Effect of *Moringa oleifera* Based Total Mixed Ration on Parasite Infestation in Meat Goats

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A thesis submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Animal Husbandry) 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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Student

Name:

Date:

I certify that the report of this final year project entitled "Effect of *Moringa Oleifera* Based Total Mixed Ration on Parasite Infestation in Meat Goats" by Muhammad Adib Bin Othman, matric number F15A0085 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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LIST OF ABBREVIATION AND SYMBOL

mTMR	Moringa Based Total Mixed Ration
EPG	Egg Per Gram
FEC	Fecal Egg Count
TMR	Total Mixed Ration
MP	Metabolisable Protein
DM	Dry Matter
CP	Crude Protein
VCO	Virgin Coconut Oil
BCS	Body Condition Scored
ME	Metabolic Energy
TDN	Total Digestible Nutrient
Ca	Calcium
P	Phosphorus
DMI	Dry Matter Intake
SD	Standard Deviation

ABSTRACT

Effect of *Moringa Oleifera* Based Total Mixed Ration on Parasite Infestation in Meat Goats

Feed cost for meat goats in Malaysia is very high due to the imported concentrates. Hence, the farmers feed their animals with forage solely such as Napier grass. Napier grass has low nutritional value, thus the growth of the animal and production are not good due to the inappropriate and low nutrition feed. Legumes is a very good source of dietary protein for animals. Nutritionally, legumes also tend to have higher levels of energy per unit weight and more calcium than grasses. Therefore, the purpose of this study was to evaluate the effect of *Moringa Oleifera* based total mixed ration (mTMR) on parasite infestation in meat goats and to compare the effectiveness of mTMR with basal diet. A total of six animals were used and divided into two groups, three for control and three for treatment, they were grouped based on the average weight which is 30kg. Two different groups of treatments (control and mTMR) were used. Fecal egg count was done to evaluate the egg per gram (EPG) of nematode eggs in gastrointestinal tract of the goats. The mMTR is more effective, efficient and profitable to feed the animals. From this research the result showed that the mean EPG of the parasite infestation between control group and mTMR group had no significant difference. However, the *Moringa Oleifera* based total mixed ration was a good diet for better health condition and reduce the EPG in the gastrointestinal tract of the goats.

Keywords: *Moringa Oleifera*, total mixed ration, meat goat, parasite infestation

ABSTRAK

Kesan Jumlah Catuan Campuran Berasaskan *Moringa Oleifera* Pada Infestasi Parasit Dalam Kambing Daging

Kos makanan untuk kambing daging di Malaysia sangat tinggi disebabkan oleh nakanan yang diimport. Oleh itu, petani memberi makan haiwan mereka dengan makanan seperti rumput Napier. Rumput Napier mempunyai nilai pemakanan yang rendah, oleh itu pertumbuhan haiwan dan pengeluaran kurang baik kerana pemakanan yang tidak sesuai dan rendah nilai pemakanan. Kekacang adalah sumber makanan protein yang sangat baik untuk haiwan. Secara nutrisi, kekacang juga cenderung mempunyai tahap tenaga yang lebih tinggi per unit berat dan lebih banyak kalsium daripada rumput. Oleh itu, tujuan kajian ini adalah untuk menilai kesan rawak jumlah catuan campuran berasaskan *Moringa Oleifera* (mTMR) terhadap serangan parasit dalam kambing daging dan untuk membandingkan keberkesanan mTMR dengan diet basal. Sejumlah enam ekor haiwan telah digunakan dan dibahagikan kepada dua kumpulan, tiga untuk kawalan dan tiga untuk rawatan, mereka dikumpulkan berdasarkan berat purata iaitu 30kg. Dua kumpulan rawatan (kawalan dan mTMR) yang berlainan digunakan. Penghitungan telur fesal dilakukan untuk menilai telur per gram (EPG) telur nematod dalam saluran gastrointestinal kambing. mMTR lebih berkesan, cekap dan menguntungkan untuk dijadikan makan haiwan. Daripada kajian ini, hasil menunjukkan EPG parasit infestasi antara kumpulan kawalan dan kumpulan mTMR tidak mempunyai perbezaan yang signifikan. Walau bagaimanapun, mTMR adalah diet yang baik untuk keadaan kesihatan yang lebih baik dan mengurangkan EPG dalam saluran perkumuhan kambing.

Kata kunci: Moringa Oleifera, jumlah catuan campuran, kambing daging, serangan parasit

CHAPTER 1

INTRODUCTION

1.1 Research Background

The livestock industry in Peninsular Malaysia consists of ruminant and non-ruminant sectors. Non-ruminant sector including pig and poultry industries are quite established compared to the ruminant sector that lags behind. Ruminants sector is dominated by cattle for meat production which has recorded steady growth due to the participation of government land development agencies in cattle and sheep that are integrated with plantations, but continue to lag behind in meeting the local demand. In comparison, goat meat has been especially neglected (Devendra, 2007).

Although goat meat production has tripled from 666 tonnes in 1990 to 1958 tonnes in 2008, domestic adequacy level only at 10% in 2008, increased slightly from 8.8% in 1990. As a result, Malaysia is depending on imports to meet shortages in domestic production. In 2003, Malaysia imported 10,707 tons of goat meat worth RM89 million. By 2007, imports increased to 16,303 tonnes valued at RM160 million. There is a high probability that the import bill on goat meat will continue to rise as a result of increased population and increased prosperity (FAMA, n.d.).

Malaysia has produced goat meat for some time. There has been a dramatic increase in goat meat development in the country with a lot of meat goat imports from various countries since meat goat has an important specialty market. In Malaysia, the scientific information about farming goat meat is very limited (Jamaluddin, Idris., 2012).

It is important to reduce production costs, particularly for food and nutrients. Although green feed is a major component of animal feed, farmers still use concentrate (goat pellets) widely to feed their animals. The main ingredients are maize and soy beans, these raw materials need to be imported and the prices change with the global market. Therefore, alternative food sources should be identified and made available in Malaysia (Jamaluddin, Idris., 2012).

The total mixed ration (TMR) system can enhance the growth of goat meat to 7%, compared to a computerized concentrate feeding system, and the meat is also better in quality. The most important reason is that the food is balanced and perfectly mixed. Goats have a bad habit to be selective in what they eat. This can be a problem, especially in the summer when feed intake drops. The use of nutrient imbalance will affect the growth and health (An-Kuo Su, 2002).

1.2 Problem Statement

In Malaysia, concentrates are very expensive because it needs to be imported from abroad, it is too expensive for small scale farmers to buy imported animal feed because they buy in small quantities compared to big buyers who buy in bulk. Most farmers in Malaysia only feed their livestock with regular feed such as Napier grasses because it is cheaper. However, the available grasses are low nutritive value. Thus, daily nutrient requirements are incomplete and animal health is poor because of inappropriate and low nutrition feed.

Legumes are different from grasses and other plants because they form a symbiotic relationship with bacteria, rhizobia, in the nodules of their roots. These bacteria are capable of 'fixing' nitrogen in the atmosphere and air into ammonia and then ammonium, which the plant can then use to make protein. Legumes tend to be a very good source of dietary protein for animals. In contrast, grasses cannot obtain nitrogen as easily from the environment and, therefore, tend to be lower in protein. Nutritionally, legumes also tend to have higher levels of energy per unit weight and more calcium than grasses.

1.3 Objectives

- To evaluate the effect of *Moringa Oleifera* based total mixed ration (mTMR) on parasite infestation on the meat goat.
- To compare the effectiveness of mTMR with basal diet.

1.4 Hypothesis

H^o = The mTMR has no significant differenceon parasite infestation.

H^1 = The mTMR can increase the digestibility and improve the health status of goats by controlling the parasite infestation in goats.

1.5 Scope of study

This research had focused on the animal nutrition. The goats cannot had fed only with *Moringa Oleifera* because *Moringa Oleifera* had less fiber and can caused abdominal pain or stomach ached such as diarrhea. This is important to exposed farmers with alternative to make own good quality feed for ruminants.

The animal nutrition had a relationship with the animal health status. The status of goat health can be seen by observing the fecal egg count. The complete feed consumption will give the goats enough nutrient requirement in the goat's body. Hence, this will enable the absorption of the nutrient.

Moringa Oleifera leaves were used in the new formulation of a mTMR. *Moringa Oleifera* based total mixed ration were fed to the goats.

1.6 Significance of study

The *Moringa Oleifera* is one of the legumes tree in Malaysia. It is available across Malaysia, therefore *Moringa Oleifera* is suitable to be utilised as ruminant feed. *Moringa Oleifera* based total mixed ration should be prepared to give full nutrient needed by the goats and also to increase the digestibility of the feed. This knowledge will be translated into higher economic returns to the small holders.

Next, the farmers will learn new knowledge related to the animal nutrition and exposed to the farmers about using legumes tree in Malaysia. Then, small scale farmers can make their own good quality and with higher protein of feed with lower in cost. Hence, the farmers can cut the cost of buying concentrate to the animals.

CHAPTER 2

LITERATURE RIVIEW

2.1 Meat Goat Industry in Malaysia

In Malaysia, goat meat industry faces various obstacles and problems especially in nutrition and parasitic control (Kioumarsi, Yahaya, Rahman, & Chandrawathani, 2011). Some of the problems that related to the nutrition are the high cost of raw material for feed. The availability of raw materials and the lack of technology that can improve the efficiency of raw materials

Developing countries such as Malaysia, Thailand and Indonesia have barriers to increase the agricultural and ruminant sectors. Food shortages and inconsistent quality in developing countries are a major restraint towards the development of the ruminant sector (Khaing, Loh, Ghizan, Halim, & Samsudin., 2015)

Urbanisation associated with increased wealth and higher purchasing power that leads to greater demand for processed meat, meat, dairy and fish while demand for grain and other retail crops will decrease (Godfray et al., 2010). This is attributed to the country's level of efficiency as well as food security (Suntharalingam, 2014).

Therefore, the initiatives should be undertaken to increase the level of self-sufficiency within the country and also to manipulate the mass production of legumes such as *Moringa oleifera*. Large-scale production of legumes such as *Moringa Oleifera* will act as another option to improve the quality of feedstuffs for livestock and to reduce the cost and importation of feedstuffs. This will lead to improved animal health, meat and carcass quality and also increase food safety and self-esteem levels.

Global human population will increase by 2050 (Tilman, Balzer, Hill, & Befort, 2011). The human population will increase by about 50% more than the year 2000 with a 2.4 higher rise in each capital income. hence, the standard of living will increase as well as the consumption of food. Higher requirements and food consumption will increase the value of food. therefore, this will make the people and developers to speed up the life cycle of species of plants and animals to meet the needs and requirements

In Southeast Asia (Malaysia, Vietnam, Laos, Cambodia, Thailand and Myanmar), there are simple statistics of existing livestock populations. Therefore, high-yielding livestock will be selected to produce the best features for raising livestock population. Thus, it will improve livestock management and improve livestock disease control programs.

Total Mixed Ration (TMR) with higher nutrient density will also be built to provide the best food ration to ensure good management of livestock. The use of legumes such as *Moringa Oleifera* will be enhanced and this will not only give the best feed to the livestock but also to fully utilize the existing legumes in the environment of this country.

2.2 Nutritional Requirement of Meat Goat

Goats are ruminant animals, meaning they have a stomach with four compartments: the rumen, reticulum, omasum, and abomasum. Bacteria and other microorganisms in the rumen and reticulum have cellulase enzymes that break down cellulose into simple carbohydrates, which are used by goats as a source of energy. The microbes also produce volatile fatty acids, which are absorbed in the rumen and used to make glucose, essential sugars, and fatty acids in the liver (Fernandez & Ahrens, 2016).

Goats tend to eat 2.5 to 3 percent of their body weight in dry matter (DM) per day. Therefore, a 100-pound doe will eat about 2.5 to 3 pounds of DM every day, and a 150-pound doe will eat about 3 to 4.5 pounds of DM every day (Fernandez & Ahrens, 2016).

Goats need a proper balance of energy in the form of roughage or grain, as well as protein, vitamins, minerals, and clean water. Calcium and phosphorus of goats needs are met. Calcium ratio to phosphorus at least 2:1 (Fernandez & Ahrens, 2016). Protein and energy requirements vary, depending on the type of goat and its stage of the production cycle. Meat goats need both high-quality forage and supplemental grain to reach their full potential, meat and carcass quality and improving the health (Laura Kieser, 2010).

Goats can be picky eaters, and they may not immediately accept new feeds. Any feed changes should be made gradually to avoid upsetting the rumen microbes. Feeding very high levels of grain can also upset the rumen. Grain should never be more than 50% of the total diet, except for heavily-producing dairy goats (Laura Kieser, 2010).

The requirement of metabolisable protein (MP) for small ruminants (2.65 and 2.2 g / kg LW 0.75 for sheep and goats) proposed by INRA (1980) and the value of 2.19 provided by the Research and Food Research Council (AFRC, 1998) for much lower goats (Salah, Sauvant, & Archimède, 2014).

Poor nutrition will not only slow the rate of gain of growing kids, decrease milk production, and make pregnancy and twinning less likely, but can also cause metabolic disorders that threaten the lives of goats. Common potential nutrition-related problems in goats are Acidosis, Enterotoxemia, Boat, Grass Tetany and Ketosis (Fernandez & Ahrens, 2016).

2.3 Total Mixed Ration

The guiding principle for the grazing system is to maximise the grass in the diet and use additional food to balance the supply of livestock feed with livestock demand. However, on a practical level concerns are usually brought to feed the results, such as increasing milk yield per cow, pasture nutrient balance the composition, or improve health status. This is often translated into more complex dietary practices involving greater mechanization and consumption of imported foods. Total mixed Ration (TMR) is one such system, which handles the idea of offering a consistent diet, with all the ingredients are physically mixed together, would improve animal performance. TMR feed consumption has been adopted in many dairy farms of Ireland (Patton, Butler, Murphy, & Mulligan, 2010).

TMR is a method of feeding goats that combines all forages, grains, protein feeds, minerals, vitamins and feed additives formulated to a specified nutrient concentration into a single feed mix.

Feeding a TMR helps animals to improve health and maximum performance. Since its inception in the 1950s, it is now the most used method for feeding high producing, indoor-housed dairy animals in the world. This is accomplished by feeding a nutritionally balanced feeds over time, enabling animals to consume as close to their actual energy requirements as possible and maintaining the physical or roughage characteristics, which we now refer to as feed particle size, required for proper rumen function.

Animal that feed with TMR have slightly higher production of milk compared to animal that feed with pasture. TMR animal had significantly higher fat percentage and solids-not-fat percentage compared with the pasture group (White et al., 2001).

2.4 Parasite Infestation in Goats

The immune system in the goat is not so strong as sheep especially in the fight against gastrointestinal diseases (Hoste, Torres-Acosta, & Aguilar-Caballero, 2007). There are many types of parasites such as parasites that live in the organ (internal) or on the skin (external). Internal parasites can cause poor goat's health. There are specific parasites that can live in the internal organs such as lung worms (*Meulleriuscapillaris* or *Dictycaulus* sp), stomach worm (*Haemonchuscontortus*), liver flukes (*Fasciola hepatica*) and intestinal parasites (*Eimeria*) (Villarroel, 2013). The environment is very important to be maintained to inhibit the reproduction and the growth of parasites. Poor management of the farm can lead to increasing the number of various parasites. When goats are infected by the parasite, there are many signs indicating that the goats are suffering because of the parasite, the signs are diarrhea, weight loss, depression, loss of appetite and etc. A research reported that there are some standard methods that can be used for examining the parasitic eggs found in goats by using a microscope (Villarroel, 2013).

The parasites found in feed or grass have the ability to live in the goats and it can also grow and reproduce the eggs in goats' internal organs after food is eaten by goats. However, the parasite can be examine using pretreatment of the feces. There are two types of test strategies that can investigate the goat's feces through a microscope, which are individual test and group test (Villarroel, 2013). Group tests are not specific compared to individual tests, where feces of a group of goats were collected and placed together in a zip lock bag. However, individual tests are very specific and rigid, the feces must be collected from each goat and placed in the zip lock bag with tagging, and the feces can be examined one by one according to each tag of the goat.

The severity of infection is assessed by the description as mild infection (EPG <500), moderate infections (EPG = 500-1500), and severe infections (EPG> 1500). In addition, the feces samples containing nematode eggs are collected for each visit. Identification of gastrointestinal nematode genera was made based on morphological larval stage 3 obtained from a coproculture of infected pooled feces samples (Seyoum, Getnet, Chanie, Derso, & Fentahun, 2018).

Parasitism claims to be one of the main obstacles in livestock rearing in Bangladesh (Jabbar and Green, 1983). The hot humid climatic condition in Bangladesh greatly favors the development and survival of helminth parasite and ectoparasites that makes parasitic infestation rampant. Parasitic diseases are of great economic importance in livestock (Islam, 1985). Asian Development Bank (1984) estimated the loss of productivity of animals in terms of mortality, loss of milk and meat, generation loss and loss of reproductive rate due to animal parasites to the extent of 50% in Bangladesh.

The study of the epidemiology and other aspects of parasites in goats were carried widely in different parts of the world (Gupta 1987; Travassoss et al., 1974; Waller and Thomas, 1975). On the contrary relatively less attention is given to this important area in Bangladesh. Despite this, different studies have been conducted in various parts of Bangladesh, but the attempts taken to study the parasite prevalence in the Rangpur district are very limited (Qadir, 1981; Haq and Shaikh, 1968).

2.5 Moringa Oleifera

Moringa oleifera is a multipurpose tropical tree. It is used primarily for food and has many industrial uses, medicine and agriculture, including animal nutrition. The plants are nutritious, fast growing and drought tolerant, this traditional plant was rediscovered in the 1990s and it cultivation has become increasingly popular in Asia and Africa, where it is among the most valuable crops economically. It has been dubbed the "miracle tree" or "tree of life" by media (FAO, 2014).

The *Moringa* leaves have a high protein that is balanced with amino acids, so the leaves are largely used as a source of protein. However, the tree is known for its high ruminal degradation of protein and organic matter. In addition, when compared with other shrubs such as *Leucaena* leaves, *Moringa* leaves containing approximately 200g / kg DM crude protein (CP), therefore it cannot be considered as a source of high protein supplements. Although the content of CP, every part of the plant *Moringa* contains several bioactive components and found to have certain nutritional characteristics. Moringa has a mode of action that is more nutritional, thereby increasing the ruminal degradation, digestion, health and animal production performance (Soltan, Morsy, Hashem, & Sallam, 2017).

The nutritional features of *Moringa Oleiferafe* are excellent. Therefore, it is used as livestock feed on a large scale in various countries in Africa and Nicaragua. It has a high productivity of fresh matter compared to other meadows, such as alfalfa, and high value is achieved with a planting density of one million plants per hectare. The leaves and pressed seed cake can be used in feed for animal feed (García López, Gutiérrez, & Gutiérrez, 2017).

2.6 Coconut meat waste

Virgin Coconut Oil (VCO) is known as coconut oil, has many benefits for human health and the demand is increasing in recent years. This promotes increased production of VCO. Production of VCO, produces by-products, which is the coconut meat waste. The remaining coconut meat contains high percentages of crude fiber (36.13%). According crude fiber content, the remaining coconut meat, a by-product of the manufacture of the VCO can be used as an alternative source of dietary fiber (Muhlisin, Noviandi, Mada, & Yusiati, 2016).

Replacing king grass with the coconut meat waste does not affect blood cholesterol, cholesterol content of the meat, and the chemical composition of meat. In addition, there is no difference in the composition of meat between different types of muscles (biceps, femoris and longissimus dorsi). Overall, the replacement of the king grass with the coconut meat waste did not give any negative impact on the chemical composition of meat (Muhlisin et al., 2016).

CHAPTER 3

METHODOLOGY

3.1 Feed Preparation

Moringa Oleifera based Total Mixed Ration was developed based on goat body weight requirement. The software used in formulation of this mTMR was Feed Formulation Software Dssmardi (MARDI, Malaysia). The characterization and formulation of mTMR was done by another colleage. The mTMR was made of 30% *Moringa Oleifera*, 30% napier grass, 20% coconut meat waste and 20% commercial pellets based on dry matter basis. The formulation was calculated manually based on goat nutrient requirement. The goat nutrient requirement is stated in Table 3.1.

Table 3.1: Goat nutrient requirement.

Category	Body Weight	Production System	Total ME (MJ/day)	Total TDN (g/day)	Total CP (g/day)	Total Ca (g/day)	Total P (g/day)	DMI (Kg)	DMI (%BW)
Meat Goat	30.00	Intensive	8.16	540.25	101.12	3.31	2.39	0.83	2.77

Source: National Research Council

3.2 Animal and Experimental Condition

A total of six meat goats were used for 30 days' animal feeding trial at Agro Techno Park, Universiti Malaysia Kelantan (UMK) Jeli Campus. The goats were assigned with two dietary treatments. All six animals were divided into two groups, three for control and three for treatment, based on average weight which was 30kg. The goats were housed individually in pens.

3.3 Experimental Diet

The goats were divided into two groups: (1) control group using normal diet following the farm practice. The normal diet consists of Napier grass and commercial pellet. The (2) experimental group with formulated mTMR diets using Dss MARDI feed formulation system. The experimental group were given mTMR, but the control group were given with normal farm diet.

3.4 Fecal Egg Count

The fecal egg count was examined using Mac Master test. First, the faeces of all goats were collected once a week from the rectums by using gloves. These test were very specific and rigid that faeces that collected for each goat in order to examine the faeces for every goat. About 10 pellets of fecal stook was collected and placed in ziplock bags. Since this fecal was collected from each goat, the ziplock bags was labelled with their tag number. Then, the sample were stored in the refrigerator at 4°C.

Then, the faeces weighed in a cup about 2 grams on the scale and putted in the cup that had been labelled. After that, the faeces were mixed with saturated salt solution to 28ml and stirred well. The mixture had been filtered using the tea strainer. Then, the chamber of Mac Master slide filled with the sample mixture using a dropper. Lastly, the Mac Master slide observed under microscope with 10 times magnification lens.These test were done once a week, including the week before the feeding trial (Katherine, 2014).

3.5 Data Analysis

The data was analysed using One-Way ANOVA Test followed by the Duncan multiple comparison test and analyzed with the IMB SPSS Statistics 25 software to calculate the data based on the effect of mTMR in the parasite infestation in meat goats. All the data had used were analyzed with triplicate and the significant difference ($P<0.05$).

CHAPTER 4

RESULT AND DISCUSSION

Parasite infestation of gastrointestinal tract nematodes in goats was evaluated based on fecal egg count of the fecal collected from each goat used in this research with two different treatments which were normal farm feed as control group and mTMR as treatment group. The fecal egg count was measured in eggs per gram (EPG).

Eggs per gram is a laboratory test that determines the number of eggs per gram of feces in goats suspected of having gastrointestinal tract nematodes. This research was done in 5 weeks including 1 week before treatment. The result of mean EPG between treatment shown in table 4.1.

Table 4.1: Mean EPG between control and mTMR (Mean±SD)

Days	Control	mTMR
0	216.67 ± 16.67	533.33 ± 433.33
7	311.11 ± 166.94	416.67 ± 389.80
14	341.11 ± 58.34	295.67 ± 222.70
21	350.89 ± 185.83	255.55 ± 154.86
28	330.33 ± 178.08	239.67 ± 142.51

According to the table 4.1, the goats of TMR treatment consists of high parasite before feeding trial, while the goats of the control treatment had low parasite before the feeding trial. The mean EPG in the control group fluctuates over the five-week period of the research. However, the mean EPG in the mTMR group dropped every week for five weeks of research was conducted.

Based on the result in table 4.1, there was no significant difference between the control and mTMR mean EPG. The significance of this study cannot be seen might be because of the research was only done within 5 weeks, it might not enough time to get the significance of his research. The difference between the treatment and control groups might be seen if the research was done for another month.

The severity of infection of all data from week 1 to week 5 was assessed by description as a mild infection (EPG < 500) except the week 1 for mTMR as moderate infection (EPG = 500–1500). Fecal egg count showed a strong negative correlation with the body condition scored (BCS). Goat that had the lowest mean EPG value had good BCS, while goat that had the highest mean EPG value had poor BCS (Seyoum et al., 2018).

EPG in all goats were mild, this may be happened because all the goats in good health condition, or it may also occur because of errors in these experiments while fecal taken from goats may be contaminated. Errors might also occur during transportation from farm to laboratory. The goat's stool may be contaminated or damaged while in its vicinity to be stored in the refrigerator in the laboratory, the goat's stool may not be stored in an optimum temperature refrigerator of 4 degrees centigrade.

The goat's feces can also be damaged before and during the FEC experiment is performed. The goat's feces may be exposed for too long before the experiment is done. Besides that, the saline solution used may also be sufficiently saturated and causing the fecal egg does not float properly.

The fecal eggs were calculated manually using McMaster slide on a microscope with 10x magnification, the fecal eggs were calculated manually using the McMaster slide on a microscope with a magnification of 10x, the fecal eggs may not be counted properly or overlooked and cause the data recorded to be incorrect.

CHAPTER 5

CONCLUSION

In conclusion, the mean EPG of the parasite infestation between control group and mTMR group had no significant different. From the result of FEC performed, most of the goats in this study were having a mild infection, this indicates that the health level of all the goats are in good condition. From the result, it was shown that *Moringa Oleifera* based total mixed ration was a good diet for better health condition and reduce the EPG in the gastrointestinal tract of the goats. The mTMR used is more balanced in term of nutritional value compared to the normal farming diet.

The housing system facilities at Agro Techno Park UMK Kampus Jeli must be suitable for feeding trial. Besides that, the facility also needs to have a goat chute for the feces can be collected easily. The feces sample that has been collected must be placed in an ice box to avoid contamination during transportation. The research and feeding trial should be extended to get better results. Lastly, this experiment need to be studied more thoroughly for better results and can help farmers in Malaysia make their own feed at lowest price and with good quality and good nutritional value.

REFERENCES

An-Kuo Su. (2002). Feeding of Total Mixed Rations to Dairy Goats.

Asian Development Bank (ADB) (1984). Asian development bank yearbook.

Devendra, C. (2007). Enhancing animal protein supplies in Malaysia: Opportunities and challenges. *Enhancing Animal Protein Supplies in Malaysia*, (Opportunities and challenges).

FAMA (Various Issues). (n.d.). (Various Issues) Warta Barangan. Kuala Lumpur: Author. *Various Issues*.

FAO. (2014). Traditional Crop of the Month.

Fernandez, D., & Ahrens, C. (2016). *MP427 Nutrition of Meat Goats*. Retrieved from https://www.uaex.edu/publications/pdf/MP427.pdf

García López, R., Gutiérrez, D., & Gutiérrez, O. (2017). Moringa oleífera (Lam.) in ruminant feeding systems in Latin America and the Caribbean region. *Mulberry, Moringa and Tithonia in Animal Feed, and Other Uses. Results in Latin America and the Caribbean*, (May).

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., … Toulmin, C. (2010). Food Security: The Challenge of Feeding 9 Billion People. *Science*, *327*(5967), 812–818. https://doi.org/10.1126/science.1185383.

Gupta RP, Yadev CL, Chaudhuri SS (1987). Epidemiology of gastrointestinal nematodes of sheep and goats in Haryana, India. Veterinary Parasitology 24: 117-127.

Haq S and Shaikh H (1968). A surveys of helminthes parasiting the gastrointestinal tracts of goats and sheep in East Pakistan. East Pakistan Journal. Veterinary Science. 2, 54-62.

Hoste, H., Torres-Acosta, J. F. J., & Aguilar-Caballero, A. J. (2007). Nutrition–parasite interactions in goats: is immunoregulation involved in the control of gastrointestinal nematodes? *Parasite Immunology*, *0*(0), 071124120643002–??? https://doi.org/10.1111/j.1365-3024.2007.00987.x

Islam, KS (1985). Present situation of livestock and poultry diseases in Bangladesh. In: Jabbar MA (ed) Bangladesh poshusampad unnayun-Neeti O Kowshal BARC, Dhaka and ADC NY: 84-128.

Jamaluddin, A.A., K. Idris., R. R. (2012). E-PROCEEDINGS FIRST ASIA DAIRY GOAT CONFERENCE. In *Challenges Facing Dairy Goat Farmers in Malaysia* (pp. 11–13).

Katherine Petersson. (2014). *Improving Small Ruminant Parasite Control in New England USDA Sustainable Agriculture Research and Education Program (LNE10-300) How To Do The Modified McMaster Fecal Egg Counting Procedure.* Retrieved from www.vetslides.com

Khaing, K. T., Loh, T. C., Ghizan, S., Halim, R. A., & A., S. (2015). Feed intake, growth performance and digestibility in goats fed whole corn plant silage and Napier grass. Retrieved from https://www.ingentaconnect.com/content/doaj/13943227/2015/00000018/00000001/art00009

Kioumarsi, H., Yahaya, Z. S., Rahman, W. A., & Chandrawathani, P. (2011). *Asian journal of animal & veterinary advances. Asian Journal of Animal and Veterinary Advances* (Vol. 6). Academic Journals, Inc. Retrieved from https://www.cabdirect.org/cabdirect/abstract/20113325785

Laura Kieser. (2010). Feeding Dairy Goats : Dairy Extension : University of Minnesota Extension. Retrieved June 6, 2018, from https://www.extension.umn.edu/agriculture/dairy/feed-and-nutrition/feeding-dairy-goats/

Muhlisin, M., Noviandi, C. T., Mada, U. G., & Yusiati, L. M. (2016). The effects of coconut meat waste as feed alternative in sheep ration on cholesterol content and meat quality. *The Animal*, (August).

Patton, J., Butler, M., Murphy, J, J., & Mulligan, F, J. (2010). *Animal & Grassland Research and Innovation*. Retrieved from http://www.teagasc.ie/publications/

Qadir ANMA (1981). An observation on the seasonal influence of gastrointestinal nematodes infestation in goats under farm condition in Bangladesh. Bangladesh Veteterinary Journal. 15 (3-4), 11-15.

Salah, N., Sauvant, D., & Archimède, H. (2014). Nutritional requirements of sheep, goats and cattle in warm climates: A meta-analysis. *Animal*, *8*(9), 1439–1447. https://doi.org/10.1017/S1751731114001153

Seyoum, Z., Getnet, K., Chanie, M., Derso, S., & Fentahun, S. (2018). Morbidity Parameters Associated with Gastrointestinal Tract Nematodes in Sheep in Dabat District, Northwest Ethiopia. *BioMed Research International*. https://doi.org/10.1155/2018/9247439

Soltan, A, Y., Morsy, A, S., Hashem, M, N., & Sallam, S, M. (2017). Utilization of Moringa oleifera in ruminant nutrition (Review article), (November), 2016–2018.

Suntharalingam, C. (2014). Economics, politics and ecology of biotechnology in Malaysian agriculture. Retrieved from https://mountainscholar.org/handle/10217/83820

Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture, *108*(50), 20260–20264. https://doi.org/10.1073/pnas.1116437108

Travassoss TE, Pereire IHO, Leite ACR, Traverses HP 1974: The epizootiology of helminthiasis of goats in the bush of Pernambuca. In Congress Brasilerio de Anais, Brazil.153. Bibliografia Brasilerio de Medicinia Veterinaria Zooleenia. 1:92. CAB Abstract 72-75.

Villarroel, A. (2013). Internal Parasites in Sheep and Goats, 1–4.

Waller PJ and Thomas RJ (1975). Field studies on inhibition of Haemonchus contortus in sheep. Parasitology.71: 285-291.

White, S. L., Bertrand, J. A., Wade, M. R., Washburn, S. P., Green, J. T., & Jenkins, T. C. (2001). Comparison of Fatty Acid Content of Milk from Jersey and Holstein Cows Consuming Pasture or a Total Mixed Ration. *Journal of Dairy Science*, *84*(10), 2295–2301. https://doi.org/10.3168/jds.S0022-0302(01)74676-0

APPENDIX

Between-Subjects Factors

		Value Label	N
Treatment	1.00	control d 0	3
	2.00	control d 7	3
	3.00	control d 14	3
	4.00	control d 21	3
	5.00	control d 28	3
	6.00	mtmr d 0	3
	7.00	mtmr d 7	3
	8.00	mtmr d 14	3
	9.00	mtmr d 21	3
	10.00	mtmr d 28	3

Descriptive Statistics

Dependent Variable: EPG

Treatment	Mean	Std. Deviation	N
control d 0	216.6667	16.66500	3
control d 7	311.1100	166.94249	3
control d 14	341.1100	58.34292	3
control d 21	350.8867	185.83487	3
control d 28	330.3333	178.07957	3
mtmr d 0	533.3333	433.33038	3
mtmr d 7	416.6667	389.80344	3
mtmr d 14	295.6667	222.69785	3
mtmr d 21	255.5533	154.86003	3
mtmr d 28	239.6667	142.51433	3
Total	329.0993	211.34074	30

Tests of Between-Subjects Effects

Dependent Variable: EPG

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	232469.134[a]	9	25829.904	.486	.867
Intercept	3249191.136	1	3249191.136	61.143	.000
Treatment	232469.134	9	25829.904	.486	.867
Error	1062813.175	20	53140.659		
Total	4544473.445	30			
Corrected Total	1295282.309	29			

a. R Squared = .179 (Adjusted R Squared = -.190)

EPG

Duncan[a,b]

Treatment	N	Subset 1
control d 0	3	216.6667
mtmr d 28	3	239.6667
mtmr d 21	3	255.5533
mtmr d 14	3	295.6667
control d 7	3	311.1100
control d 28	3	330.3333
control d 14	3	341.1100
control d 21	3	350.8867
mtmr d 7	3	416.6667
mtmr d 0	3	533.3333
Sig.		.160

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square (Error) = 53140.659.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

Figure 1: Chopped Napier

Figure 2: Fresh *Moringa Oleifera*

Figure 3: Dried *Moringa Oleifera*

Figure 4: Dried Coconut Meat Waste

Figure 5: Commercial Feed

Figure 6: Moringa Based Total Mixed Ration

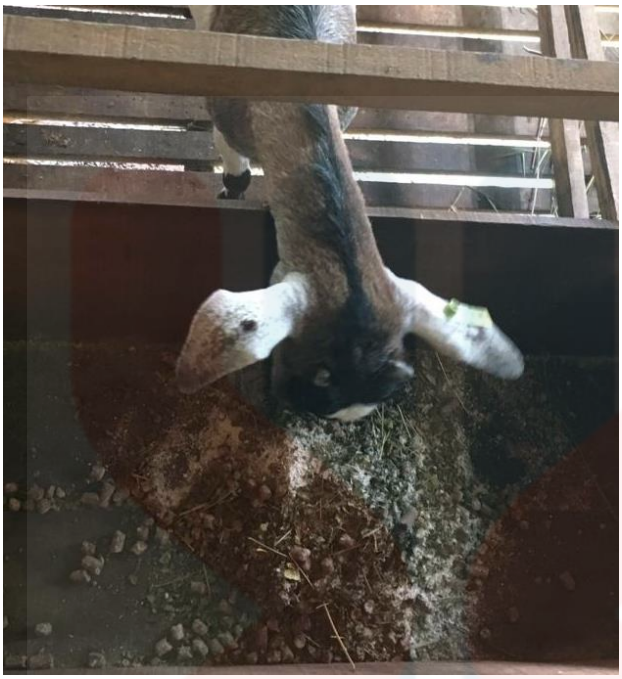

Figure 7: Goat Fed with mTMR

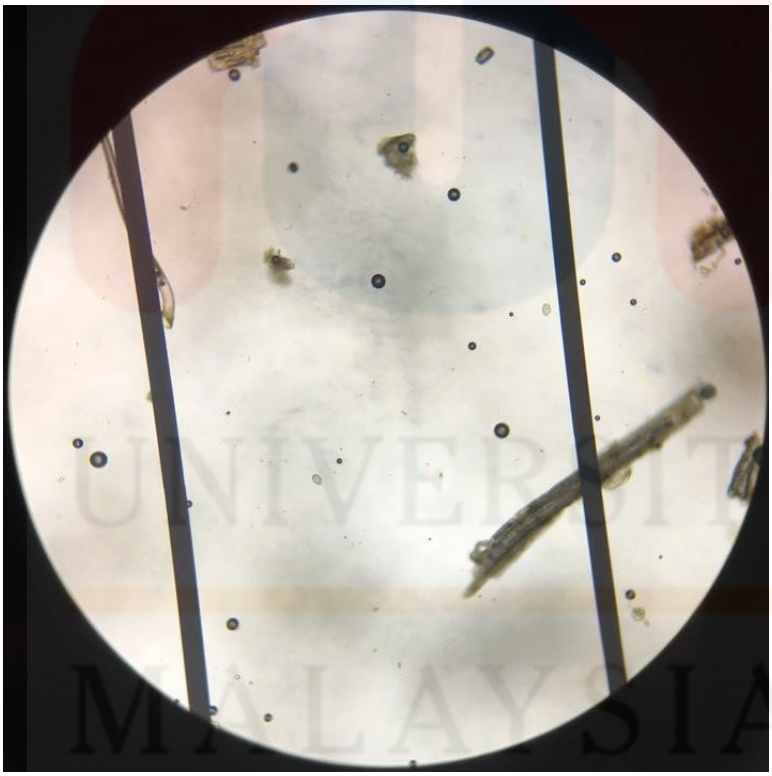

Figure 8: Fecal Egg Count on McMaster Slide