata* (Hempedu bumi), *Orthosiphon stamineus* (Misai Kucing), *Euphorbia hirta* (Ara Tanah) and *Boreria latifolia* (Boreria) are examples of herbal plants that are widely available in Malaysia. These herbal plants have been utilized as traditional medicine and also as dietary supplementation. Generally, the antimicrobial and antioxidant characteristics of these herbal plants are due to the presence of various phytochemical such as the flavonoid, phenol, tannins and tocopherols (Jaganath and Crozier, 2010; Edziri *et al*., 2011 and Embuscado, 2015). Apart from that, feed additives derived from the herbal plant are also able to improve the productivity of animal through improving the feed characteristics and add the value of food that was obtained from those animals besides enhancing general health of an animal (Edziri *et al*., 2011; Tekippe *et al*., 2011 and Paraskevakis, 2015).

Introducing herbal plants as supplements in a diet also may increase the effectiveness of digestion and metabolism of nutrients besides being able to improve the quantity and quality of production of milk in dairy animals (Berhane and Eik, 2006; Mesquita *et al*., 2008; Hutton *et al*., 2011; Chiofalo *et al*., 2012; Boutoial *et al*., 2013; Bonanno *et al*., 2013; Di Trana *et al*., 2015 and Embuscado, 2015).

On the other hand, as far as milk quality and composition are concerned, antioxidants can act as efficient tool for reducing deterioration of goat milk's quality. Synthetic antioxidant is lack in natural responses. Hence some studies have been conducted using natural antioxidants as an alternative to synthetic antioxidants (Heidarian Miri *et al*. 2013; Akbarian *et al*., 2014; García *et al*., 2014; Paraskevakis, 2015). It was believe that natural antioxidant is safer and more acceptable when involve animal and human consumption.

Hence, the aim of this study is to determine the chemical composition, *in vitro* parameter studies and antioxidant content of four local herbal plants (*Andrographis paniculata*, *Orthosiphon stamineus*, *Euphorbia hirta* and *Boreria latifolia*) and to evaluate the effect of selected herbal plant supplementation (*in vivo* feeding trial) on nutrient digestibility, milk yield, milk composition and antioxidant content of milk in Jamnapari and Saanen goat.

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BIODATA OF STUDENT

Siti Fatimah Binti Hamzah was born in Pasir Puteh, Kelantan, Malaysia. She was attained her Primary and secondary school in Sekolah Kebangsaan Tok' Bali and Sekolah Menengah Kebangsaan Dato' Ismail before continuing her study for A-level in Pusat Asasi Sains Universiti Malaya in 2008 till 2009. After that, she continues her first degree in Bachelor of Animal Production and Health in Universiti Sultan Zainal Abidin (UniSZA), Malaysia until 2013. During undergraduate studies, her final year research focused on sero-prevalence of brucellosis in beef herd cattle in Terengganu under provision Associate Professor Dr. Abdul Rashid Baba at that time. She was active with PEMBINA Organization and ALPHA Club during her studies. She also has undergoes varies training involving animal production and health in several companies, field and Department of Veterinary services. During her undergraduate convocation ceremony, she was awarded an Ibnu Awwam Medal for being best student for Agriculture and Biotechnology. She also awarded as the best student in both animal production and animal health category in her courses in Universiti Sultan Zainal Abidin. Apart from that, she also has awarded Best oral presenter Award in 2nd ASEAN Region Animal Production Conference (ARCAP) and 36th Malaysian Society Animal Production (MSAP) Conference 2015 during presenting her paper during her studies of Master of Science (Animal Nutrition) in Universiti Putra Malaysia. In 2013 and until now, she was involved in many NGO's program that involved with education program in B40 community. She also one of the founder of i-Backyard Science organization which was one of NGO that educated community for environmental and sustainability through tawhidic science education.

LIST OF PUBLICATIONS

Hamzah, S. F., Alimon, A. R. and Yaakub, H. 2017. Nutritive Value Assessment of Four local Herbal Plants as animal Feed supplements. Mal. J. Anim. Sci. 20(2): 47-59

Hamzah, S. F., Roslan, N. A., Alimon, A. R. and Yaakub, H. 2014. Nutritive Value Assessment of Five local Herbs (*Andrographis paniculata*, *Orthosiphon stamineus*, *Moringa oleifera*, *Euphorbia hirta and Boreria latifolia*): Anti nutritional; Compounds and Antioxidant Activities. Proceeding of the 1st ARCAP and 35th MSAP Annual Conference 2014, Kuching, Serawak.

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