



UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF RUMEN PROTECTED FAT ON GROWTH PERFORMANCE
AND DIGESTIBILITIES IN SHEEP**

EE LI YEN

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BY

EE LI YEN

A project report submitted to Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirement of SHW 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture (Animal Science)

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CERTIFICATION

This project report entitled Effects of Rumen Protected Fat on Growth Performance and Digestibilities in Sheep is prepared by Ee Li Yen and submitted to the Faculty of Agriculture in fulfillment of the requirement of SHW 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture (Animal Science).

Ee Li Yen

Certified by:

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Prof. Dr. Loh Teck Chwen

Department of Animal Science

Date:

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ABSTRACT

The effects of different types of rumen protected fat (RPF) supplementation on growth performance and digestibility of sheep were studied. This study was carried out due to limited information on digestibility and feeding of different types of RPF in sheep. Forty-five male sheeps of 24.81 ± 5.29 kg were used in complete randomized design (nine sheeps per treatment). Five isonitrogenous and isocaloric dietary treatments were Treatment 1 (T1, palm oil), Treatment 2 (T2, RPF with calcium), Treatment 3 (T3, RPF without calcium), Treatment 4 (T4, RPF without lecithin) and Treatment 5 (T5, RPF with lecithin). The feeding trial was conducted for four weeks; however, digestibility trial was conducted for a week on 15 sheeps (three sheeps per treatment). The sheep were weighed at weeks 0, 2 and 4. Blood samples were collected before and after the study for determination of fatty acid (FA) profile in blood serum. Fecal samples were collected during digestibility trial and used to calculate apparent nutrient digestibility. Thirty-five sheeps were slaughtered for meat quality analysis. Average daily gain, feed conversion ratio and dry matter intake were not affected ($P>0.05$) by the treatments. Apparent nutrient digestibility values in T5 were significantly higher ($P<0.05$) for ether extract, crude protein and crude fiber compared to other treatments. Neither the inclusion of RPF with calcium or lecithin impacted ($P>0.05$) carcass characteristics but only drip loss after 24 h showed significant differences with the lowest value (1.51%) observed in T4. Aging after 7 d resulted in brighter meats, less redness and generally increased yellowness. Polyunsaturated FA in blood serum showed significant increase for all treatments and T4 yielded the most significant reduction (4.22%) for n-6/n-3 FA ratio. There are no negative effects of RPF on the measured parameters as compared with palm oil.

KEYWORDS: Rumen protected fat, Growth, Digestibility, Meat quality, Polyunsaturated fatty acids.

ABSTRAK

Kesan jenis suplemen lemak lindungan rumen (RPF) terhadap prestasi pertumbuhan dan pencernaan biri-biri dijalankan disebabkan oleh kajian tentang jenis RPF yang terhad. Empat puluh lima biri-biri jantan (24.81 ± 5.29 kg) digunakan dalam reka bentuk rawak lengkap (Sembilan haiwan setiap rawatan). Lima rawatan pemakanan "isonitrogenous" dan "isocaloric" adalah Rawatan 1 (T1, minyak sawit), Rawatan 2 (T2, RPF dengan kalsium), Rawatan 3 (T3, RPF tanpa kalsium), Rawatan 4 (T4, RPF tanpa lesitin) dan Rawatan 5 (T5, RPF dengan lesitin). Kajian ini adalah merupakan empat minggu kajian pemakanan dan seminggu kajian pencernaan pada 15 biri-biri (tiga haiwan setiap rawatan). Biri-biri ditimbang pada minggu 0, 2 dan 4, sampel darah diambil sebelum dan selepas kajian untuk penentuan asid lemak (FA) profil, sampel najis digunakan untuk mengira pencernaan nutrient jelas dan 35 kambing biri-biri disembelih untuk analisis kualiti daging. Keuntungan purata harian, nisbah penukaran makanan dan pengambilan bahan kering tidak dijejas ($P > 0.05$) oleh rawatan. Jelas nilai-nilai pencernaan nutrient dalam T5 berbeza secara ketara ($P < 0.05$) bagi ekstrak eter, protein kasar dan serat mentah berbanding rawatan lain. Suplemen RPF dengan kalsium atau lesitin tidak berkesan ($P > 0.05$) pada ciri-ciri bangkai tetapi kehilangan titisan selepas 24 jam menunjukkan perbezaan yang signifikan (1.51%) dalam T4. Penuaan selepas 7 hari mengakibatkan daging lebih cerah dan kuning serta kurang kemerahan. Asid lemak tidak tepu berganda dalam serum menunjukkan peningkatan yang ketara untuk semua rawatan dan T4 menghasilkan pengurangan yang paling banyak (4.22%) untuk n-6/n-3 nisbah FA. Tiada kesan negatif RPF terhadap parameter yang dikaji.

Petunjuk: Lemak lindungan rumen, Pertumbuhan, Pencernaan, Kualiti Daging, Asid lemak tidak tepu berganda.

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1. INTRODUCTION

The livestock industry in developing countries like Malaysia has always been plagued by the lack of affordable and good quality local feed resources to fulfill the nutritional requirements of livestock, specifically in terms of energy value (Devasena *et al.*, 2007). The common method to increase energy value is to provide livestock especially ruminants with fermentable carbohydrates such as cereal grains or supplemental fats. This feeding regime can lead to rumen acidosis as feeding cereal grains or supplemental fats in levels higher than recommended can affect rumen pH (Naik *et al.*, 2009).

There are two classifications of supplemental fats; rumen active fat and rumen protected fat (RPF). There are possibility for rumen active fats to affect microbial fermentation in the rumen whereas RPF is resistant to hydrolysis by microbes in the rumen (Naik *et al.*, 2009). RPF are considered as insoluble lipids because they are protected from microbial fermentation and biohydrogenation and remain insoluble at normal rumen pH range of 6 to 7. Thus, RPF that escaped rumen fermentation are then utilized as a source of energy when absorbed through the small intestine.

Protected lipids which reduce fatty acid biohydrogenation in the rumen resulted in unsaturated fatty acid (UFA) being absorbed in small intestine and posterior inclusion in the adipose and muscle tissues of ruminants (Andrade *et al.*, 2014). Using RPF, polyunsaturated fatty acids (PUFA) especially omega-3 FA can be protected from rumen biohydrogenation which indirectly improves the omega-6:omega-3 FA ratio and yield healthier meat cuts (Andrade *et al.*, 2014). Palmquist and Jenkins (1980)

reported that the usage of RPF enhances fiber digestibility in the fat supplemented diets by forming insoluble soaps (as cited in Bhatt *et al.*, 2013b). Additionally, supplementation of protected FA improves energy efficiency due to reduced production of methane from the rumen and direct use of long-chain FA (Ki Park *et al.*, 2010).

In this study, RPF used is produced from the by-products of the oil palm industry and is one of the supplements that are available in the market. There were three kinds of RPF used in this study which were calcium soap of fatty acids, prilled fat (with no lecithin or calcium) and prilled fat with lecithin (Figure 1).

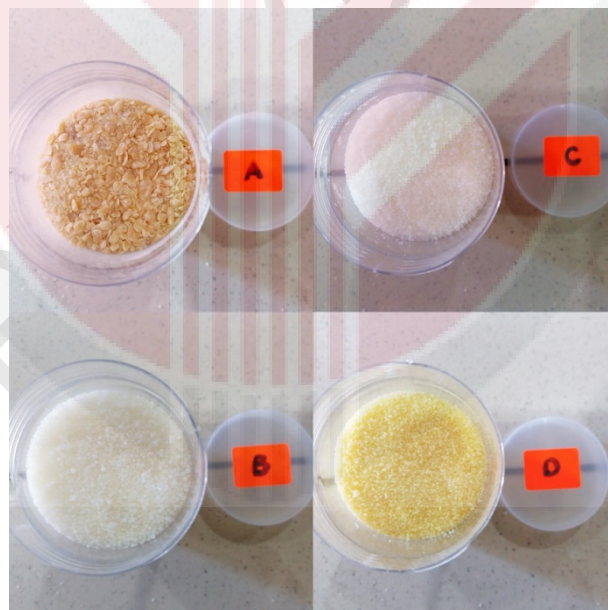


Figure 1: RPF used (A is calcium soap; B and C are prilled fat; D is prilled fat with lecithin)

A common method of protection is by the usage of calcium soap of palm oil fatty acids. It is opined that the supplementation of calcium soap of palm fatty acids could be an alternative feeding method when there is lack of fresh pasture (Warner *et al.*,

2015). Some reviews stated that calcium soaps are produced in a simple and economical method as well as being easily supplemented into animal's diet as they are present in "dry fat" form (Daniel, 2015). Additionally, calcium soaps have high intestinal digestibility and acts as a calcium source to the body as well (Naik *et al.*, 2009).

Calcium soaps are not soluble in rumen and therefore do not disturb organic matter digestibility. It was reported that the effect is due to ionized calcium (Devasena *et al.*, 2007). Additionally, calcium soaps work in a way such that calcium replaces the glycerol backbone of a lipid and attaches to the fatty acids and will not dissociate easily in the rumen environment, in comparison to the glycerol backbone which will dissociate easily and release fatty acids into the rumen. As calcium soaps enter the intestines, calcium ions will dissociate from fatty acids due to the presence of low pH and allow fatty acids to be absorbed through the intestinal walls.

On the other hand, prilled fat with lecithin act as an emulsifier by dispersing fatty acids and enhancing fatty acid absorption (Wettstein & Sutter, 2001). It was stated that although emulsification of added oils was not extensively studied in ruminants back then, it was concluded that crude lecithin played a role to reduce the adverse effects of supplementation of fat on ruminal fermentation (Enjalbert *et al.*, 1994). Prilled fat with lecithin also enhances the digestibility of fats and fat-soluble vitamins (Sontakke *et al.*, 2014). Moreover, lecithin is also not easily hydrolyzed in the rumen thus allowing it to be less susceptible to microbial alteration and able to maintain their unsaturated characteristics. Similarly, Grummer (1988) also stated that prilled fat (with no calcium or lecithin) is one type of RPF that consists of saturated fatty acids that are liquefied and mixture of fatty acids are sprayed under pressure into a cooled

environment (as cited in Devasena *et al.*, 2007) resulting in dried prilled fatty acids, which are inert in rumen.

1.1 Research Problem

There are very few literatures found where effect of RPF with calcium versus RPF with lecithin in meat sheep were studied simultaneously using RPF obtained from two different companies. Besides that, identification of the level of nutritional management which results in optimum production of mutton has always been the primary challenge for sheep producers. The single, largest expense in the total cost of raising sheep is the fulfillment of nutrient needs of a sheep. The major nutrients needed in sheep nutrition are water, energy, protein, minerals and vitamins.

Inadequate energy may limit sheep's performance more than any other nutritional deficiency, which arises due to insufficient quantity of feed or low quality feed. As a result, there is a decrease in body growth, reduced fertility, reduced wool quantity and quality, and in severe cases, death. The undesirable effect of energy insufficiency can be countered by providing RPF which remains intact from the action of rumen microbes without affecting the fermentation process.

1.2 Research Hypothesis

The inclusion of RPF can protect polyunsaturated fatty acids (PUFA) from rumen biohydrogenation, improves digestibility of neutral detergent fiber (NDF), acid detergent fiber (ADF), ether extract (EE), crude protein (CP) and growth performance. RPF can also help to improve carcass and meat quality. Besides that, RPF with lecithin was also hypothesized to have higher efficacy than RPF with calcium in the parameters evaluated in this study.

1.3 Objectives

The main objective of the study was to determine the effect and efficacy of supplementation of RPF in improving the quality of meat production of small ruminants. The specific objectives of the study were:

1. To determine the effects of palm oil and different types of RPF on digestibility and growth performance in Dorper sheep, and
2. To evaluate the effect of palm oil and different types of RPF on serum fatty acids in sheep, and
3. To compare the effects of palm oil and different types of RPF on carcass composition and meat quality in sheep.

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