THE EFFECT OF NON-MEDICATED UREA MOLASSES BLOCK (UMB) AND MEDICATED UREA MOLASSES BLOCK (MUMB) ON GROWTH, CARCASS CHARACTERISTICS, BLOOD METABOLITES, AND CONTROL OF GASTRO-INTESTINAL NEMATODE INFECTION ON THE GOAT (*CAPRA SP*) IN MALAYSIA

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ABBREVIATIONS

ADG	Average daily gain
ANOVA	Analysis of variance
BUN	Blood urea nitrogen
BW	Body weight
Cl	Chlorine
CP	Crude protein
CLWG	Cumulative live weight gain
DMI	Dry matter intake
EDTA	Ethylenediaminetetraacetic acid
FBZ	Fenbendazole
FDA	Food and drug administration
FEC	Faecal egg counting
EPG	Egg per gram
GIT	Gastrointestal
Hb	Hemoglobin
K	Potassium
MUMMB	Medicated urea-molasses-mineral block
NPN	Non-protein nitrogen
Na	Sodium
PCV	Packed cell volume
RBC	Red blood cells
UMMB	Urea-molasses-mineral block
WBC	White blood cells

KESAN BLOK MOLAS UREA (UMB) DAN BLOK UREA MOLAS BERUBAT (MUMB) KE ATAS PERTUMBUHAN, CIRI-CIRI KERANGKA, METABOLIT DARAH DAN PENGAWALAN JANGKITAN NEMATOD GASTRO-USUS PADA KAMBING (CAPRA SP) DI MALAYSIA

ABSTRAK

Penyelidikan ini telah dijalankan untuk mengkaji kesan penggunaan blok makanan molas/ mineral bersama blok berubat keatas pertumbuhan,efisensi, kecekapan, cirri-ciri karkas, metabolit darah dan pengawalan jangkitan nematod gastro-usus pada kambing meragut di Malaysia. Keputusan menunjukkan blok makanan molas/mineral dan blok berubat mempunyai kesan signifikan ($p<0.05$) keatas berat akhir, purata peningkatan harian, panjang karkas, berat karkas selepas disembelih, berat kawasan rusuk ke - 9, 10 dan 11, ketebalan lemak bahagian belakang, ketebalan dinding badan, kawasan 'ribeye'-REA, kelebaran otot mata, kedalaman otot mata, organ dalaman, lemak dalaman dan kesemua bahagian utama karkas. Pada penghujung kajian, sampel darah telah diambil dan dianalisa unutk mengukur parameter patologi dan biokimia. Keputusan menunjukkan kesan kombinasi penggunaan blok makanan molas/ mineral bersama blok berubat yang signifikan ($p<0.05$) keatas factor darah termasuk kalsium, kreatinin, nitrogen urea dan isipadu sel padat (PCV) dan tiada kesan negative keatas fungsi badan. Keputusan pengiraan telur pada tinja (FEC) menunjukkan kesan positif penggunaan blok makanan molas/ mineral bersama blok berubat dalam pengawalan nematod gastro-usus. Keputusan histologi menunjukkan kerosakan epithelium usus pada kambing yang dijangkiti nematode gastro-usus dalam kumpulan kawalan. Secara ringkas, dengan merujuk kepada keputusan kemajuan pertumbuhan, pengukuran ciri-ciri karkas, ujian darah,

pengiraan telur pada tinja kerja histologi dan juga pemerhatian yang dilakukan oleh penyelidik untuk mengukur produktiviti komersil projek, penggunaan blok makanan molas/ mineral bersama blok berubat adalah sangat dianjurkan.

THE EFFECT OF NON-MEDICATED UREA MOLASSES BLOCK (UMB) AND MEDICATED UREA MOLASSES BLOCK (MUMB) ON GROWTH, CARCASS CHARACTERISTICS, BLOOD METABOLITES, AND CONTROL OF GASTRO-INTESTINAL NEMATODE INFECTION ON THE GOAT (CAPRA SP) IN MALAYSIA

ABSTRACT

This research was carried out to examine the effects of introducing molasses/mineral feed blocks beside the use of medicated blocks on growth, efficiency, carcass characteristics, blood metabolites and control of gastro-intestinal nematode infection in grazing goats in Malaysia. Results shows that molasses/mineral feed blocks and medicated blocks have significant effects ($p<0.05$) on final weight, average daily gain, carcass length, hot carcass weight, weight of 9th, 10th and 11th rib area, backfat thickness, body wall thickness, ribeye area- REA, eye muscle width, eye muscle depth, internal organs, internal fats and all major carcass parts. At the end of the experiment, the blood was taken and analyzed to measure pathological and biochemical parameters. The results shown that a combination of molasses/mineral feed blocks and medicated blocks has significant effects ($p<0.05$) on blood factors includes calcium, creatinine, urea nitrogen and Packed Cell Volume (PCV) and has no negative effects on body function. The results of faecal egg counting (FEC) stated the positive effect of using molasses/mineral feed blocks along with the use of medicated blocks on controlling gastrointestinal nematodes. Histological results revealed the damages in intestinal epithelium of the goats affected with gastrointestinal nematodes in the control group. In summary, with regards to the observed results in growth performances, carcass traits measurements, blood tests, fecal egg counts, the histological work and also the observations made by

the researchers to measure the commercial productivity of the projects, the use of urea molasses/ mineral blocks and medicated urea molasses mineral blocks is highly recommended.

CHAPTER ONE

GENERAL INTRODUCTION

Goat husbandry is a multifarious set of activities dependent on very different factor such as abiotic, biotic and socio-economic factors. Improving growth performance and carcass characteristics are various and interdependent options. A multidisciplinary method is necessary to characterise animals and systems for the different interrelated production traits (Alexandre *et al*., 2010). However, many different strategies can be used to improve livestock industry in order to reach our ultimate goal, which is of course, to improve, animal's health, performance and the commercial productivity (Rahman, 1988; Shariman and Rahman, 2000; Rahman *et al*., 2002; Waller and Chandrawathani, 2005; Shahrbabak *et al*. 2006; Du and Zhang, 2008).

Goat farming is developing in Malaysia. Milk, meat, skin, and fur are the most important product of goats. However, meat is the most important product of goat and farmer raise goats for the purpose of sacrifice the goats for celebration, wedding, and religious activities such as ' Qorban and Aqiqah' for the Muslim (Ali Khan, 2009).

The meat goat can be reared easily if the farmers pay attention to fencing, nutrition, parasite control, and marketing in order to maximize profit. In fact, housing needs for meat goats are very simple, and do not require costly housing, and in moderate climates may only consist of natural cover such as thick trees and brush or rock ledges. Meat goats can tolerate cold weather but should not remain cold and wet for long periods of time. While goats are generally more tolerant of the heat and humidity than sheep, during the summer months it is important to provide a shady area with adequate air circulation (NCAT, 2006).

However, the most important problems in meat goat industry are nutrition and parasite control. Adding to that, it is also essential to improve carcass quality of meat goats with regard to customer's demands. Inadequate nutrition and gastrointestinal nematode parasitism can be two major constraints to ruminant production in tropical countries. In Malaysia, Gastro-intestinal nematode is a common problem in grazing animals, particularly in sheep and goats (Waller and Chandrawathani, 2005). Wholly, nematode parasites of domestic ruminants has the negative effects on grazing livestock systems worldwide (Papadopoulos *et al*., 2003; Waller and Thamsborg, 2004; Torres-Acosta and Hoste, 2008).

Gastrointestal (GIT) nematodes are among the commonest causes of poor productivity and profitability in tropical climates. The gastrointestinal nematodes of small ruminants include *Haemonchus contortus*, *Telodorsagia circumcinta*, *Trichostrongylus axei*, *Nematodirus* spp, and *Cooperia* spp. The proportions of each of these nematodes in small ruminant populations vary according to geographic location. *Haemonchus contortus* and *T circumcincta* represent most of the parasite burdens seen in small ruminants, with *H contortus* being present in highest numbers (Rahman, 1997; Chiejina, 2001; Behnke *et al*., 2006).

Goats have numerous gastrointestinal parasites. The most important include coccidia (a protozoan), bacteria and viruses, nematodes (roundworms), cestodes (tapeworms) and trematodes (flukes). Among the gastrointestinal parasites, the most important and problematic is the barberpole worm *(H. contortus)*. In fact, *H. contortus* is the most important helminth that affects the livestock industry, especially small ruminants of most developing countries (Rahman and Collins, 1991; Rahman, 1997).

The problem of anthelmintic resistance in gastrointestinal nematodes of small ruminants is worldwide (Githigia *et al*., 2001; Chandrawathani *et al*., 2004; Álvarez-Sánchez *et al*., 2006). However, the scientists hope to solve the problem by using different strategies such as using medicated feed-supplement blocks (Forsberg *et al*., 2002; Rahman *et al*. 2003), biological control (Chandrawathani *et al*. 2004), and also work on genetic parameters of resistance to gastrointestinal nematodes (Gauly and Erhardt, 2001; Mandonnet *et al*., 2001; Mandonnet *et al*., 2002).

Manninen and Oksanen (2010) stated that *H. contortus* is able to survive in a very different situation and even in a very cold region. Considering the effects of the climate change, that can be very affirmative for *H. contortus* life cycle, this research revealed the ability of the parasite to adapt to its host. Moreover, it could be transmitted to other species include wild species and effect the environment.

Hosseini *et al.* (2010) conducted a research to evaluate clinical pathology changes in experimentally infected sheep with active and arrested larvae of *H. contortus*. Twenty-eight lambs, whose were divided into four groups. Groups 1 and 4 received fresh larvae and placebo while treatment groups were infected by arrested larvae obtained under different conditions such as humidity, temperature and light intensity. Clinical signs were monitored for two months. The haematological and biochemical examination were conducted on the first day and two months after infection. Moreover, faecal egg counting was conducted. The results revealed that the mean number of adult worms and faecal egg count in group one were higher compare to the rest. The body weights of group four were also significantly different compare to the rest. There has been a different in red blood cell, hemoglobin and also paced cell volume between different groups. However, these reductions were significant in group one compare to the rest. The comparison of total white blood cell and differential cell count between groups revealed the presence of eosinophilia in group one. Serum protein, albumin and calcium concentration decreased only in group one.

On the other hand, inadequate nutrition is one of the most problem constraints to livestock industry in tropical country. In recent years, researchers are trying to find new strategies to solve nutrition problems in goats in this area and subsequently to find new methods to improve growth factors. In this regards, the carcass characteristic is one of the most factors that have high effect on income fattening industry. The carcass characteristic is affected by different factors like nutrition, management and season, awareness of which is critical in livestock production (Kioumarsi *et al*., 2008ab; Khorshidi *et al*., 2008).

Urea is a nitrogen-based product secreted in the kidneys. It is created for the duration of the breakdown of protein. However, urea is not a protein; it does contain nitrogen and can be used by the microbial population in the rumen to synthesize protein. In fact, urea is classified as non-protein nitrogen (NPN). Molasses has been used both as a carrier for urea and mineral supplements and as a supplementary feed for ruminants (Sudana and Leng, 1986; Tamboura and Abou, 1992).

Molasses, urea and other components are used for producing molasses/urea feeds (blocks, pastes or licks). These preparations are a suitable way of preparing degradable protein and fermentable energy to ruminant animals, and they aid increase the protein supply to the ruminant animals. Furthermore, Medicated feed-supplement blocks have been used in an effort to deliver anthelmintic medication but with varying success (Knox, 1995). There has been a vast amount of research by scientists to control gastrointestinal nematode infection and to improve nutrition in goats; however, to date, the data is inconclusive. There is therefore a need for research on gastrointestinal parasitism in goats. This research was carried out to examine the effects of introduce molasses/mineral feed blocks beside the use of medicated blocks on growth, efficiency, carcass characteristics, blood metabolites, and control of gastro-intestinal nematode infection in grazing Goats in Malaysia. The objectives of this study were:

1) The effect of molasses/mineral feed blocks along with the use of medicated blocks on growth rateand carcass characteristics of Boer goats.
2) The effect of molasses/mineral feed blocks along with the use of medicated blocks on blood metabolites of Boer goats.
3) The effect of molasses/mineral feed blocks along with the use of medicated blocks on control of gastro-intestinal nematode infection in grazing Boer goats.
4) The effect of molasses/mineral feed blocks along with the use of medicated blocks on commercial productivity of rising Boer goats.

CHAPTER TWO

LITERATURE REVIEW

2.1. The establishment and development of *H. contrortus*

2.1.1. Direct life cycle

The life cycle of *H. contortus*, a gastrointestinal parasite of small ruminants has a very simple and straight forward type (Fig. 1), and does not involve an intermediate vector host and needs only one ruminant host. *H. contortus* or barber pole worm is a pathogen (Smyth, 1976).

An egg of *H. contortus* is oval, a special character of the egg is that one side is more curved than the other side and the poles are also unequal. The average size of the egg is approximately 70 - 9 μ x 45 -9μ, minimum size is 66 - 5 μ x 43 -3μ, and maximum size is 79μ, X 46-6μ. The egg has a transparent shell with approximately 1 micron thickness. The yolk of the egg usually fills the entire of the shell. The yolk is bordered by a hyaline substance. However, the yolk is segmented and in faeces freshly examined 24-26 segments or blastomeres. The blastomeres are homogenous and around 12 microns in diameter. In the stomach of the host animal eggs can be found at three different cell stages include six, seven and eleven stages and also at the morula stage. No eggs further than the morula stage are found in the intestinal tract of host animals. The majority are in earlier stages. It is possible that oxygen is necessary for a further development from the morula stage (Veglia, 1915).

The duration of the embryonic stage depends on temperature and media. First of all, the eggs used consisted of batches to contain 11-26 blastomeres, together with batches in the morula stage and four hours later, a number of the eggs are in a new morula stage. The hyaline sac is filled with many blastomeres. In fact, the whole egg is filed by the embryo, but there is also an empty space on both poles. However, there are only a few eggs to survive and for this eggs a few hours later the embryo will be at the tadpole stage, and after around eight hours the embryo will be twice and will shows some structural details. Embryo will continue to growth and in some cases the embryo could be three times the length of the egg. Consequently, the embryo body will shape and twelve hours later, the movements of the embryo will be more and more and around fourteen hours later, almost twenty five per cent of eggs are hatched and around seventeen hours later, almost fifty per cent of the eggs are hatched and the process will continue till around 48 hour only a few eggs have not hatched. The larvae stage of the *H. contrortus* is divided to the different sub stages. The size of the larvae in first stage is 340-350μ in length and 15-20μ in thickness and the larvae fit in to the rhabditoid category. The shape of the body is cylindrical and decreasing in thickness from oesophagus to the tail that is particular character of the first stage can be distinguished from the second stage by an accustomed eye. After that larvae will move to the second stage. The first perform of the second stage larva is to get rid of the old skin and when the larvae are awakened, the crawling movements are obvious and along with this the old tail is bent in the form of a hook and the larva is attached to a piece of faeces by the hook and will free itself from the skin. Consequently, larvae will grow to reach around 500μ with a width of 3μ. However, the stage of the worm is characterized by the structure of the lateral lines and the larvae show itself in swimming movements at this stage. The larvae start feeding again from intestinal lumen. After larvae have obtained enough food they will move again. Totally, the structural changes of larvae during the second stage will bring larvae to a mature stage (Veglia, 1915)

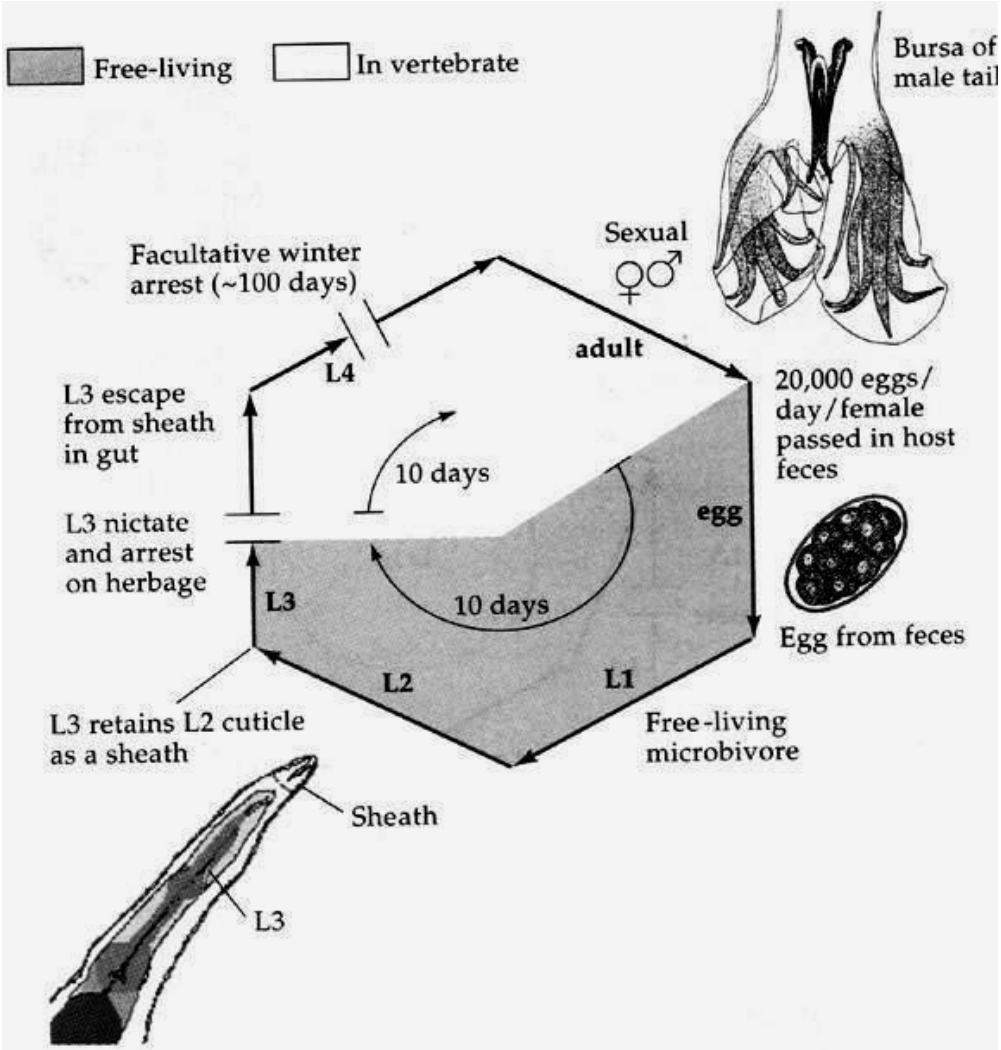

Figure 1. Life cycle of *H. contortus* (Weischer and Brown, 2000).

Adult *H. contortus* live in the animal's gut where they feed on mucosal blood. Consequently, anemia and weight loss will happen that will be fatal. The animal's gut is a unique environment in case of oxygen tension, acid pH, enzymes, and detergent secretions. Therefore, adaptations to gut environments are considered difficult, and *H. contortus* use the animal's blood as both a protein and an oxygen source for this purpose (Rogers, 1962). The infected animals will response to the *H. contortus* infections naturally by a combination of immune responses. Infections can also be removed by drug treatment, but it has been shown that *H. contortus* resistant to drugs, is worldwide (Prichard, 1994; Weischer and Brown, 2000; Chandrawathani *et al*. 2003; Chandrawathani *et al*. 2004; Waller and Thamsborg, 2004).

The female worms produce 5,000 to 10,000 eggs per day after mating and they are passed through goat feces. When the soil is warm and moist, eggs will hatch into L1. The larvae will develop through stages L2 and L3. The third larvae stage (L3) or infecting larvae are consumed by the goats, eventually, the infecting larvae burrow into the goat's abomasums where the larvae develop to a L4 or pre–adult larvae. The L4 developed into L5 (the adult form) and live in the abomasums, where they feed on the host's blood. However, the adult worm, found in the abomasum, is about 10 to 30 mm in length. Warm, moist soil surface conditions is the best condition while hot, dry or extremely cold conditions are unflavored to larvae survival. The most important character of *H. contortus* is the ability to overwinter in the abomasum of its host in a dormant state known as hypobiosis (Veglia, 1915; Smyth, 1976; Rahman, 1988).

Once the L1 larva hatch, they will start to feed on microbes and bacteria until they stop eating the third stage larva (L3). The third stage larvas have two protective cuticles called sheaths which help to protect them from the acidic condition in host's stomach. During a hot day, the larvae will move to a colder surface on the grass usually at the lower part near the ground and will wait until they are ingested by their host. The third cuticle is shed with the effect of digestive enzymes in the rumen; the larva will emerge as the fourth stage larva and reaches the fourth stomach. After a short period of time, the fourth stage develops into the adult worm and begins mating and producing eggs (Albers *et al*., 1987; Gruner *et al*., 1992).

2.1.2. Prepatent periods

The time between infection of the host and the most primitive time when the contributory agent can be recovered from the host or in the case of parasites, eggs or larvae can be recovered from blood, urine or feces are called prepatent periods, and the awareness of the prepatent periods is very important as it helps to prevent and control infection at the critical time. Djafar (1961) noted that the prepatent period of *H. contortus* appeared earlier in protein deficient kids when compared to those receiving a normal diet. However, the prepatent period of *H. contortus* in sheep is frequently recorded and apparently very variable from minimum 12 days to maximum 21 days (Veglia, 1915; Andrew, 1942; Misra and Ruprah, 1971; Coadwell and Ward, 1975; Raisinghani and Singh, 1977; Mendez and Cabo, 1980; Rahman, 1988). In addition, Veglia (1915) noted that a shorter period is required by the parasite to reach maturity in the 'hot season' and in the 'cold season'.

Sharma *et al*. (2000) examined relations between *H. contortus* and *Trypanosoma evansi* infections using forty two male goats. Parasitological results revealed that prepatent period were made in animals infected with *H. contortus* followed one week later with *T. evansi* and vice versa and results also revealed that different factors could affect the prepatent period that awareness of them could be effective to prevent and control the infection.

Okaiyeto *et al*. (2010) conducted a research on joint infection with *Trypanosoma congolense* and *H. contortus* in 30 female sheep aged between twelve and twenty five months from the same breed. The researchers divided the animals into five groups of six animals. Animals in two groups received infection with *H. contortus* or *T. congolense* and two other groups received infection with *T. congolense* and then by *H. contortus*. The control group was kept uninfected. The results revealed that all the trypanosome-infected groups showed different prepatent periods, the *T. congolense* was patent at day 10 post-infection while *T. congolense, H. contortus* and *H. contortus, T. congolense* were patent at day 5 and 7 post-infection, respectively.

Agyemang (1999) in a part of his six years of research in the Gambia evaluted the possibility of changing prepatent period of *H. contrtous* and the he stated that the most important part of his study was succeed to reduce prepatent period of *H. contrtous* from an average of approximately three weeks and the increased pathogenicity of *H. contrortus* superimposed on a primary *T. congolese* infection.

Nwosu *et al*. (2006) evaluated effect of concurrent *Trypanosoma brucei* infection in goats infected with *Haemonchus contortus* alone or concurrently with *Trypanosoma brucei.* The results showed that the goats infected with *H. contortus* alone were without mortality. The results also stated that infection with *T. brucei* resulted in severe clinical disease more obvious losing weight, diarrhoea and death of all the goats. The concurrent infection with *T. brucei* also revealed a shorter prepatent period and the establishment of a greater number of adult *Haemonchus* worms per animal than in those infected with only *H.contortus* alone with prepatent period of 18 ± 0 days and 98 ± 26 adult worms per animal.

2.1.3. Morphology and structure of the *H. contortus*

Haemonchus contortus, also known as Barber's pole worm is a common parasite and one the most pathogenic nematode of the goats. Adult worms are attached to abomasal mucosa and are blood feeder that would cause anemia, bottle jaw, and death of infected goats. The most the most problematic time is during summer months in warm and humid reigns. *H. contortus* is the most economically important parasite of goats. The eggs from is approximately 70–85 μm long by 44μm wide, and the early stages of cleavage containing between 16–32 cells. Adults are 20-30 mm and eggs are thin-shelled, which contain 24 cell. The adult female is longer and is simply recognized by its trademark "barber pole" colouration. The different colour appearance is a special character of the *H. contortus* that is varies between red and white. The male adult worm is much smaller (Albers *et al*., 1987; Gruner *et al*, 1992).

Kumsa (2008) conducted a study to evaluate morphology and sympatry of *Haemonchus* species innaturally infected sheep and goats of Ogaden region, eastern Ethiopia, a number of female *Haemonchus* worms collected from August 2003 to March 2004 and also a number of adult male *Haemonchus* worms were collected for species identification study. The results showed that for the female *Haemonchus* worms 49.5% were linguiform, 28.5% were knobbed and 23% were smooth vulvar morph types in sheep while 53.8% were linguiform, 18. 5% were knobbed and 27.6% were smooth vulvar morph types for the goats. Significant variations were obvious between the three different morph types in different time of the study.

Rahman and Hamid, (2007) conducted a research Morphological characterization of *H. contortus* in goats (*Capra hircus*) and sheep (*Ovis aries*) in Penang, Malaysia and the results of their efforts are presented in the Table 1.

Table 1: Morphometrics of *Haemonchus contortus* in goats and sheep.

Character	*H. contortus* in goats	*H. contortus* in sheep
Body length ♀ (mm)	18.8	17.8
Body length ♂ (mm)	11.8	12.3
Cervical papillae ♀ #	319.7	333.2
Cervical papillae ♂ #	319.2	335.0
Left spicule length	446.0	483.2
Right spicule length	453.2	489.3
Gubernaculum length	234.0	231.7
Synlophe (4 mm from anterior)	26	24
Synlophe (8 mm from anterior)	20	22

2.1.4. Clinical symptoms caused by *H. contortus* infection

Haemonchus contortus is one of the greatest concerns in goats from tropical and sub-tropical countries. Females worms could produce thousands eggs per day, which are secreted from the goats via the faeces. After hatching from their eggs, *H. contortus* larvae molt, resulting in an L3 form that is infectious. Goats can take up these larvae when eating grass leaves. The L3 larvae develop into L4 larvae. L4 larvae will digest the host's blood in the abomasum of the animal, and this will cause anaemia and oedema, which then subsequently can lead to the death of the animal. However, the common clinical signs of disease are all secondary effects of blood loss. These goats do not thrive or grow well, and milk production is reduced. As the depletion of blood continues, the goat develops hypoproteinemia and edema, particularly under the bottle jaw. Wholly, the signs of the worm infection in goats include dehydration, diarrhea, rough hair coat, depressed, low energy, lethargic, fluid accumulation in bottle jaw, abdomen, thoracic cavity, blood loss, anemia/PCV, and reduced growth performance. If untreated, death follows within a few days (Albers *et al*., 1987; Gruner *et al*., 1992).

Crompton and Newton (1982) described clinical symptoms caused by *H. contortus* infectionin his book, trends and perspectives in parasitology. He mentioned that the primary symptom is a microcytic and hypochromic type of anemia. Other effects include loss of body weight, weakness, emaciation, loss of wool and rough hair cost, paleness of all the visible mucous membrane, change of temperature, coughing and constipation followed by diarrhea. In more serve and chronic cases, discharge from the eye is also seen and the infected animals may develop a habit of earth, wool or hair eating.

2.2. Disease management

There are many important diseases of small ruminant, but none are as important or present as direct a threat to the health, growth and consequently the productivity of livestock industry as gastrointestinal nematode parasites. Control of gastrointestinal nematode is therefore main concern in any health management program. A successful gastrointestinal nematode parasites control programs must take into account many different factors (Kaplan *et al*., 2005). Gastrointestinal nematode parasites are everywhere and practically not feasible to eradicate. These parasites are difficult to manage. Heavy infections result in clinical parasitic gastroenteritis characterized by diarrhea, lack of appetite and weight loss. However, subclinical disease without obvious symptoms constitutes the majority of infections and may cause economic losses due to sub-optimal performance (Dimander, 2003). Many methods have been used by the scientist to control these problems in herds. Management practices include the use of chemical anthelmintics, improved herd and pasture management, and use of food with anthelmintic properties.

Waller *et al* (2004) conducted a study was conducted to assess the effect of mineral supplement to control gastrointestinal nematode but the results revealed that there is little, if any, benefit from a parasite control standpoint in recommending mineral therapy.

2.3. Anthelmintics

Since the early 1960's there have been only three major classes of broad-spectrum anthelmintics commercially released for the control of nematode parasites of ruminant livestock, namely: the benzimidazoles / probenzimidazoles, the tetrahydropyrimidines / imidazothiazoles, and also the macrocyclic lactones , or avermectins /mylbemycins. There are also novel classes of anthelmintic drugs that main a constraint in their commercial development is the high costs involved (Waller, 1997). Total failure of modern broad spectrum anthelmintics to control nematode parasites of sheep and goats is rapidly increasing in the tropical areas. This is primarily associated with the highly pathogenic, blood sucking parasite, *Haemonchus contortus.* This parasite continues to be more important in the tropical regions of the world, with the change in weather conditions that favour this parasite (Waller and Thamsborg, 2004). However, anthelmintics are widely used to treat gastrointestinal nematode infections but the anthelmintics resistance had been diagnosed in many countries include Malaysia (Chandrawathani *et al*., 2003; Chandrawathani *et al*. 2004).

Van Wyk and Van Schalkwyk (1990) conducted a research to control anthelmintic-resistant H. contortus in sheep by replacing it with a susceptible strain. The researchers used infected donor sheep for this purpose; they used six groups with a resistant field strain of *H. contortus*. Afterwards, the researchers used donor sheep infected with a susceptible laboratory strain of *H. contortus* for seeding the pasture and attempts repeated in different time during a year to replace the resistant strain on the pasture with the susceptible strain in five of the group while the sixth remained as a control group. In two of the five experimental groups, the susceptible strain was introduced in the autumn while in three groups, the susceptible strain in spring or summer. The results revealed that the susceptibility of the worm strains introduced initially, as well as of those that developed in the different groups, was connected either by controlled non-parametric anthelmintic slaughter trials at the beginning and at the conclusion of the trial, and by an in vitro egg hatch test. A reversion to susceptibility occurred in three of the five groups. These included both of the groups infected with the susceptible strain in the spring and one of the two infested in the autumn.

2.4. Environmental management

Controlling nematode parasites of goats is facing challenges on many farms in the tropical and subtropical regions worldwide. This is highly associated with the highly pathogenic, blood sucking parasite, *H. contortus,* and also where it now cannot be controlled and as a results mortalities exceeding every years. Hence, goat enterprises become totally unsustainable, unless major changes in management are effected (Waller *et al*. 2004; Waller and Chandrawathani, 2005).

Environmental management, specifically pasture management is a method used to control gastro-intestinal nematode. The purpose of pasture management is to give safe pastures for grazing. A safe pasture is one that is not grazed for 6 months during cold weather or 3 months during hot, dry weather by goat or sheep. Weaning animal at 2 months of age and rotating them ahead of the adults through pastures will decrease the introduction of infective larvae to adult animal. Pastures could be divided into smaller lots to let extended time before regrazing (Linda, 1996). Maintaining pastures shorten will help in weed and parasite control. In the coming years, it may be possible that pastures be reseeded by plants containing condensed tannins to take benefit of their anthelmintic effects (Nguyen *et al*., 2005). On the other hands, goats prefer to feed on underbrush like leaves and a number of weeds. This also can help to increase the meat and milk production, at the same time help to maintain the pasture in good condition and reducing the growth of weed as well.

Burke *et al*. (2009) conducted a research to evaluate the effect of grazing management of gastrointestinal nematodes in lambs. Initially, naturally infected lambs were randomly assigned to graze continuous bermudagrass, rotational bermudagrass moved every few days and returned to original plot after around one month for three rotations or three rotational bermudagrass rotated when forage height fell below 10 cm where first day of grazing. In late summer, all lambs were supplemented with 500 g corn because of poor condition. The following year, similar animals were used and included the continuous bermudagrass and the rotational bermudagrass groups only. In both years, fecal egg counts, blood packed cell, body weight were measured. Although the results of their research revealed a little improve in economic value of these system but they also mentioned with using new managing strategies obtaining a better results would be possible.

2.5. Resistance of gastrointestinal parasites

The problem of anthelmintic resistance in gastrointestinal nematodes of ruminants is universal (Chandrawathani *et al*. 2003; Chandrawathani *et al*. 2004; Waller and Thamsborg, 2004). There are three classes of anthelmintics commonly used in ruminants: benzimidazoles, cholinergic agonists, as well as the macrocyclic lactones or avermectins and milbemycins. Besides, host response against nematodes also plays a very important role. Two main components composed the host response to the trichostrongyles, i.e. the resistance and the resilience. Resistance is defined as the capability of the host animal to control the nematode populations. Alternatively, resilience refers to the ability of a host to survive the affects of nematode infections and to keep productions in parasitic confront. The main alternatives to increase these two faces of the host responses are either nutritionally or genetically based. The relations between nematode infections and host nutrition refer to two connected aspects. Primary, it has been well-known for a long time that the major pathophysiological cost of parasites affects the host digestive physiology. The presence of the different nematode species in the various parts of the digestive tract is typically linked with: 1) a reduce in food utilization; 2) a syndrome; and 3) changes in the host metabolism. On the other hand, main studies have brought evidence saying that manipulation of the host nutrition could represent a choice to increase the host resistance to the parasites (Hoste *et al*., 1997; Coop and Kyriazakis, 1999; Hoste *et al*., 2001).

Sissay *et al*. (2005) evaluated anthelmintic resistance of nematode parasites of small ruminants in eastern Ethiopia and for this purpose the faecal egg count reduction tests (FECRT) were conducted to evaluate the efficacy of anthelmintics used for treatment against nematode parasites in sheep and goat. The results revealed high levels of anthelmintic resistance to albendazole, tetramisole, also to the combination of these two drugs in the goats flock.

Chauhan *et al*. (2003) were studied resistance to naturally acquired gastro-intestinal (GI) nematode parasite infections of two breeds of Jamunapari and Barbari goats in different physiological stages. The faecal egg counts (FECs) for GI nematode infections were examined in different physiological stages in both the breeds in two periods, i.e. an early period (October–November) and a late period (February–March). Results revealed that breed had significant effect on FEC in early and late periods in pregnant, dry and lactating does. Breed by physiological interaction had significant effect on FEC in both the early and late periods. Jamunapari lactating goats had significantly higher FEC than that of dry and pregnant does but there was no peri-parturient rise in FEC in the resistant Barbari goats.

Terrill *et al*. (2009) assessed anthelmintic resistance on goat farms in the southeastern United States. Spanish goats were used for this experience. The animals allocated to nine different groups, which are albendazole, fenbendazole, ivermectin, doramectin, moxidectin, levamisole, morantel tartrate, a combination of ivermectin and albendazole, and untreated controls. Anthelmintic efficacy was measured by faecal egg count (FCR) every two weeks and the results stated the presence of gastrointestinal nematode resistant to all three major anthelmintic classes in both goat herds.

Saeed *et al*. (2010) conducted a research to examine multiple anthelmintic resistance and the possible contributory factors in goats in an irrigated area (Pakistan). Eighteen privately owned goat flocks were selected in order to evaluate the anthelmintic resistance against the three anthelmintics viz., oxfendazole, levamisole and ivermectin. Anthelmintic resistance was observed. Faecal egg count reduction test revealed high prevalence of anthelmintic resistance (83.3%) and it was either single (levamisole) or multiple (oxfendazole and levamisole). Subsequently, Egg hatch test confirmed the resistance against oxfendazole as detected with faecal egg count reduction test. They also found out that *H. contortus* was one the most common species exhibiting resistance to levamisole and oxfendazole.

2.6. Domesticated Goats

The domestic goat (*Capra aegagrus hircus*) derived from goat domesticated that is a subspecies of the wild goat . *Capra hircus* has been kept productively in very different regions. Feral groups are found usually in rugged mountain country, rocky crags, and alpine meadows. Domestic goats have a successful herding instinct and prefer to be in the group. Totally, the social behaviour of goats is unique. But, in farm system, much of the goat's social behavior is controled by farmers. Goats spend most of the day hours grazing. *Capra hircus* need a year-round supply of roughage. C. *hircus* need grass for grazing, but prefers to browse brush lands or a varied selection of pasture. About the breeding, during the decades humans control the breeding behavior of these goats, but environmental factors such as whether in the wild or in captivity breeding follows a polygynous system. The breeding cycles usually occur in summer to winter. The female goat has less than one month estrus cycle that called season. The doe's season is varied from a few hours to a few days. In Malaysia, stocks of goats are made up from Katjang, Boer, Jamnapari, Anglo Nubian and Feral breeds and the goat population is about 250,000 heads, having risen from 19,000 in 1999 (IRLI, 2007). Boer goat is successfully selected for meat and currently is a main source of producing meat in many parts of the world (NCAT, 2006). Boer goats are typically raised on pastures and can be raised successfully with cattle or sheep and some other species but they do compete with some browsers.

2.6.1. Boer Goats

Boer goat is originally from South Africa and the breed was produced in the early 1900s for meat consumption. The name of Boer goat came from the Dutch word "Boer" that means farmer. The Boer goats were chosen for meat rather than milk and due to selective breeding, Boer goat has a suitable growth performance and well carcass qualities (Malan, 2000). In the recent years the Boer goats become the most popular meat goat breed in the U. S and the world. Boer goats are adaptable to a variety of weathers. Boer goats commonly have white bodies and distinctive brown heads, fast growing, and having high reproductive rates. Does are reported to have superior mothering skills as compared to other goats. Mature boer bucks usually weigh between 110-135 kg and mature does between 90-100 kg (ABGA, 2007).

Boer goats are scoring high marks as income-earners among two groups of farers in Malaysia due to their fast growth and nutritional value. There is demand for boer goats. There are even people from Brunei who want to import goat from Malaysia. However, there is a need to create awareness that goat meat has better nutritional value compared with some other meats (Malan, 2000; IRLI, 2007; ABGA, 2007).

2.6.2. Characteristics

Goats have a muscular heads with brown eyes and nose with a gentle curve, large nostrils, as well as strong mouth with well-opposed jaws. Their horns are usually dark, round, strong, of moderate length, placed fit apart and have a steady backward curve prior to turning outward symmetrically. Ears are horizontal of average length and fall down. Boer goat has a strong and muscular neck in