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DIETARY SUPPLEMENTATION OF BLACK CUMIN SEED MEAL ON RUMEN FERMENTATION IN GOATS

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By

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

DIETARY SUPPLEMENTATION OF BLACK CUMIN SEED MEAL ON RUMEN FERMENTATION IN GOATS

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November 2015

Chairman : Assoc. Prof. Halimatun Yaakub, PhD

Faculty : Agriculture

Improving production is important in ruminant industry and to solve this problem, much effort has been carried out to manipulate the rumen ecosystem as it plays an important role in ruminant nutrition. The use of herbal by-products has been considered in order to maximize the usage of herbs and to reduce feed cost. Black cumin seed meal is the by-product of *Nigella sativa* seed that has been pressed to produce oil and is also believed to contain nutrients that are not fully removed from the whole seed. As such, the present study was to evaluate the effect of black cumin seed meal supplementation on nutrient digestibility, rumen fermentation characteristics, rumen fatty acid profiles and rumen total protozoal counts of goats fed with black cumin seed meal-based feed.

In the first part of the study, proximate analysis, fatty acid profiling and determination of saponin and flavonoid of the black cumin seed meal were conducted. In this study, total of five rumen fistulated mixed breed male goats between 18 kg to 20 kg of body weight were used. All goats were fed on 1.5% dry matter (DM) of body weight with formulated concentrate diets supplemented with four levels of black cumin seed meal and 1.5% DM of body weight guinea grass hay as basal diet. The four levels of black cumin seed meal were fixed at 0% (BC0), 0.8% (BC8), 1.6% (BC16) and 2.4% (BC24). The goats were subjected to a three week cycle consisting of two weeks adaptation and one week of experimentation. After one week of washout period, the cycle was resumed. The feeding regime consisted diets supplemented with different levels of black cumin seed meal with guinea grass hay, *ad libitum* feeding.

Results had shown that the black cumin seed meal had 31.2% crude protein, 19.2% crude fat, 56% linoleic acid and 0.41% linolenic acid. The saponin content in the black cumin seed meal was about 0.139 mg /100 g while flavonoid content about 3.0 mg / 100 g. The pH of rumen in goats fed with dietary treatments ranged from 6.5 to 7.0 throughout the study. The

supplementation of black cumin seed meal had no effect (P>0.05) on all the fatty acid proportions. There were also no significant differences (P>0.05) between dietary treatments on the total VFA concentrations, molar proportions of individual VFA, or ratio of acetate to propionate. The total mean protozoa numbers were also constant throughout the study. In conclusion, the supplementation of black cumin seed meal at 0.8%, 1.6% and 2.4% in the diets did not affect nutrient digestibility, rumen fermentation characteristics, rumen fatty acid profiles and total protozoa counts of the goats.

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

SUPLEMEN DIET HAMPAS BIJI JINTAN HITAM KE ATAS FERMENTASI RUMEN DALAM KAMBING

Oleh

THAYALINI A/P KATHIRASER

November 2015

Pengerusi : **Prof. Madya Halimatun Yaakub, PhD**

Fakulti : **Pertanian**

Peningkatan dari segi pengeluaran adalah penting dalam industri ruminan. Untuk mengatasi masalah ini, pelbagai usaha dalam memanipulasikan ekosistem rumen telah dilaksanakan kerana ia memainkan peranan penting dalam nutrisi ruminan. Penggunaan bahan sampingan herba telah dikaji bagi memaksimumkan penggunaan herba dan mengurangkan kos sumber makanan. Hampas biji jintan hitam merupakan produk sampingan dari biji Nigella sativa yang telah ditekan untuk menghasilkan minyak dan juga dipercayai mengandungi nutrien yang tidak sepenuhnya dikeluarkan daripada keseluruhan biji. Tujuan utama penyelidikan ini adalah untuk menilai kesan hampas biji jintan hitam sebagai makanan tambahan ke atas pencernaan nutrien, ciri-ciri fermentasi rumen, profil asid lemak rumen dan jumlah protozoa dalam rumen pada kambing yang diberi makanan berasaskan mil biji jintan hitam.

Sebelum kajian ini dimulakan, analisis proksimat, profil asid lemak rumen dan penentuan saponin dan flavonoid telah dilaksanakan untuk mil biji jintan hitam. Untuk kajian ini, lima ekor kambing jantan baka kacukan yang rumen berfistula dengan berat semasa antara 18 kg hingga 20 kg telah digunakan. Semua kambing diberi diet yang mengandungi 1.5% berat kering mengikut peratus berat badan diet konsentrat yang disuplementasikan dengan empat tahap mil biji jintan hitam dan 1.5% berat kering mengikut peratus berat badan berasaskan diet rumput guinea kering. Empat diet tahap mil biji jintan hitam ditetapkan pada 0% (BC0), 0.8% (BC8), 1.6% (BC16) and 2.4% (BC24). Semua kambing tertakluk kepada kitar selama tiga minggu yang merangkumi dua minggu untuk adaptasi dan satu minggu untuk eksperimentasi. Selepas satu minggu washout, kitar pemakanan kambing diteruskan. Rejim pemberian makanan mengandungi diet suplemen dengan mil biji jintan hitam pada tahap berlainan, dengan rumput guinea kering secara ad libitum.

Keputusan menunjukan mil jintan hitam mengandungi 31.2% protein kasar, 19.2% lemak kasar, 56% asid linoleik and 0.41% asid linolenik. Kandungan

saponin dalam mil jintan hitam adalah 0.139 mg /100 g dimana kandungan flavonoid adalah 3.0 mg / 100 g.

Kesemua kambing yang diberi makan rawatan diet mempunyai nilai pH rumen dalam lingkungan 6.5 hingga 7 untuk keseluruhan hari. Suplemen mil biji jintan hitam tidak memberi kesan signifikan ($P>0.05$) kepada semua bahagian asid lemak. Selain itu, tiada perbezaan ($P>0.05$) antara rawatan diet pada keseluruhan kepekatan asid lemak meruap (VFA), perkadaran molar VFA individu atau nisbah asetik kepada propionik keseluruhannya. Malah, jumlah protozoa tetap iaitu tidak berubah sepanjang masa

Kesimpulannya, suplemen mil biji jintan hitam pada 0.8%, 1.6% dan 2.4% dalam diet tidak memberi kesan terhadap pencernaan nutrien, ciri-ciri fermentasi rumen, profil asid lemak rumen dan jumlah protozoa pada kambing.

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I certify that a Thesis Examination Committee has met on 25 November 2015 to conduct the final examination of Thayalini a/p Kathiraser on her thesis entitled "Dietary Supplementation of Black Cumin Seed Meal on Rumen Fermentation in 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.

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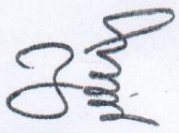

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LIST OF ABBREVIATIONS

Symbol	Description
ADF	Acid detergent fiber
ADL	Acid detergent lignin
BC	Black cumin seed meal
BWT	Body weight
CF	Crude fat
CLA	Conjugated linoleic acid
CP	Crude protein
DE	Digestible energy
DM	Dry matter
DMI	Dry matter intake
DW	Dry weight
FAME	Fatty acid methyl esters
FCE	Feed conversion efficiency
FID	Flame ignition detector
GE	Gross energy
Mcal	Mega calorie
NaOH	Sodium hydroxide
NDF	Neutral detergent fiber
NS	Not significant
OM	Organic matter
PSM	Plant secondary metabolites
PUFA	Polyunsaturated fatty acids

SE	Standard error
UFA	Unsaturated fatty acids
VFA	Volatile fatty acids

CHAPTER 1

INTRODUCTION

1.1 Background

The ruminant livestock industry plays an important role in the production of both meat and milk as an essential source of protein for human consumption. Earlier than cattle or sheep, goats are among the smallest domesticated ruminants and have provided much service to mankind. They can be found all over the world owing to their nutritional and environmental adaptability. With proper attention, they maintain good health and are easily manageable (Mirzaei, 2012). Small scale goat farming has been known to give significant benefit for families all over the world. Goats worldwide are mostly owned by poor rural families who lack modern management skills, and thus have poor feeding and housing practices with insufficient adoption of technologies which are important to improve productivity.

The importance of goat as a source of meat is increasingly accepted by the societies. However, animal production with desired properties for consumption can only be achieved by ensuring the animals are healthy and care is taken in terms of improvement in feed quality, hygiene, potable water and management (Saxena, 2008).

There are numerous investigations that focused on utilization of natural plant extracts as feed additives in animals (Frankic *et al*., 2009). In addition, due to the wide variety of active components, different herbs results in different effects on the digestion processes (Frankic *et al.,* 2009).

Addition of herbal feed additives in the form of natural plant products in animals feed may also help to stimulate the immune response (Khosravi *et al*., 2010) and improve digestibility of the feedstock, thereby enhancing quality of locally available feed source which in turn, helps to increase the production of goats in our country. Some of natural plant produced products compounds such as essential oils, flavonoid and saponin. Essential oils are naturally formed by aromatic plants as secondary metabolites and are volatile, natural, complex compounds which give out strong odour (Bakkali *et al*., 2008). In fact, essential oils are found in all parts of plant, which include roots, bark, flowers, petals, leaves and fruit bodies (Hirasa and Takemasa, 1998).

Among the well-known herbal additives include *Nigella sativa* or black cumin which is small herbal plant of 30 to 60 cm height, and belongs to the Ranunculaceae family. In the Middle East, it is known as "Habbah Al-Sauda". The seed is rich in various nutritional properties such as protein, carbohydrates, essential fatty acids for example linoleic acid; vitamin A, B1, B2, C and niacin as well as minerals. The oil from black cumin seeds also has many medicinal properties and is known to improve the immune system. The

seed is believed to be a rich source of linoleic acid (Matthaus and Ozcan, 2011). The black cumin seed has been used as feed additives, especially for poultry as growth promoters, in view of its therapeutic values and high nutritional content.

Many studies have highlighted the use of the whole black cumin seed but not the oil-extracted cake or meal (in the pressed form), as a supplement in ruminant diets. The aim of adding fatty acid supplements to control the antimicrobial effects of fatty acids so that the addition of these supplements will not disrupt the ruminal fermentation and digestion while regulating the biohydrogenation process so that the performance of the animal will be improved (Jenkins, 1993). This black cumin seed meal is also believed to be high in phytochemical properties like saponin and flavonoid. Furthermore, the information on the use of black cumin seed meal in diet of goats was not available.

1.2 Hypothesis

It was hypothesized that the supplementation of black cumin seed meal in goats would improve feed digestibility and rumen fermentation while reducing rumen biohydrogenation and total protozoa counts.

1.3 Research Objectives

Therefore the main research objective of this study is to investigate the effects of black cumin seed meal supplementation on goats. The specific objectives of this thesis are:-

- To determine the composition and to quantify linoleic and linolenic acid contents in the pressed black cumin seed meal.
- To evaluate the apparent digestibility of nutrients and rumen fermentation characteristics of goats fed diet supplemented with black cumin seed meal.
- To determine rumen fatty acid profiles and total protozoa counts of goats fed diet supplemented with black cumin seed meal.

1.4 Thesis Organization

This thesis consists of 5 chapters including introduction in this chapter. Chapter 2 summarizes the recent aspects on use of herbs in veterinary medicine, and highlights the importance of utilizing herbs especially in ruminant production. In addition, an overview of the digestive process in ruminants is covered, along with special focus on black cumin seed and its use in livestock, especially ruminants. The main focus of Chapter 3 is to present the methods, results and discussion of the proximate analysis and fatty acid analysis of black cumin

seed meal, digestibility trial and volatile fatty acid analysis of goats supplemented with black cumin seed meal. Moving on, the main focus of Chapter 4 is to present the methods, results and discussion on rumen fatty acid profiles and total protozoa in goats supplemented with black cumin seed meal. Chapter 5 presents the general discussion, main conclusions of this thesis as well as recommendations for future research.

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