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EFFECTS OF MANGOSTEEN PEELS ON IN VITRO RUMEN FERMENTATION AND METHANE PRODUCTION IN GOATS

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EFFECTS OF MANGOSTEEN PEELS ON *IN VITRO* RUMEN FERMENTATION AND METHANE PRODUCTION IN GOATS

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It is hereby certified that we have read this project paper entitled "Effects of Mangosteen Peels on *in vitro* Rumen Fermentation and Methane Production in Goats" by Izdihar Bin Ishak and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course VPD4901 – **Project**

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Dedicated to my parents,

Ishak Bin Sharif, Aidah Bt Zubir,

my siblings and my best friends.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

LIST OF APPENDICES

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada kursus VPD 4901 – Projek.

KESAN PENGGUNAAN KULIT MANGGIS MENGGUNAKAN KAEDAH *IN VITRO* TERHADAP FERMENTASI RUMEN DAN PENGHASILAN GAS METHANA PADA KAMBING

Oleh

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Kesan kulit manggis terhadap rumen fermentasi dan penghasilan gas methana dikaji mengunakan teknik penghasilan gas secara *in vitro*. Tiga kumpulan direka yang merangkumi kumpulan kawalan tanpa kulit manggis (50% konsentrat + 50% alfalfa), separa kulit manggis (50% konsentrat + 25% alfalfa+ 25% kulit manggis) dan tinggi kulit manggis (50% konsentrat + 50% kulit manggis). Fermentasi *in vitro* dilakukan mengunakan 100ml picagari yang tertutup mengandungi 0.25g bahan makanan kering dan 30ml cecair rumen diinkubasi pada suhu 39°C selama 24 jam. Penghasilan gas total selama 24 jam menunjukkan tiada perbezaan signifikan ($p>0.05$) antara kumpulan tetapi kumpulan yang mengandungi kulit manggis menunjukkan jumlah penghasilan gas yang rendah berbanding kumpulan kawalan. Kadar penghasilan gas pula

menunjukkan rendah pada kedua kumpulan yang mengandungi kulit manggis tetapi tiada perbezaan signifikan diantara kesemua kumpulan. Penghasilan asik lemak meruap, pH dan ammonia nitrogen juga tiada perbezaan signifikan ($p>0.05$). Penghasilan gas methana pula mempunyai perbezaan signifikan ($p<0.005$) iaitu lebih rendah pada kedua kumpulan yang mengandungi kulit manggis selepas 24 jam proses inkubasi jika dibandingkan dengan kumpulan kawalan. Jumlah total bakteria menunjukkan perbezaan signifikan dimana kumpulan HMP menunjukkan jumlah signifikan yang lebih rendah berbanding MMP dan kumpulan kawalan. Jumlah metanogen pula menunjukkan perbezaan signifikan iaitu lebih rendah bagi kedua kumpulan yang menganduni kulit manggis jika dibandingkan dengan kumpulan kawalan. Walaubagaimanapun, jumlah protozoa menunjukkan tiada perbezaan signifikan ($p>0.05$) di antara kesemua kumpulan. Kseimpulannya, penggunaan kulit manggis dalam makanan haiwan menggunakan kaedah *in vitro* menunjukkan tiada kesan sampingan yang ketara pada parameter fermentasi rumen tetapi mengurangkan jumlah backteria methanogens serta penghasilan gas methana yang boleh mengurangkan pencemaran persekitaran.

Katakunci: kulit manggis, *in vitro*, fermentasi rumen, penghasilan methana

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4901 – Project.

EFFECT OF MANGOSTEEN PEELS ON *IN VITRO* FERMENTATION AND METHANE PRODUCTION IN GOATS

By

Izdihar Bin Ishak

2015

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The effect of mangosteen peels (MP) on rumen fermentation and methane production were evaluated using an *in vitro* gas production technique. Three groups were designed which comprised a control group without MP (50% concentrate + 50% alfalfa), medium mangosteen peel (MMP) (50% concentrate + 25% alfalfa+ 25% mangosteen peel) and high mangosteen peel (HMP) (50% concentrate + 50% mangosteen peel) group. The *in vitro* fermentation was carried out in 100ml sealed syringes that contained 0.25g of dried feed materials and 30ml of rumen fluid incubated at 39°C for 24 hours. The total gas production over 24 hours showed no significant

difference ($p>0.05$) between groups although the supplemented groups with MP showed lesser total gas production. The rate of gas production also showed a lower rate for MMP and HMP groups compared to control group although it was not significantly different ($p>0.05$). The volatile fatty acid production, pH and ammonia nitrogen showed no significant difference between all treatment groups. However, methane production in both MP groups was significantly lower ($p<0.05$) than the control after 24 hours of incubation. The MP supplementation reduced the total bacterial population significantly ($p<0.05$) in the HMP group compared to MMP and control groups. The population of total methanogenic bacteria was significantly reduced ($p<0.05$) in the two groups supplemented with MP. However, there was no significant difference ($p>0.05$) in the protozoal population between all the groups. In conclusion, supplementation of goat diets with mangosteen peels under *in vitro* conditions showed no adverse effects on rumen fermentation parameters but reduced the population of methanogenic bacteria hence reducing the methane production which should reduce environmental pollution.

Keywords: mangosteen peels, *in vitro*, rumen fermentation, methane production

CHAPTER 1

1.1 INTRODUCTION

The purple mangosteen or scientifically known as *Garcinia mangostana* comes from the family species of Guttiferae. It is believed that this tropical evergreen tree originated in Indonesia but it can be widely found in Southeast Asia regions like Malaysia, Thailand, Vietnam and Singapore. In the orient, the purple mangosteen has been dubbed as the queen of tropical fruits due to its unique appearance, delicious taste and the many health benefits this fruit can offer to consumers. The outer layer of mangosteen fruit is called the rind (pericarp) and the color is green when it is young and slowly turns to dark reddish purple when it is ripe. The middle layer, which is snow-white in color is the edible part. The flavor can be described as sweet and salty with peach flavor and texture. The seed can be found within the white edible pulp. The seed is inedible due to its bitter taste. The size of the mangosteen fruit can be described as the size of a tennis ball with a diameter range of 3-7cm.

The mangosteen can be categorized as a seasonal fruit where the peak production is between June to August and December to February. In Malaysia, the four main states where mangosteen trees are widely cultivated are Kelantan (1,024 ha), Kedah (730 ha), Johor (788 ha) and Perak (615 ha) (Department of Agriculture, 2012). The productivity of mangosteen is moderate at an average of 7.2 mt/ha. A report done by MARDI (2009) showed that, although the land where mangosteen is planted has declined from 7,630 ha (1998) to 6,060 ha (2010) the production has increased from 16,000 tons to more than 28,900 tons in the same period. The abundance of mangosteen and its availability in

Malaysia makes it a good choice to be used as one of the by-products for ruminants feeds in the future.

Mangosteen fruits have been used for about several hundred years ago by people living in Southeast Asia to treat wounds, inflammation and various types of infection (Chin and Kinghorn, 2008). Recently, the mangosteen has been noted to contain an abundant source of polyphenols which act as an anti-oxidant and promoting good health. Others claimed that the mangosteen fruit is a rich source of phenolic compounds which are xanthone, condensed tannins and anthocyanins (Jung et al., 2006 and Mahabusarakam *et al*., 1987). Polyphenols has been a popular subject for research mainly for the treatment of cancer (Ji *et al.*, 2007; Jung et al., 2006; Mahabusarakam *et al*., 1987). However, the effect of polyphenols from mangosteen peels on ruminant fermentation and wellbeing still needs further investigation to determine whether these fruit peels can be incorporated in the animal diet.

1.2 PROBLEM STATEMENT

The ruminant industry in Malaysia is still at a low self-sufficiency level. Many parameters need to be checked and improved in order to increase the overall livestock production. One of the factors is low nutrition and lack of good quality feed. Malaysia has been blessed with an abundance of by-products that has good quality value and can be incorporated into feedstuff to be fed to animals. This study aimed to evaluate another important by-product, which is the mangosteen peels and to determine its suitability as a ruminant feed supplement based on their effect on *in vitro* rumen fermentation.

1.3 HYPOTHESIS

1. Mangosteen peels have no adverse effects on *in vitro* rumen fermentation
2. Mangosteen peels reduce rumen methanogenic bacteria hence methane production *in vitro.*

1.4 OBJECTIVES

The objectives of this study were as follow:

1. To determine the effects of mangosteen peels on *in vitro* rumen fermentation in goats.
2. To investigate the effects of mangosteen peels on *in vitro* rumen methane production.
3. To determine the effects of mangosteen peels on the i*n vitro* methanogenic bacterial population

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