EFFECT OF FEEDING *Moringa oleifera* ON BODY WEIGHT AND MILK PRODUCTION OF SAANEN GOATS

By

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A proposal is submitted in fulfilment of the requirements for the degree of Bachelor Applied Science (Animal Husbandry Science) with Honours

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DECLARATION

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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I certify that the report of this final year project entitled “Effect of Feeding *Moringa oleifera* on Body Weight and Milk Production of Saanen Goat” by Gunarangini A/P Muniandy, matric number F14A0076 has been examined and all the correction recommended by examiners have been done for the degree of Bachelor of Applied Science (Animal Husbandry Science) with Honours, Faculty of Agro-Based Industry, Universiti Malaysia Kelantan.

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Gunarangini Muniandy

Effect of Feeding *Moringa oleifera* on Body Weight and Milk Production of Saanen Goat

ABSTRACT

Dairy goats need to feed well to increase their body weight and milk production. They require a balanced diet for milk production. Additional feed which has more protein and dry matter as *Moringa oleifera* can be feed to animals to improve their performance. The objective of the study was to identify the potential of dried *Moringa oleifera* in increasing body weight and milk yield in Saanen goats. Nine goats are choosen and dived into three groups and randomly assigned for three treatments: (1) control group which follows farm practice (2) treatment 1: 10% of dried *Moringa* leaves with farm practice and (3) treatment 2: 15% of dried *Moringa* leaves with farm practice. The result of the study, the daily weight gain for treatment 2 (58.3±3.5) is higher (P>0.05) than in the treatment 1 (43.2±3.1). While for the milk yield, the goats in treatment 2 (952.4±124.3) produced high milk compare to treatment 1 (601.0±177.2). The results shows that providing supplement of 15 % of dried *Moringa oleifera* or more to goats can increase the body weight and milk production.

Keywords: body weight, milk yield, *Moringa oleifera*, randomly, potential

Mengkaji Kesan Perubhan Makanan *Moringa oleifera* Terhadap Berat Badan dan Penghasilan Susu Kambing Saanen.

ABSTRAK

Kambing tenusu perlu memberi makanan yang berkhasiat untuk meningkatkan berat badan dan pengeluaran susu. Mereka memerlukan diet seimbang untuk pengeluaran susu. Makanan tambahan yang mempunyai lebih banyak protein dan bahan kering seperti *Moringa oleifera* boleh diberi pada haiwan untuk meningkatkan pertumbuhan badan dan pengeluaran susu. Objektif kajian ini adalah untuk mengenalpasti potensi *Moringa oleifera* dalam meningkatkan berat badan dan penhasilan susu kambing Saanen. Sembilan kambing telah dipilih dan diagihkan secara rawak bagi tiga kumpulan: (1) kumpulan terkawal dengan mengikuti amalan kandang, (2) kumpulan 1: 10% daun *Moringa* yang kering dengan amalan kandang dan (3) kumpulan 2: 15% daun *Moringa* dengan amalan kandang. Keputusan kajian ini menunjukkan berat badan harian kambing dalam kumpulan 2 (58.3±3.5) tinggi ($p>0.05$) daripada kambing dalam kumpulan 1 (43.2±3.1). Sementara itu, penghasilan susu bagi kambing dalam kumpulan 2 (952.4±124.3) tinggi daripada kumpulan 1 (601.0±177.2). Keputusan menunjukan bahawa pemberian makanan tambahan yang mengandungi 15 % daun *Moringa* yang kering atau lebih dapat meningkatkan berat badan dan penghasilan susu.

Kata kunci: berat badan, penghasilan susu, *Moringa oleifera*, rawak, potensi.

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dbh	Diameter at breast height
cm	Centimeter
g	Gram
kg	Kilogram
kcal	Kilocalorie
CP	Crude Protein
mL	Milliliter
L	Littre
N	Normality
mg	Milligram
rpm	Rotation per minute
d	Day
w	Week
FAO	Food and Agriculture Organization
No	Number
ANOVA	Analysis of variance

LIST OF SYMBOL

%	Percentage
°C	Degree Celcius
>	More than
<	Less than

CHAPTER 1

INTRODUCTION

1.1 Background of Study

World goat milk production increased by 39.2% during the period of 2000 to 2012. The larger goat milk producing countries in the world are India, Bangladesh, Pakistan and Sudan. America's countless milk mustaches and the iconic "Milk, it does a body well" announced that 65% of the world drinks goat's milk over cow's milk (Landis, 2013). Milk is a source of micro and macronutrients and contain multiple number of active particles that plays significant role in human health (Ceballos, et al., 2009). Due to the specific composition in goat milk, it is considered as high quality raw material for manufacturing foods. The composition of milk will be differ based on the breed, lactation state, feeding and other environment conditions. Protein and fat in goat milk are more digestible compared to cow's milk (Ceballos, et al., 2009).

Saanen is the largest of the dairy goat breeds. This breed is one of the best goat for consistent high volume and high quality milk production. It is originated in Switzerland but spread throughout Europe and also in some Asian countries. Saanen breed mainly developed for milk production and the lactation yield ranging from 825 to 3,850 liters per

lactation (Peacock, 1996). Saanen are very docile animal and can be easily trained (Belicho, et al., 1998).

Moringa oleifera contain many nutrients that are beneficial for both human and animals. It is well known and most widely distributed and naturalized species of a monogenic family *Moringaceae* (Anwar, et al., 2007). The tree can grow up to 9m. This plant native from western and sub-Himalayan tracts, India, Pakistan, Asia Minor Arabia and Africa is now distributed almost most of the countries (Makkar & Beckar, 1996). It is also known as tree of immortality, Drumstick tree, Horseradish tree, Mother's Best Friend, Radish tree and West Indian ben. While in Malaysia called as 'Pokok Kelor' or 'Murungai'. *Moringa oleifera* is edible plant, which consists of a massive natural nutrient that is very useful for human and animal (Anwar, et al., 2007). *Moringa* leaves, flowers, fruits and immature pods of this tree consist of enormous nutrition and used as vegetables in most of the countries. *Moringa* leaves have been reported to be loaded with protein, potassium, β-carotene and also a good source of natural antioxidant (Nouman, et al., 2014). *Moringa* tree also known as mother's best friend because it can increase the production of milk in women and prescribed for anemia (Anwar, et al., 2007).

1.2 Problem statement

Milk production, milk quality and body weight of dairy cattle is influenced by the nutrients it consumed (Pramono, et al., 2016). Some farmers use sorbitol (Jewel, Los Angeles Patent No. US 7,037,518 B2, 2002), chemically treated soy bean meal (Atwal,

et al., 1998) and many more chemical or artificially produced feed supplements are provided to dairy cows to increase the milk production and body weight. The usage of this kind of supplements can lead to health issues in ruminants. Researches incorporate with the healthcare department are in attempt to produce safe and cost effective supplement. At the same time the researchers also in process to discover solution to overcome the side effects feeding this supplement. Thus the need for find solution from herbal plants has increased. Therefore, this plant is chosen to test on their effectiveness in increasing body weight and milk production. There are some research done on controlling mastitis by feeding or udder administration *Moreinga oleifera* seed oil in dairy herds (Hektoen, et al., 2004) and there is also little research had been reported on the milk yield, milk composition and body weight with *Moringa oleifera* leaves in dairy cattle.

1.3 Hypothesis

H_0: *Moringa oleifera* do not has potential in increasing body weight and milk production in Saanen goats.

H_1: Moringa oleifera have potential in increasing body weight and milk production in Saanen goats.

1.4 Objectives

To identify the potential of *Moringa oleifera* in increasing body weight and milk yield in Saanen goats.

1.5 Scope of study

There are many types of supplement given to raise the body weight and milk yield of goats. The feed must be nutritious enough to increase the weight and milk production. Animal nutrition is very important to solve problem related to the lack of nutrients in dairy animals. Animal nutrition also help us to solve problem by identifying the source.

1.6 Significance of study

At the end of this study, the finding will provide benefits to the dairy industry. This study will help other researches to create safe and cost effective feed, medicine or antibiotics. This study also will provide awareness about the plant on its natural and beneficial properties.

1.7 Limitation of Study

There are some limitations might occur during this study. Variation in chemical compositions of the plants species may lead to mild changes in the animal's digestibility or their performance. Difficulties in obtaining the plant may occur too. During the experimental work, shelf life of plant has to be considered.

CHAPTER 2

LITERATURE REVIEW

2.1 Saanen goat breed

Saanen breed is the largest dairy goat breed. The Saanen goats are originated from Saanen Valley of Switzerland (Luttwiltz, 1996). This breed is one of the best goat for milk production. Does weighing around 68kg while the bucks can grow until 80 to 91 kg. Saanen goat are weathers tolerants and take change in stride. This breed can perform well in temperate than tropical region. Sometimes they can perform well in any situation as long as they are provided with shade, shelter, pasture, quality hay and fresh clean water. Saanen is a breed which can produce high milk with 3.5% of butterfat. The average milk production of the Saanen doe is about 2545 pounds of milk per year.

2.2 Milk production in goats

According to FAO (2004), world's 2% of total milk supply produced by the goats. More people drink goat milk compare to other animal species milk. Since goat milk can provide basic nutrients, it plays vital role in underdeveloped countries especially in rural areas. Cow milk is often unavailable in underdeveloped countries and the goat milk and

its products becomes important in daily food. Goat milk and its products as cheeses and yogurt also being an alternative to cow milk and its product to whom have allergies and gastrointestinal disorders towards cow's milk.

There are few factors that could influence the milk production in goats. The breed is one of the factor that effect the milk production. There are six major breeds, Saanen, Alpine, Toggenburg, Oberhasiol, LaMancha and Nubian which are famous for their high milk productivity. Saanen is called as the queen among the other dairy goat breeds which can produce the highest milk with lower fat levels.

The physical appearance and the quality of udder play important role in the milk production capacity (Haenlein & Abdellatif, 2004). The drop in milk yield in later lactation is mainly due to the loss of secretary tissues and a decrease in the rate of secretion per unit of tissue capable of milk secretion. Pendulous udder can be found when the milk yield is high in some breeds. A high correlation occurs between the milk yield and the udder size. Between one milking to another, milk secretion continuous to accelerate up to 18 hours.

As in dairy cows, diet has the same effect in dairy goats too on the milk production (Fehr & Sauvant, 1980). Increase in the amount of energy content in diet, increases the milk production, as well as increases the nitrogen content in milk. Water intake also can influence the milk yield. In high milk yielding breeds, privation of water for 48 hours, leads to low milk yield. Indigenous breeds have greater adaptation for water shortage in arid condition and able to maintain constant milk yield. The daily diets of

goats should present with 17% of crude fiber to prevent serious distress in fat content of milk (A.Shkolnik, et al., 1980).

The lactation period in goats are 10 months, but if no pregnancy initiated it can be lengthen. Negative relationship occurs between milk yield and the composition of fat, proteins and minerals; while for the lactose it is positive relationship. Dry period is the period when the dairy animal conceived but not milking. This dry period is important for the animal to replenish the mammary tissues and to strengthen their body for the next lactation. Dry period for dairy animals should be more than 6 weeks for high milk yield for the next lactation; dry period less than 6 weeks can cause decline in milk yield. The environment temperature plays a vital role in milk yield. The effect of the environment temperature on milk production depends on the breed of goats. Cold environment reduces milk secretion in goat as the udder blood flow reduced (Thompson & Thompson, 1977).

2.3 Lactation Physiology

There are two valves in goat udder with separated mammary gland. The formation of lobular-alveolor system initiates the mammary secretion. Enzymes needed for the lactogenesis and galactogenesis secreted within the cells of udder before kidding. During parturition, hormones cause rise in milk secretion in udder. First colostrum, which also called as the first milk, produced after parturition and it will be secreted for 5 days. Colostrum is high in immunoglobulin and responsible for immunity development for

newborn (Amin, 2012). Before parturition the progesterone level falls and estrogen, adrenocorticotrophic hormone and prolactin level rises.

Lactogenesis is process of milk secretion which involves of the intracellular synthesis of milk. The secretory tissue have alveolus which made up of single layer of epithelial cell which aid precursor absorption from blood then deposit milk components into the lumen of alveolus. The myoepithelial cells, which is the outer layer of alveolus, help in alveolus contraction and let milk down. Synthesis and diffusion are the two major secretory processes by alveolar cells for milk secretion.

During hand milking or machine milking and nursing, the milk withdrawn from teat and gland cisterns and then from major ducts. Oxytocin, a milk secretion hormone causes ejection of milk by inducing contraction of myoepithelial cells around the alveoli. The secretion of oxytocin initiated by the suckling of kid or milking. Following parturition, the milk yield reach peak after 4 to 8 weeks. Then it will gradually decrease during the late lactation period. Farmers usually record the period of the peak production since they vary with species, breeds and nutrient intake. After onset of estrus the milk yield decline (Peaker & Linzell, 1974).

2.4 Body Weight Correlated with Milk Production

Age is an important factor for the variation of milk yield (Alderson & Pollak, 1980). Milk production peaks at 4 years of age as goats reaches mature body weight (Williams,

1981). As the age increases it results in gradual decrease in milk fat percentage. Body weight of dairy goats should be 30 to 80 kg when it matures. This is called mature body weight. There is a positive correlation exists between the body weight and milk yield. When a goat can produce high quantity of milk, loss of energy occurs in its body. So to withstand high energy drain, the goat should store more body fat. Increase in body weight contributes for a larger digestive system and larger mammary gland which helps in the secretion of milk.

2.5 *Moringa oleifera*

2.5.1 Taxonomy

Kingdom Plantae

Subkingdom Tracheobionta

Class Magnoliophyta

Subclass Dilleniidae

Order Capparales

Family Moringaceae

Genus Moringa Adans

Species *Moringa oleifera*

Figure 2.1: Taxonomy of *Moringa oleifera* (Roloff, et al., 2006)

2.5.2 Botany and Morphology

Moringa tree is domestic of northwest India (Ramachandran & Gopalakrishnan, 1980). This *Moringa oleifera* found wild in the sub-Himalayan tract from the river. This tree is widely distributed in India, Egypt, Philippines, Ceylon, Thailand, Malaysia, Burma, Pakistan, Singapore, West Indies, Jamaica, China and Nigeria (Ramachandran & Gopalakrishnan, Drumstick (Moringa oleifera): A Multipurppose Indian Vegetable, 1980). *Moringa* can grow in all type of soil and at altitude from sea level to 1800m (Fahey & Jw, 2005). *Moringa* is a drought tolerant and can grow even in 6 months of dry season. This tree can grow up to 9m high and about 60cm dbh.

The leaves are spirally arranged, 25 to 45cm long. They are green in colour when young and turns yellow when matured it. This flowering type of tree produced all the year and provides sweet smelling all the year (Ramachandran & Gopalakrishnan, 1980). The finely hairy green leaflets are almost hairless on the upper surface. The twigs are branching brown then green and fairly green. The flowers are yellowish white in colour and have fragrant. The stalks hairy in spreading drooping axillary cluster which is 10 to 25m long. Fruits of *Moreinga oleifera* are pendulous, linear 3-sided pods and usually 20 to 50m long. The pods containing up to 26 seeds, dark green during development turn brown on maturity and split open. The woods are soft, corky and becoming rough as it continues to grow.

2.5.3 Traditional uses

Almost all parts of *Moringa oleifera* are have been used for various disorder by South Asians in indigenous medicine. The medical properties of this plant have been recognized long time ago in the Ayurveda and Unani system of medicine (Anwar, et al., 2007). It contain many nutrients that can be utilized by humans and also animals.

Figure 2.2: *Moringa oleifera* (Marlowe, 2014)

Table 2.1: Nutritional value of *Moringa oleifera*, *Moringa* pods, *Moringa* fresh leaves and dried *Moringa* leaf powder (Patois & Creole, 2009).

Nutrition Type	*Moringa* pods	*Moringa* fresh leaves	Dried *Moringa* leaf powder
Moisture (%)	86.9	75.0	7.5
Calories (kcal)	26.0	92.0	205.0
Protein (per 100g)	2.5g	6.7g	27.1g
Fat (per 100g)	0.1g	1.7g	2.3g
Carbohydrate (per 100g)	3.7g	13.4g	38.2g
Fiber (per 100g)	4.8g	0.9g	19.2g
Minerals (per 100g)	2.0g	2.3g	-

The *Moringa oleifera* stem used for vegetable soup while the leaves used to prepare pastes with groundnut to use in salads. The leaves also used as tea. The raw leaves chewed as snacks; used as complementary baby foods; purify dirty water and also pond water (Gopalakrishnan, et al., 2016). This *Moringa oleifera* have ability to cure ear and eye infection (Gopalakrishnan, Doriya, & Kumar, 2016). The parts of trees are capable of treating high blood pressure, lowering blood sugar level, treat common cold, cure male impotency and treat skin problems and allergies (Stevens, et al., 2013). The research done by Faizi et al., (1994) proves that nitrite, mustard oil glycosides and thiocarbonate glycosides were isolated from *Moringa* leaves which responsible for the blood pressure lowering effect. *Moringa* leaves can provide 7 times more vitamin c than oranges, 15 times more potassium than bananas, 25 times more iron than spinach, 10 times more vitamin A than carrots and 9 times more protein than yogurt

(Gopalakrishnan, et al., 2016). *Moringa* helps to increase the milk production in lactating cows by providing phytosterols which is a hormone precursor for reproductive growth (Gopalakrishnan, et al., 2016). Traditionally used as antispasmodic, stimulant, expectorant and diuretic (Mishra, et al., 2011). The barks of *Moringa oleifera* have antifungal and antimicrobial properties. The flowers of *Moringa oleifera* are useful in increasing the flow of bile. The root juice used for nervous debility, asthma, enlarged liver and spleen and deep seated in inflammation (Mishra, et al., 2011).

2.5.4 Uses in livestock production

Livestock production is a very important sector of the agricultural field in many tropical countries. Dairy industry one of the sector that increases the economics of the country. Ensiled *Moringa* leaves have highest digestibility for the fiber and protein compared to Elephant grass when the ensiled *Moringa* fed to dairy cows (Mendita, et al., 2011). Fresh forage of *Moringa* also added to the diet of different animals. There was positive effect shown on the feeding behavior in goats and growth rate of sheep (Salem & Makkar, 2009). Studies shows that the diet containing fresh *Moringa oleifera* is more palatable than the diet containing sesame meal. The milk production rises 10 to 15% when the goats were provided with diet that contain *Moringa* leaves (Kholif, et al., 2015). There is also a study reported that the *Moringa* is rich in poly unsaturated fatty acid and it is good for the health of the ruminants when included in their diet as *Moringa* enhances the immune system of the ruminants (Moyo B. , Masika, Hugo, & Muchenje, 2011).

CHAPTER 3

MATERIALS AND METHODS

This part consists of two sections, the proximate analysis of dried *Moringa oleifera* leaves and feeding trial to Saanen goats.

3.1 Collection of plant sample

Moringa oleifera leaves were collected from Gurun, Kedah. The 85 kg of fresh leaves collected so that it can become half of its original weight when it sundried. The stems were removed from the plant and only the leaves were sun dried and brought to University of Malaysia Kelantan for feeding. The dried leaves were packed in big, black plastic bags and tied well before it brought to university. This is to ensure the leaves do not deteriorate before the feeding.

3.2 Proximate analysis

For proximate analysis, about 200 g of fresh *Moringa oleifera* leaves were dried in oven at 60°C for 24 hours. These leaves then were used for the proximate analysis of dry matter, crude protein, ash and crude fat.

3.2.1 Dry matter analysis

An aluminum dish weighed and recorded as W1. Approximately 2 g of dried *Moringa* leaves weighed, recorded as W2 and put into the aluminum dish. Then the aluminum dish dried in oven at 100°C at 24 hours and then cooled in desiccator (Faichney, 1983). Then final weight taken by weighing the aluminum dish and recorded as W3. The percentage of dry matter calculated by using the formula below (Kashif & Ullah, 2013):

$$Percentage\ of\ dry\ matter\ (DM\%) = \frac{W3 - W1}{W2} \times 100\%$$

W1-weight of empty dish (g), W2- weight of sample (g), W3-weight of dried sample (g)

3.2.2 Crude protein analysis

Crude protein analysis done using the Kjeldahl method. There are 3 stages in this crude protein analysis. They are digestion, distillation and titration.

3.2.3 Pre-preparation for Kjeldahl analysis

0.1 N hydrochloric acid were prepared before the distillation process starts. 2 g of anhydrous sodium carbonate powder placed in an aluminum foil and dried in oven at 200°C for 2 hours. Then it transferred in crucible and placed in desiccator for cool down.

Then methyl red was prepared by dissolving 0.1 g of methyl red powder in 100 mL of 95% ethanol. Bromocresol green solution was prepared by dissolving 0.1 g of bromocresol green powder in 100mL of 95% of ethanol. These both solutions were kept in different reagent bottles. Then, 33.1 mL of concentrated hydrochloric acid were mixed with water to make up the solution for 4 L. This was done in fume chamber. Then approximately 0.4 g of heated sodium carbonate powder was weighed 3 times and added to 3 conical flasks. 40 mL of distilled water were added to each of the conical flask then 4 drops of methyl red and bromocresol green solution were added to the conical flask too.

Then this content was titrated with the hydrochloric acid which was prepared earlier. The reading of hydrochloric acid in burette was taken and recorded as A1 when the colourless solution in conical flask turns into pink colour. Then the conical flask heated using hotplate until it turns colourless again. Then immediately the flask cooled rapidly under running water. Then it titrated again and the reading to change the solution from colourless to pink was recorded as A2. Then it heated again and cooled down rapidly when the colour of the solution becomes colourless. Then the content was titrated again and the reading to change the colourless content to pink was recorded and stated as A3. The molarity of the acid was calculated using the formula below (Kashif & Ullah, 2013):

$$Molarity\ (M) = \frac{18.870 \times weight\ of\ sample(g)}{A1 + A2 + A3}$$

3.2.4 Digestion

In this part, 1g of dried *Moringa* leaves and 1g of Kjeldahl powder added into 3 digestion flasks. Then 12mL of sulphuric acid added to the each flasks using serum pipette. Blank was prepared by adding 12mL of sulphuric acid and 1g of Kjeldahl tablet only. The four flasks inserted into the rack and placed in the control unit. Then the contents heated until 400°C for 4 hours. After that, the control unit and the scrubber unit was switched off. The exhaust system lifted up and the insert rack moved into fume hood. The sample left for cool for 1 hour before it continue to distillation process. The samples were in greenish blue after digestion process.

3.2.5 Pre-preparation for Distillation

32% of sodium hydroxide solution was prepared by mixing 1L of distilled water into 320g of sodium hydroxide powder and let to cool in fume chamber. Then 300mL of boric acid prepared by adding 12g of boric acid in 300mL of distilled water and heated on hot plate (Jongrungruangchok, Bunrathep, & Songsak, 2010).

3.2.6 Distillation and Titration

Distilled water of 80mL and 50 mL previously prepared sodium hydroxide solution added to each of the flask that contains digested samples including blank. Then another 4 conical flask prepared for the distillation process. Boric acid of 30mL added to each

flask. Bromocresol green of 3mL and 2.1mL of methyl red solution added to the flask by using micropipette. The solution then becomes reddish pink in colour. An empty flask placed in both digestion stand and receiver stand to wash the machine. Then the conical flask with boric acid, bromocresol green and methyl red placed on the receiver stand and the deliver tube submerged into the conical flask. The Kjeldahl digestion flask placed on the digestion stand, properly seated and sealed.

Then the process of distillation starts when the program 2 was switched on in the machine. Then the distillation starts for the first digested sample. For the blank, there was no colour changes occur in the conical flask placed on the receiver stand. But for the digested *Moringa* leaves there is colour change occur from reddish pink to green. After every distillation the conical flask were taken out and the content titrated with 0.1N of hydrochloric acid. The reading taken when the green colour of the content changes into reddish pink in colour. After every distillation, the tube washed by switch on program 1. The percentage of nitrogen in the dried *Moringa* leaves were calculated by using the formula below:

$$\text{Percentage of Nitrogen (N \%)} = \frac{(\text{volume of acid neutralize sample - blank}) \times n \times 14.007}{\text{Weight of sample (mg)}}$$

n = normality of titrant

Percentage of Crude Protein (CP %) = Percentage of Nitrogen x 6.25

Figure 3.1: Kjeldahl analysis of dried *Moringa oleifera* leaves.

3.2.7 Ash analysis

3 empty crucible were weighed and each stated as W1. Then approximately 2g of dried *Moringa* leaves were weighed and placed in each crucible, then stated as W2. The crucibles with sample were incinerated in furnace at 600°C for 8 hours. After the incinerator cold down the crucibles were taken out and placed in desiccator. After the crucibles cooled down they weighed and then each stated as W3. The percentage of ash calculated by using the formula below (Kashif & Ullah, 2013):

$$\text{Ash} = \frac{W3 - W1}{W2} \text{ X } 100\%$$

Figure 3.2: Ash analysis of dried *Moringa oleifera* leaves

3.2.8 Ether Extract Analysis

About 6 grams of dried *Moringa* leaves were measured and added to 3 thimbles. Then each thimbles placed in the different extraction tube of the soxhlet in the fume chamber. Then 300mL of petroleum ether measured with measuring cylinder and poured into 3 round bottle flask (29/32) on the heater. The boiling point set for 70°C and the soxhlet run for 5 hours. After 5 hours, the soxhlet turned off and the 3 thimbles were removed from their respective extraction tube. Then the solution in the round bottle flask poured into different 500mL media bottle before it is brought to the rotary evaporator.

Crude fat extraction from the solution was done by using the rotary evaporator. First, 3 round empty bottle flasks that was known as bottle A, B and C were weighed

using weighing balance and noted as W1. Then the solution from each media bottle poured into the flask. First the flask A containing the solution was sealed in the double sealing ring of the rotary evaporator. After the machine and the vacuum source switched on, the water bath temperature set for 40°C and the rotary speed set to 97rpm. The charging valve was controlled by turning on and off frequently. This was done to avoid overflow of the solution from the flask to the collecting flask. The flask let to rotate until only the crude left in the flask. The flask with crude fat was weighed and denoted as W3. The steps was repeated from the flask B and flask C. The percentage of the crude fat calculated by using the formula below (Kashif & Ullah, 2013):

$$EE\ (\%) = \frac{W3 - W1}{W2} \times 100$$

Where W1 – Weight of empty aluminum cups (g), W2- Weight of sample (g), W3- final weight.

Figure 3.3: Extract of dried *Moringa* leaves dried using rotary evaporator.

3.3 Selection of goats

Before the feeding trial started about 9 goats were selected from the farm located in FELDA Kemahang. The goats were selected followed some criteria as have constant milk flow, not affected by mastitis disease, not conceived and healthy. After the goats selected they were shift to separated stalls.

Figure 3.4: Goats fed with dried *Moringa oleifera* leaves

3.4 Feeding trial

Feeding trial were conducted using 3 treatments, which is control, 10% of *Moringa oleifera* and 15% of *Moringa oleifera* feed. The controlled goats followed the daily routine of the farm. A goat need 3 to 4 % of dry matter (DM) feed of its body weight per day. 3 goats were used for each treatment. The total goats used for this research is 9 goats. Before starting the feeding trial body weight, amount of milk yield and milk sample for somatic cell count was collected on the first day. The amount of dried *Moringa oleifera* leaves fed according to their body weight. The feed amount calculated using the formula below:

A goat need 3-4 % of dry matter of its body weight everyday

100 grams of sundried *Moringa oleifera* leaves contain 92.5 grams of dry matter

Example: Goat with 100 kilograms of body weight need 3 kilograms of dry matter feed

If the goat is 50 kilograms and it needed to be provided with 10% of sundried *Moringa* leaves:

A) The dry matter needed per day: 50kg/100kg x 3kg = 1.5kg

B) The amount of 10% in the daily needs of dry matter: 1.5kg x 10% x 10^3 = 150g

C) The amount of dried *Moringa* leaves that needed to be provided: 150g/92.5g x 100g =162g

Table 3.1: The amount of dried *Moringa* provided to goat according to their body weight

Goat	**Type of treatment**	**Weight of goat (kilogram)**	**Dry matter needed per day (kilogram)**	**Dry matter needed based on percentage (gram)**	**Amount of dried *Moringa* provided (gram)**
1	**Control**	42.4	-	-	-
2	**Control**	46.5	-	-	-
3	**Control**	48.8	-	-	-
4	**10%**	44.8	1.344	135	146
5	**10%**	47.6	1.428	143	155
6	**10%**	37.7	1.131	131	122
7	**15%**	48.6	1.458	219	237
8	**15%**	63.4	1.902	285	308
9	**15%**	54.5	1.635	245	265

3.5 Parameter

The parameter of the research is the body weight, amount of milk yield and the somatic cell count. While the milk yield were measured with measuring cylinder and recorded daily. Furthermore, body weight of goats was taken 1st day before the feeding trial, 14th day middle of the feeding trial and the last day 28th day. The weight was recorded using digital weighing scale.

Figure 3.5: Measuring body weight of goat using digital hanging scale

3.6 Data collection and analysis

Milk yield and body weight on the control and 2 treatments was subject to one ways ANOVA analysis under ($p<0.05$) of significance level.

CHAPTER 4

RESULT

4.1 Proximate analysis of *Moringa oleifera*

Before the feeding trial to Saanen the proximate analysis of *Moringa oleifera* was done to identify the amount of nutrient content in the feed. The feed analysis that was done for the dry matter, crude protein, crude fat and ash. Due to certain limitation the crude fibre analysis cannot be done in the researcher's university laboratory. But according to Nweze et al., (2014), Jongrungruangchok et al., (2010) and Offor et.al., (2014) that have done the fibre analysis and stated that the percentage of fibre content in *Moringa* leave is in the range of 9.31% to 23.89%. The table below shows the average value of the nutrients that was calculated after the analysis.

Table 4.1: Average value of chemical composition of dried *Moringa oleifera.*

Components	Value
Dry Matter, DM (%)	92.5
Ash (%/)	7.00
Crude Protein, CP (%)	20.78
Crude Fat, CF (%)	1.11

As can be seen from the table above, the dry matter percentage is the highest nutrient content of the dried *Moringa oleifera* leaves. The second highest nutrient in the dried *Moringa oleifera* leaves is the protein. The lowest is the ash content.

4.2 Effect of different treatment on body weight (kg/d) in period of 28 days.

The effect of feeding dried *Moringa* leaves to the body weight gain of Saanen goat were presented in Table 4.2 for period of 28 days. The body weight of the goat was taken before, in the middle and after the feeding trial, 1st, 14th and 28th day respectively. The values presented in the table were expressed as the mean ± SE. Based on the data yielded, the treatment 2 shows the highest final weight gain. However the weight of the control group shows the second highest value than the treatment 1.

Table 4.2: Average body weight gain of goats (mean±SE) expressed in (g) in period of 28 days.

Treatments	Control	Treatment 1	Treatment 2
Weight gain (g)	(0.017±0.005)	(-0.006±0.017)	(0.108±0.027)

*SE= Standard error, kg/d= kilogram per day, ^{abc} means in the same row with significant different superscripts significantly differ (*P<0.05*)

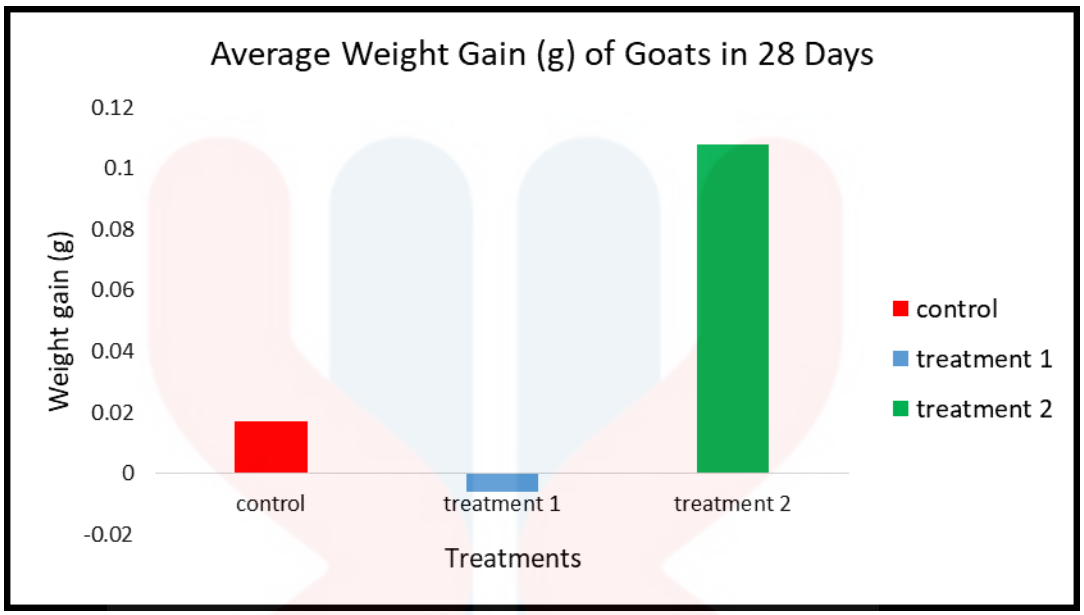

Figure 4.1: Average weight gain (g) goat

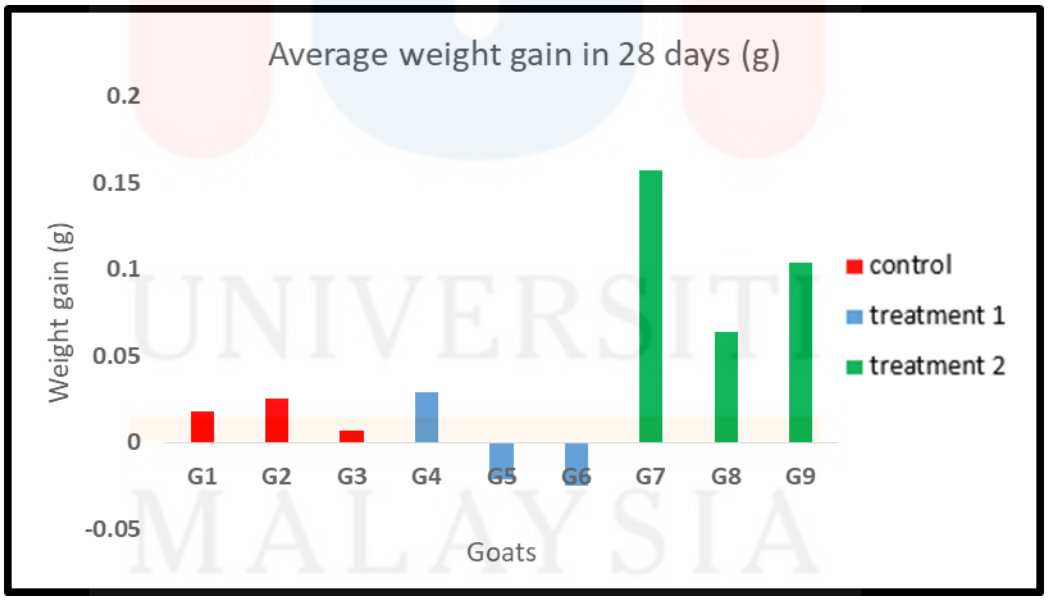

Figure 4.2: Average weight gain (g) in 28 days of each goat

The figure above shows the average weight gain for every goat. The weight gain for goat 7 is the highest among the others. This goat was fed under treatment 2. The lowest weight gain is the goat 3. While, the goat 6 shows the decrease in weight.

4.3 Effect of treatment on dairy milk yield of Saanen goat in period of 28 days.

The milk yield is collected every day and the data shows the mean and the standard error for every week. The milk yield of control group increases on the second week and fluctuate after that. Based on the data collected the milk yield, the treatment 2 shows the increasing trend of milk production.

Table 4.3: Average milk yield (mean±SE) expressed in (mL/w) in period of 28 days.

Period (week)	Control	Treatment 1	Treatment 2
1st	505.2±144.0	588.1±156.6	813.8±153.0
2nd	589.0±174.0	753.3±160.5	881.9±129.0
3rd	465.2±166.1	550.0±171.2	914.8±121.7
4th	459.0±171.4	601.0±177.2	952.4±124.3

mL/w = milliliter per week, SE= Standard error

*not significant difference (P>0.05)

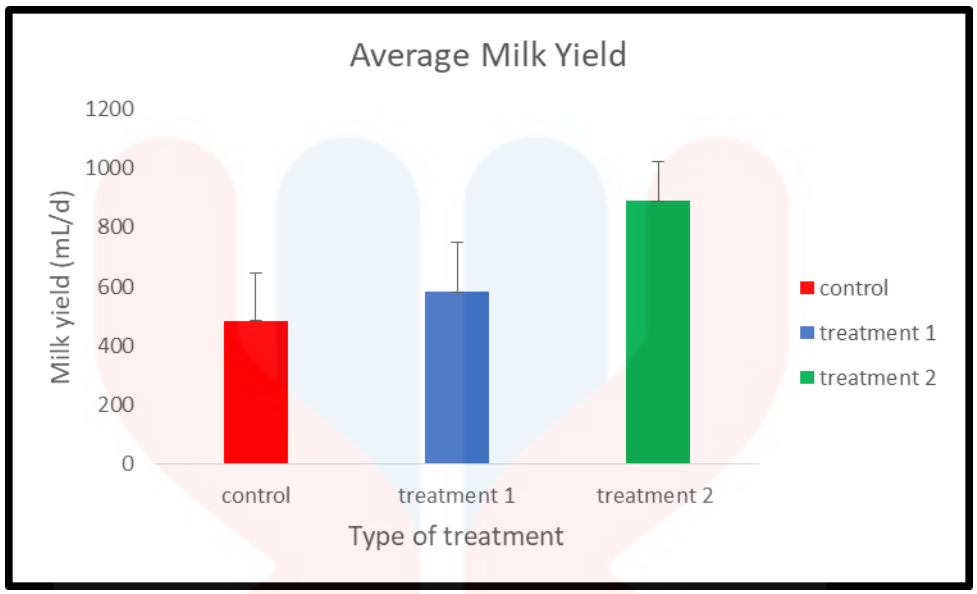

Figure 4.3: Effect of treatment on milk yield (mL/d)

The figure above shows that the treatment 2 shows the positive result for this research. While the control group shows the lowest average value for overall milk yield.

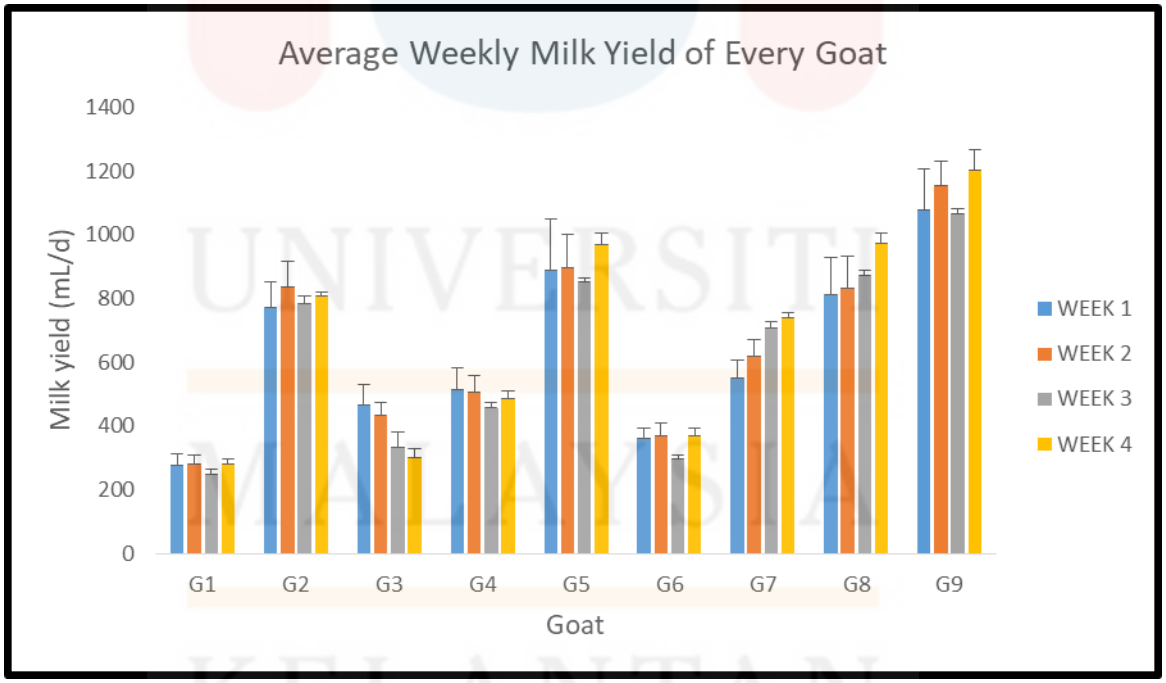

Figure 4.4: Average weekly milk yield of every goat

This figure shows the milk yield based on the goats. This figure can show which goat has the most effective result. Based on the figure, goat 7 and goat 8 shows the gradually increasing for the milk production. While for the goat 9 there is drop in the milk production on the 3rd week. Milk yield of Goat 3 from control group gradually decreasing.

CHAPTER 5

DISCUSSION

Moringa oleifera is a tropical plant that has great potential as a source of supplement for ruminants. *Moringa* is also contain high proteins and vitamins. Research also shows that the *Moringa oleifera* also able to boost the immune system (R.Minor, 2014). Dry matter is the dried portion of the feed ingredients or diet. Different feed vary in their dry matter content because of their moisture content. About 75 to 90 percent of dry matter contain in the pastures and liquid feeds. It is important in determining the dry matter content to compare the feed with the other feed based on nutrient. The dry matter of feed indicates the nutrient available to animals. Normally feed that contains high moisture is low in nutrient.

A dairy goat need 3 to 4 percent of dry matter of its body weight for gradual milk yield. Normally the Alfalfa hay contains about 90.2 percent of dry matter (Average Dry Matter Percentages for Various Livestock Feeds, 2014). While, in this research the dried *Moringa* leaves contain about 92.5 percent of dry matter. This indicates that the *Moringa oleifera* hay contain less moisture and nutritious. Similar studies for analysis of dry matter of *Moringa oleifera* leaves were done by (Nweze et al., (2014), Jongrungruangchok et al., (2010) and Offor et al., (2014) and dry matter content is

beteween the range of 85% to 92%. This shows that the dry matter yield in this research shows the similar content as the studies before.

Analysis of crude protein is the measurement for quality feed. Protein is a nitrogenous compound which is larger in molecular weight and composed of amino acids. They are playing important role in living organisms as enzymes, hormones, structural compound of cells, enhance immunity, blood clotting, oxygen and carbon dioxide transport and balancing osmotic pressure. Protein which is metabolizable or digestible mainly used for maintenance and repairing body tissue, milk or wool production and conceptus gain. The purpose of proteins are fed to the ruminants is to provide amino acid to complement the microbial protein and supply dietary protein for amino acid absorption in intestines.

A lactating doe need 11.6 % of protein every day to produce high milk. From the result, the dried *Moringa oleifera* leaves contain 20.78 % of protein. The protein content in this feed is high when compare to Alfalfa hay which is only 8.4 percent (Balliette & Torell, n.d). A study done by Shih et al., (2011) shows that the crude protein of *Moringa oleifera* is between the range of 24.42% to 25.29%. Another study reveal that crude protein content in this plant is 30.29 (Moyo B. et al., 2011). This shows that the crude protein yield from this research does not lied between the range of 24.0 % to 30.30 %. This is because of the genetic variation and the weather condition in different countries that lead to the changes in the nutrient content.

Ash content shows the mineral content in a feed. They are essential components of a diet and plays many vital role in animal body. Minerals do not yield energy or produce protein for ruminants, they help in nutrient absorption and metabolism. Their fuctions are to regulate cell replication and differentiation, play role in balancing acid base in electrolytes, body fluid volume regulation, act as coenzyme and aid in teeth and bone formation. A study revealed that the ash content in Moringa oleifera is between the range of 6.00% to 7.13 %. From the table 4.1, percentage of ash content in the Moringa is 7 %, indicates that the value lies between the range mentioned above.

The crude fat contain in this supplement is 1.11 %. Another study on the same research shows the crude fat content is between the range 2.30% to 2.50% (Sodamade, Bolaji, & Adeboye, 2013). This specify that the result is not compatible with the previous study. There are few reasons for the different value of the dry matter, crude protein, ash and crude fat content. Stage of maturity is the most important factor that influences the chemical composition of plants. This also determines the digestibility in ruminants. Moreover,early growth contains high protein and enhance the palatability. During this stage the fibre content is low that can provide high nutrition for ruminants. Lignin content increases as the plants grow older. This made them not much suitable to feed to livestock animals.

The physical and chemical properties of soil directly influences the mineral content in plants. This is why the ash content in this study is low compared with the previous studies. Physical properties of soil such as texture and porosity affect the nutritive quality of forages. Poor aerated soil limits the nutrient absorption by the forage.

Climate factors such as temperature, humidity, altitude and light intensity affects the nutrient content in plants. These factors affect the assimilation, metabolism, photosynthesis and respiration in plants. According to Oelberg (1956) rainfall increases the nitrogen, phosphorus and ether extract. High temperature trigger the transformation of starch to sugars which then used for plant metabolism. Plant in high altitude and low temperature have high nitrogen content (Laramie & Wyoming, 1906).

In the result, the body weight of the Saanen goat under treatments 2 does shows significance difference. The goats feed with 15% *Moringa* leaves showed highest weight gain compared to treatment 1 and control. For control and treatment 1 the body weight didn't showed significance difference. Treatment 1 shows negative value since there are 2 goats which loss weight during this treatment.

The increasing growth performance showed in treatment 2 is due to the better utilization of *Moringa oleifera* protein with better rumen digestibility (E.Babiker, Juhaimi, Ghafoor, & Adoun, 2016). This shows that the treatment 2 which the goats fed with 15 percent of dried *Moringa* leaves is more effective than the treatment 1. Milk production can be maximized with various approaches including manipulation of rumen fermentation (Morsy, Kholif, Kholif, Kholif, & Sun, 2016). Providing supplement which is similar to *Moringa oleifera* leaves is one of the method to manipulate the rumen fermentation. Protein when digested they will broke down into peptides which is also known as the short chain of amino acid. Further digestion forms ammonia. The protein from feed or from the microbes washed from rumen. The amount of protein absorbed is depend on the dietary protein that can be degraded in rumen and on the growth and outflow of the

microbes from the rumen. Rumen microbes are the major source of protein in goat's diet. This microbe breakdown the rumen degradable protein in feed to form amino acids, then ammonia. A study shows that the in vitro rumen crude protein degradability at 24 hours of incubation is higher for *Moringa* leaves (Kakengi, Shem, Sarwatt, & Fujihara, 2003). This shows that there is rumen degradability for protein in the *Moringa* leaves that increase the daily weight gain.

Some studies also reported that *Moringa* is rich in protein and amino acid composition which is suitable to promote growth in animals (Makkar & Beckar, 1996), (Guptaa, G.K.Barat, D.S.Wagle, & H.K.L.Chawlaa, 1989). Previous study done by Makkar and Beckar, (1996) also shows that both unextracted and extracted *Moringa* leaves contain high crude protein which is about 0.95 of total crude protein that is available for ruminants. However they also found that ruminal degradability of *Moringa* leaves is high. This indicates that there are high potential of using *Moringa oleifera* leaves as supplement for dairy cows or goats which are reared through integrated farming system. Aregheore (2002) also reported that 200g/kg dry matter of low quality grass with Moringa leaves supplement can increase the daily gain of goats by 50 %. From the figure 4.1, goat 7 shows the highest average daily weight gain. This indicates that this goat have better rumen bypass characteristic towards dried *Moringa* leaves.

In the result, the body weight gain of goats in treatment 1 shows the negative value which indicates that there is loss in weight. Health history can be a reason for this situation. Since the goats are randomly selected there is high chances of having disease or digestibility problems. If the goats are unable to digest the dried *Moringa* leaves, the

nutrients cannot be used up and will drained in their wastes. Parasitic infection also can be a reason for decrease in weight in the next half month of goat in treatment 1 and the 10% of dried *Moringa* leaves given was become ineffective to the Saanen goat. High yield animals are most energetic and the ingested energy will drain to the mammary gland for milk production (de Oliveira, et al., 2014). When the milk yield increases than the dry matter intake, the demand for energy will be higher than the amount of energy consumed. This lead to loss of energy and weight. This also could be a reason for decrease in mean body weight of goats in treatment 1.

While for the average milk yield for the control increases and decreases constantly. Another point, treatment 1 increases in the second week but decreases after third week. For treatment 2 the milk yield rises from second week to fourth week. The milk yield for control, treatment 1 and treatment 2 was not significance ($p>0.05$). When compare both treatment 1 and 2, the final mean milk yield for treatment 2 is higher than the treatment 1. This shows that the treatment 2 is much more effective compare to treatment 1. The Goats in treatment 2 get more nutrients than the goats in treatment 1. Since *Moringa oleifera* is a good source of protein supplement in ruminant nutrition, when it supplemented to goats in treatment 2 in large amount the milk yield increases. The amino acid content in the plant can cover the protein needs and boost the immune system. Greater digestibility for dried *Moringa* leaves implies increased availability of nutrient for milk production.

Based on the figure 4.3 in result, there is decrease in milk yield in 3rd week for almost every goat. This is because of the hot weather that gave thermal stress to the

goats. This lead to drop in milk production in 3rd week. Heat stress or thermal stress often limits the livestock animal performance (Sharma, et al., 1983). Another study done by Thatcher (1974) reported that high environment temperature causes drop in milk production and fat content in milk. This is because the rising of body temperature impacts the secretory function of udder (Silanikove, et al., 1998). R.E.McDowel, et al. (1976) reported that changing Holstein cows from place which temperature is 18°C to place where 30°C, the milk production reduced to 35%. Another study done by W.Bianca (1965) reported that the milk yield reduced for 33% when the cows from temperate country exposed to ambient temperature of 35°C. The average milk yield for goat 6 is low even though it is supplemented with 10 percent of dried *Moringa oleifera*.

The goat 6 is small in size and it was in the late lactation period. The udder size also plays an important role in the milk production. The udder traits were influenced by the age, lactation status and live weight. The weight of the goat 6 is 37.7 kg, which is the lowest among the goats. Therefore, the small size of the udder produces low milk production. A study by Gowen and Tobey, (1927) shows that there is relationship between udder traits and milk secretion. The udder traits are refer to udder depth, udder attachment, teat size, teat placement and udder shape. From their research they also revealed that the milk yield and mammary gland size appear to be linear. Milk increases in the early lactation period as for goat 3 which gave birth before the feeding trial started. Then the milk yield decreases gradually until week 4.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

CONCLUSION

The feeding trial of dried *Moringa oleifera* leaves is mainly to determine the potential of *Moringa* on the body weight gain and the milk yield. For body weight gain, significance difference can be seen between control, treatment 1 and treatment 2. But in the milk production there is no significance difference be seen in control, treatment 1 and treatment 2.

RECOMMENDATION

There are few recommendation that can be useful for the future studies that can be conducted. Some parameters can be added to this type of feeding trial, they are body condition score, milk composition, dry matter intake, rumen digestibility and mastitis control. Body score condition is used to evaluate the nutritional status of livestock animals. This is an indication of energy score in an animal. This management tool for goats use range from 1.0 to 5.0 with 0.5 increments. Healthy goats normally scores about 2.5 to 4.0. A study by A.V.Stella, et al (2007) reported that administration of live

Saccharomyces cerevisiae to lactating dairy goats improves the body condition score. This shows that there are previous studies done to prove that the body condition score can be taken as a parameter for feeding trial.

Next, the milk composition varies with breeds and the nutrient intake by the animal itself. There are several studies done by Sanchez et al., (2005) and Sarwatt et al.,(2004) that shows the milk composition is improved when Moringa oleifera is added to formulated feed as supplement. For future studies, the milk composition can be checked by producing new ratio by adding Moringa leaves, replacing the main feed with Moringa or by adding enzymes or additives to increse the palatability. Due to certain limitation dry matter intake cannot be done during this research.

For future studies can proceed with identifying the dry matter intake by lactating goats. This is important to know the correlation between the daily dry matter intake and the milk yield by goats. Since Moringa oleifera contain anti-inflammatory and anti-bacterial properties (Saini, Sivanesan, & Keum, 2016). It can be used in controlling high level of somatic cell count which can lead to disease. Somatic cell count of goat varies due to many factors. Future studies can be done by topical administration on udder and oral application of Moringa leave extract and examine somatic cell count of milk. More animals need to be used for the feeding trial. The animal choosen must have good health history and high yield of mik. This will give more accurate result on milk production and body weight gain. Then the feeding trial must be lenghten to see the longterm reaction on the body weight and milk production of dairy goats. Due to the time limitation the feeding only can be done for 28 days.

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APPENDIX

Table A.1: ANOVA for body weight gain for control, treatment 1 and treatment 2 in period of 28 days.

ANOVA

Body weight gain

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.022	2	.011	10.381	.011
Within Groups	.006	6	.001		
Total	.028	8			

Table A.2: Duncan test for average weight gain

Weight Gain

Duncan[a]

		Subset for alpha = 0.05	
treatment	N	1	2
treatment 1	3	-.0057	
control	3	.0167	
treatment 2	3		.1083
Sig.		.432	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.3: ANOVA for milk yield for control, treatment1 and treatment 2 in period of 28 days.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
milk_yield_wk 1	Between Groups	153028.571	2	76514.286	1.115	.388
	Within Groups	411906.122	6	68651.020		
	Total	564934.694	8			
milk_yield_wk 2	Between Groups	129285.714	2	64642.857	.890	.459
	Within Groups	435922.449	6	72653.742		
	Total	565208.164	8			
milk_yield_wk 3	Between Groups	342307.483	2	171153.742	2.387	.173
	Within Groups	430296.599	6	71716.100		
	Total	772604.082	8			
milk_yield_wk 4	Between Groups	387016.780	2	193508.390	2.538	.159
	Within Groups	457440.816	6	76240.136		
	Total	844457.596	8			

Table A.4: Duncan test for milk yield for week 1

Milk Yield Week 1

Duncan[a]

treatment	N	Subset for alpha = 0.05
		1
control	3	505.2381
treatment 1	3	588.0952
treatment 2	3	813.8095
Sig.		.213

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.5: Duncan test for milk yield for week 2

Milk Yield Week 2

Duncan[a]

treatment	N	Subset for alpha = 0.05
		1
treatment 1	3	589.0476
control	3	753.3333
treatment 2	3	881.9048
Sig.		.245

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.6: Duncan test for milk yield for week 3

Milk Yield Week 3

Duncan[a]

treatment	N	Subset for alpha = 0.05
		1
control	3	465.2381
treatment 1	3	550.0000
treatment 2	3	914.7619
Sig.		.094

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.7: Duncan test for milk yield for week 4

Milk Yield Week 4

Duncan[a]

treatment	N	Subset for alpha = 0.05
		1
control	3	459.0476
treatment 1	3	600.9524
treatment 2	3	952.3810
Sig.		.079

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.