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Review on Control of Haemonchus Contortus in Sheep and Goat

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Abstract

Small ruminant livestock, such as sheep and goats, are extremely susceptible to internal Parasites, especially gastrointestinal nematodes. Haemonchus contortus is a highly pathogenic, blood-feeding nematode of small ruminants and a significant cause of mortalities worldwide. Haemonchosis is a particularly significant threat in tropical, subtropical and warm temperate regions, where warm and moist conditions favors the free-living stages, but periodic outbreaks occur more widely during periods of transient environmental favorability. Barber's pole worm is singly the most important of all the gastrointestinal nematodes that affect the survival and productivity of shoat owned by rural poor farmers in the developing world. Barber's pole worm which is called Haemonchus contortus by its scientific name is highly pathogenic blood sucking parasite. Haemonchus contortus is highly pathogenic blood sucking parasite. Haemonchosis caused by Haemonchus contortus is a predominant, highly pathogenic and economically important disease of sheep and goats. Contortus is active mainly in warm, humid climates in the summer months. High levels of prevalence, intensity and abundance of these parasites were generally observed around the middle of the two rain seasons, with peaks occurring in May and September of the year. There are number of factors such as poor nutrition, concurrent disease, stress, overstocking, or pregnancy/ lactation can cause a loss of immunity to parasites. Haemonchosis can be diagnosed based up on the characteristic clinical sign of anemia, Submandibular edema, weight loss, and ill thrift along with finding large numbers of eggs in the feces. It causes great loss in sheep and goat farm. To prevent this problem the owner or farmer and veterinarian should work effectively. They should be prevent pasture contamination on larval stage in early spring via timely and planned treatment strategies, rotate different doses of drugs on animal basis, avoid under dosing antihelminthic, utilize safe pasture treatment and move shames.

ABBREVIATION

ACSRPC: American Consortium for Small Ruminant Parasite Control; COWP: Copper Wire Particle; DNA: Deoxyribonucleic; FEC: Fecal Egg Count; GI: Gastrointestinal; GIN: Gastrointestinal Nematode; HU: Haramaya University; K Da: Kilo Dalton; L: Larva; MOA: Minister of Agriculture; NGO: Non- Governmental Organization; PCR: Polymerase Chain Reaction; PCV: Packed Cell Volume; PH: Power of Hydrogen; PPR: Per Parturient Rise; and Goat; Spp: Shoat Sheep Species; US: United States; US$: United States Dollar.

INTRODUCTION

There are a lot of diseases of shoat, but none of them are found everywhere as or present as direct a threat to shoat as internal parasites [1]. Gastrointestinal nematodes (GIN) that infect sheep and goats include Haemonchus contortus, Trichostrongylus colubriformis, T. axei, Teladorsagia (Ostertagia) circumcincta, Cooperia spp., Oesophagostomum, Trichuris ovis, Strongloides papillosus, and Bunostomum. These parasites can contribute to the overall problem of gastrointestinal parasitism of ruminants. Barber's pole worm which is called Haemonchus contortus by its scientific name is highly pathogenic blood sucking parasite which is the most prevalent and important in most regions of the US, especially in the southern [2].

Barber's pole worm is singly the most important of all the gastrointestinal nematodes that affect the survival and productivity of shoat owned by rural poor farmers in the developing world. This haematophagus parasite is infamous throughout the humid tropic subtropics, which is responsible for acute disease outbreaks with high levels of mortalities, particularly in young animals [2]. It is economically important parasites in India about 103 million US$ was spent. H.contorus is prominent parasites amongst the reports of anthelmintic resistance that has emerged in all countries of the world that produce small ruminants. This emergence of multiple anthelmintic resistances has provided a spur for research on alternative forms of control. Recent surveys in developing countries have identified many plants that are intended and have the potential to be used as anthelmintic against this parasite [1].

Haemonchosis can be diagnosed based up on the characteristic clinical signs of anemia, submandibular edema, weight loss, and ill thrift along with finding large numbers of eggs in the feces. Female Haemonchus produce approximately 5,000 eggs per day and caprine can be infected with thousands of these worms and these results in tens to hundreds of thousands of eggs being shed on to pasture by each animal each day. Because the life cycle is so short (< 3 weeks), this cycle of infection pasture contamination, reinfection and more pasture contamination can rapidly transform pastures in to very dangerous places for goats. This is especially true in a warm environment such as Georgia, because transmission of H. contortus occurs virtually year – round.

As other form of most parasitic diseases, haemonchosis is most severe in young animal during their first year on pasture. However, since immunity to GI nematodes in goats is slow to develop and is incomplete, even mature goats are at considerable risk. There are number of factors such as poor nutrition, concurrent disease, stress, overstocking, or pregnancy/lactation can cause a loss of immunity to parasites. It is well established that ewes and does lose much of their protective immunity to GIN around the time of kidding/ lambing causing the number of parasites infecting the does to increase. Subsequently, parasite egg production and contamination of the environment with infective larvae increases, creating a dangerous situation for the highly susceptible young kids. This phenomenon, known as the per parturient rise (PPR) is an extremely important part of the epidemiology of Haemonchus and must be considered when designing control programs [2].

OBJECTIVES

The objective of this review will be:

1. To provide the concise review on haemonchus contortus

2. To highlight control and prevention strategies on haemonchus contortus

LITERATURE REVIEW

Etiology

Phylum: Nematoda; Class: Secernentea; Order: Strongylida; Family: Trichostrongylidae; Genus: Haemonchus; Species: Haemonchus contortus; The majority of gastrointestinal strongyles of ruminants belong to the family Trichostrongylidae. The genus Haemonchus is in the sub – family of Haemonchinae and consists of four main species in domestic ruminants, namely, H. contortus (in ovine and caprine), H. placei and H. similis (in bovine) and H. longistipes (in dromedary). Haemonchus contortus is a cylindrical gastrointestinal nematode commonly known as the red stomach worm, the wire worm or the Barber pole worm [3]. Adult worms are found in the abomasum of goats and sheep [4]. Haemonchosis caused by Haemonchus contortus is a predominant, highly pathogenic and economically important disease of sheep and goats [5]. These parasites are common blood feeders that caused anemia and reduced productivity and can lead to death in heavily infected animals [6].

According to [7] H. contortus is a highly pathogenic parasite of small ruminants, capable of causing acute disease and high mortality in all classes of stock affected. These parasites produce large numbers of eggs per parasite per day; this together with suitable climates of high temperature and rainfall ensures year – round, undisrupted development of larvae. H.contortus infection is so significantly high and of importance that it made the top ten list of the most common pathogenic nematodes of sheep and goats in the tropics and together with other nematodes and the second most common gastrointestinal infection that results in death of sheep in Malaysia [8]. Gastrointestinal nematode infection ranks highest on a global index, with H. contrortus being of overwhelming importance [7].

Morphology

An adult H. contortus measures about 15 to 30 mm long, the male being shorter than the female. The morphological characteristics of H. contortus are a mouth capsule with a single dorsal lancet and two prominent cervical papillae in the esophageal area. The male parasite is characterized by its copulatory bursa formed of two large lateral lobes and a small asymmetrically positioned dorsal lobe [9]. Together with the two chitins spicules, which are inserted in the female genital opening during copulation, this part of the worm is important for identification [10]. Female's parasites have a reddish digestive tube filled with ingested blood, spirally surrounded by two white genital cords (ovaries) [11]. Eggs of strongyle type with a diameter ranging between 70-85 μm [12] (Figure 1).

One study which was conducted in HU indicates that important parasites of sheep and goats were intensified and those factors affecting the epidemiology of these parasites of small ruminants in eastern Ethiopia were elucidated. Those parasites are includes that Haemonchus, Trichostronglus, Nematodirus, Oesophagostomum, Fasciola and Paramphistomum species were common helminthes of sheep and goats in this part of Ethiopia. According to the researcher from these GIT parasites H.contortus is the most prevalent, representing more than 60% of the total worm burdens recorded in tracer tests. Sheep and goats examined at abattoir mean H. contortus worm counts exceeded 4000 during the peak time. High levels of prevalence, intensity and abundance of these parasites were generally observed around the middle of the two rain seasons, with peaks occurring in May and September of the year. This confirmed that the weather conditions of the wet seasons were generally favorable for the development, survival and transmission of the free- living stages of nematodes [13].

Barbers pole worm is species most commonly encountered in small ruminants. The disease caused by this parasitic worm is haemonchosis, which is the most frequently observed gastro intestinal problem in tropical and sub-tropical regions of the world [14]. Like any other the parasitic diseases it is in a dynamic interaction with its environment and the host, the outcome of which depends on various intrinsic and extrinsic factors.

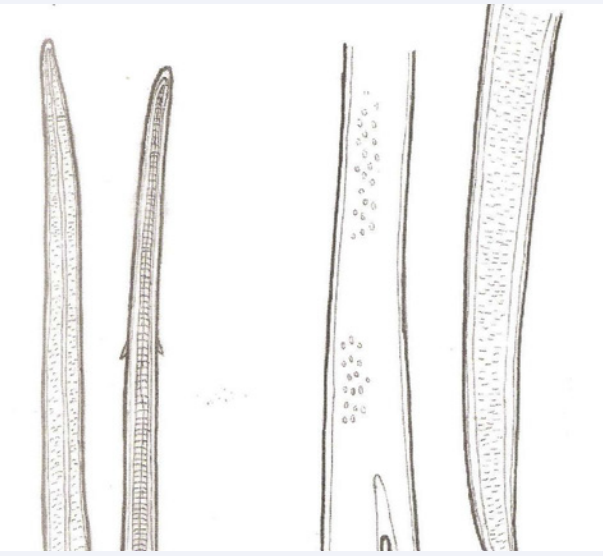

Figure 1 Morphology of male and female H. contortus Haemonchus contortus (Rudolphi, 1802) Cobb, 1898; A, anterior end of female; B, anterior end of male; C, vulva of female; D, bursa of male showing spicules.

Risk factors

Intrinsic Factors: H. contortus is a highly prolific, blood-feeding parasite with various strategies to escape adverse climatic conditions and immune reactions of the host. Its ability to produce large number of eggs during its lifetime provides H. contortus with an advantage over other parasites in that it can easily contaminate grazing areas and may survive in its small ruminant hosts through frequent and rapid re-infections. Variations in the degree of infectivity of different H. contortus isolates have been documented. A comparison in infectivity between H. contortus isolates from France with those from West Indies (Guadeloupe) in two breeds of sheep, namely the Black Belly and the INRA 401, has shown that the latter established between than the former in the Black Belly [15] suggesting that it is important to take in to account parasite genetic diversity in different agro0 ecological zones.

EXTRINSIC FACTORS

The environment

Climate and vegetation: Factors including temperature, rainfall, humidity and vegetation cover influence patterns of parasite development [16]. In most tropical and sub-tropical countries, environmental temperatures are permanently favorable for larval development. The ideal temperature for larval development of many nematode species in the microclimate of the pasture or vegetation is between 22^0c and 26^0c while the best humidity is close to 100% [17].

Desiccation from lack of rainfall kills eggs and larvae rapidly and is the most lethal of all climatic factors. A pasture larval assessment in Ghana and the use of tracer lambs in Kenya revealed that very few or no H. contortus infective larvae were available during dry periods while numbers of larvae were high in the rainy seasons and shortly after [18]. Below 5^0C, movement and metabolism of L3 is minimal favoring prolonged survival as these larvae are enclosed in a double sheath and thus unable to feed to continuously renew their energy [19].

Nutrition: There is substantial evidence for a beneficial role of a good plane of nutrition in the resistance or resilience of sheep to GI nematode infections [20]. Nutrition can influence the development and consequences of parasitism in three different ways: (1) it can increase the ability of the host to cope with the adverse consequences of parasitism (resilience), (2) it can improve the ability of the host to contain and eventually to overcome parasitism (resistance) by limiting the establishment, development and fecundity of the parasitism and/or (3) it can directly affect the parasite population through affecting the intake of certain antiphrastic drugs. Highly metabolizable protein diets have been shown to augment resistance of Ile de France and Santa Ines lambs against H. contortus. Well - fed animals can withstand the harmful effects of GI parasitism and remain reasonably productive and may require less anti -helminthic treatments when compared with undernourished animals [21]. Major problem in this respect is that haemonchosis is more prevalent in regions where the animal feed resources are very scarce and/or improperly managed and therefore insufficient to satisfy the demand throughout the year.

Nature of the host

Breed: Though it is still not clear how natural selection might shape patterns of immune responsiveness in terms of type and strength of response, different breeds of sheep express different susceptibility to gastro- intestinal parasitic infections. In this respect the Santa Ines [22], Barbados Black Belly and Texel [23]. Breeds of sheep are known to be more resistant to infection with H. contortus compared with Suffolk and Ile de France, INRA 401 and Suffolk breeds respectively [11]. This is evidenced by reductions in faecal egg count (FEC) and/or worm number, slower worm development and reduced fecundity. Genetic variations in the resistance to H. contortus with in sheep flocks have also been demonstrated and used in breeding schemes in Australia [24].

Age, sex and reproductive status: In addition to genetic factors, animals of different ages and sex respond differently to parasitic infections under similar management conditions [11]. Young animals are generally more susceptible to parasitic diseases than adults [25]. It is believed that lower resistance to disease in young ruminants is partly due to immunological hypo responsiveness, and is not simply a consequence of their not having been exposed sufficiently to pathogens to develop immunity. Innate immunity, often age-related, is also considered important in many cases. This may be due to physico-chemical differences in the gut environment in adult compared with young hosts [26]. On the other hand, previous exposure to H. contortus infection could result in enhanced resistance to subsequent infections [27]. Improved resistance to H.contortus was reported in second infections in Rhon and Merino land and Black Belly and INRA 401 lambs [28]. This may be due to the alteration of immunological and physicochemical mechanisms that while incapable of controlling the primary infection is nevertheless able to influence the challenge infections [15].

In a recent study, it was reported that male lambs excreted significantly higher number of faecal eggs, carried higher number of H - contortus worms and were more anemic than their female counterparts [28]. Earlier studies with H. contortus showed that castration enhanced the resistance of male lambs to the extent that FEC were lower than those of female lambs suggesting the existence of hormone related influences [29]. The phenomenon of the peri -Parturient rise (PPR) in nematode egg output is also of great importance in the epidemiology of GIT nematodes of sheep. This is due to a temporary loss of acquired immunity to infection at around the time of parturition and during lactation and the PPR in FEC started 2 to 4 weeks before lambing and continued in to lactation in the post - parturition period [30].

Pathogenesis

Haemonchosis in sheep may be classified as hyper acute, acute, or chronic. In the hyper acute form, death may occur within one week of heavy infection without significant signs. This form of the disease is very rare and appears only in highly susceptible lambs. The acute form is characterized by severe anemia accompanied by edema bottle jaw [31]. Anemia is also characteristic of the chronic infection, often of low worm burdens and is accompanied by progressive weight loss [19].

The chronic form is the most commonly observed during natural infections. The lesions are associated to anemia resulting from blood loss. H. contorus is known to produce calcium and a clotting factor binding substance known as calreticulin enabling the parasite to feed easily on host blood and in so doing cause hemorrhagic lesions [32].

Life cycle

H. contortus is a blood sucking gastro- intestinal nematode parasite belonging to the family Trichostrongylidae. The typical life cycle being's when the adult female lays eggs that are passed out in the feces of the animal. Hatching of the eggs is controlled by temperature and humidity and also to an extent by the larva within the egg [33]. Eggs are passed out in the faeces of the mammalian host. The eggs hatch and develop in to the L1 and L2 juvenile stages in the faeces while feeding on bacteria. The L1 stage usually takes about 4-6 days to develop under temperatures in the range of 24^0c - 29^0c [34]. The L2 stage then develops in to the L3 stage, which is referred to as the filiari- form infective larvae, by shedding its cuticle.

The L3 stage remains in its cuticle and crawls up the grass blades awaiting ingestion by a final host (the herbivore), which becomes infected post- ingestion. This larva settles in the abomasum where it sheds its cuticle and burrows in to the abomasum layer where it develops in to the adult stage L4 [35]. This larva in turn sheds its cuticle and develops in to the adult stage (L5). Male and female worms mate and live in the abomasum where they feed on the blood of the host. The life cycle reported here is extracted from [3].

An important phenomenon observed in the life cycle that has epidemiological implications is arrested larval development or hypobiosis. Hypobiosis is the temporary cessation of development of a nematode at a particular point in its parasitic development. Hypobiosis usually follows the onset of cold autumn/winter conditions in the northern hemisphere or very dry conditions in the subtropics and tropics [36]. It is usually due to an unfavorable environmental stimulus, such as cold weather or dry conditions received by the free- living L3 prior to ingestion and usually coincides with onset of winter or very dries conditions. Arrested development can occur in the gut of sheep or on pasture and ensures survival of the nematode under adverse climatic conditions. Subsequent maturation of the larvae due to resumption of development known as the 'Spring rise', when favorable conditions return in the spring, leads to a rapid rise in infections levels or fecal egg counts in the sheep [37] (Figure 2).

Clinical signs

The clinical signs, mainly anemia, edema and loss of weight in association with reduced hematocrit values might be characteristic of heamonchosis in sheep [19]. At Post mortem, the abomasum appears edematous with petechial hemorrhages, occasional nodular developments and a rise in pH. Feces are well formed; diarrhea occurring only in infections complicated by the presence of such species as Trichostrongylus specie and Cooperia species. Labs are the most seriously affected members of the flock, but older sheep under stress also may have fatal anemia A heavy Haemonchus species infection (20,000 - 30,000 worms) can kill a sheep very quickly [38].

Diagnosis

Clinical signs: Haemonchus contortus infection is clinically diagnosed by anemia, dehydration, and sub mandibular internal fluid accumulation those results in the formation of a bottle neck, diarrhea and low packed-cell volume (PCV). Infection also results in retarded growth; weakness reduced reproductive performance, general illness and death [4].

Microscopical techniques: Haemonchus eggs were identified on the basis of morphology [39]. Species whose eggs exhibit similar morphological characters and therefore cannot be distinguished from each other can further be subjected to larval culture and identification of the third stage larvae (L3) [40] . Supplementary diagnosis is achieved through the use of microscopic techniques by the recovery of H. contortus eggs from stool samples. Because the eggs of many important genera are morphologically similar and therefore hard to identify to species level, a better way of delineate species is by larval culture and identification of 3rd stage larvae.

Demonstration of parasite eggs in faecal material can prove the presence of infection and is the most commonly used diagnostic method. Nevertheless, this method does not always reveal the presence of the parasite during low level of parasitic burden and pre-patent periods requiring repeated examinations. Host resistance to GIT helminthes also delays egg laying and a change in female worm size affects its fecundity. Hence, egg counts do not necessarily reflect the number of worms present. Other methods like measurement of parasite - specific antibodies can be used as supplementary diagnostic tools [41].

Serological techniques: Alternative diagnosis is based on serological techniques including ELISA [42]. According to Thekisoe et al., 2007 the biggest drawback of tests that rely on the detection of antibodies is their inability to distinguish between

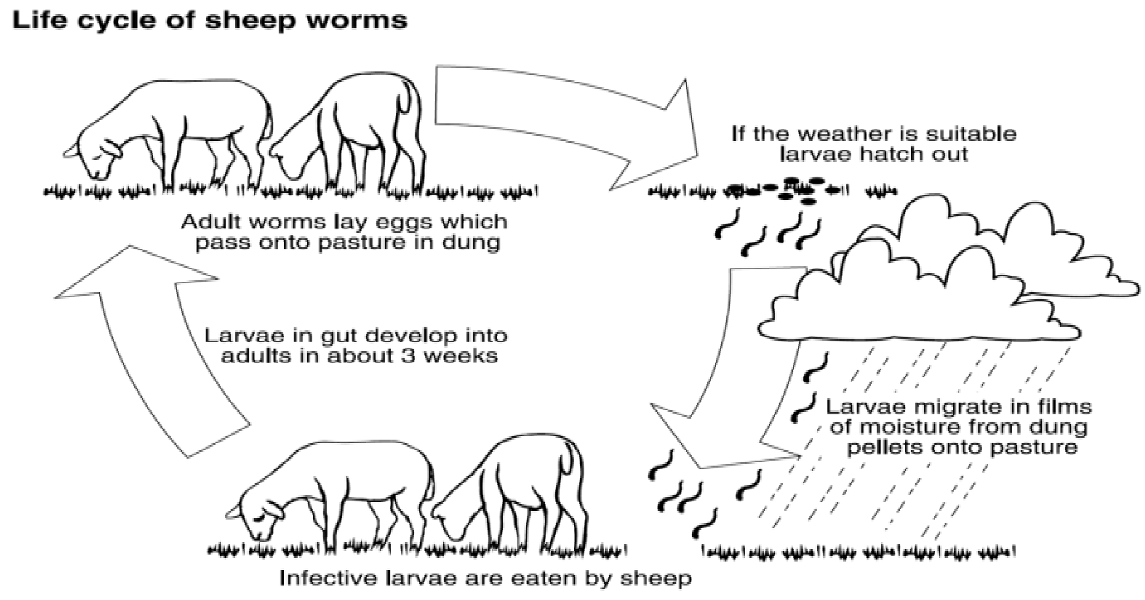

Figure 2 https:www.agric.wa.gov.au/livetock-parasites/barbers-pole-wom-sheep
Figure 2: Lifecycle

past and present infections. Molecular techniques have proved more rapid and accurate than both microscopy and serology hence there has been recent movement towards the development of molecular assays for detection of helminthes infections.

PCR: PCR was first developed in the 1980's by Kary B. Mullis [43]. PCR for detecting trichostrongyle infections, including H. contortus, in ruminants was developed by [40]. The assay consisted of four genuses - specific primer/probe sets enabling sensitive and specific amplification of target DNA from four trichostrongyle genera in the presence of multiple infections. Many other successful PCR- based assays have been developed over the past decade for identification and differentiation of strongly infections. However, PCR assays are more expensive as they include the use of expensive probes and cheaper methods of diagnosis are a necessity, justifying the need to develop a PCR assay for detection of H. contortus infections as a supplementary diagnostic tool.

Worm count and identification: According to Zajac et al., 2006 Haemonchus can be recovered from each of the infected abomasum in slaughterhouses is possible to count and morphologically identify [44].

TREATMENT

One of the challenges of haemonchus contortus in shoat is killing the animals in short period of time in acute case and other economic losses in chronic condition. At this time treatment is important Albendazole 5mg kg, Fenbendazole 5mg kg, oxfendazole 5mg kg, levamisole 7.5mg kg, Ivermectin 0.2 mg kg, Moxidectin 0.2 mg kg and closantel 10 mg kg (Table 1).

PREVENTION AND CONTROL MEASURES OR STRATEGIES

The objective of most parasite control method is not to completely avoid the parasites in livestock, but to keep the population under a threshold, above which it would otherwise inflict harmful effects on the host population. Any parasite control method aimed at minimizing a given parasitic population must consider the basic disease determinants briefly described above. The relative success or failure of any control strategies can be judged in terms of immediate and long term objectives, the ultimate goal being increase production, minimizing risks regarding drug resistance and consumer and environment associated problems. Generally, nematode control strategies can be directed against the parasite in the host and in the environment [45].

Methods to control H. contortus must attempt the break the life cycle of the worm; whether through anthelmintic, animal management, or pasture management [46]. Anthelmintic, drugs that removes the parasite from the intestines are the most common method for managing H. contortus. Chemical anthelmintic are often used to combat haemonchosis, because they are cheap, simple and cost effective; but parasite resistance to them is growing [47,48]. Ivermectin as well as albendazole and fenbendezol (both benzimidazoles) have produced the highest levels of resistance, and resistance with levamisole and moxidectin is increasing [49,50].

Resistance to these drugs is high because each one uses a specific mechanistic pathway to kill H. contortus. For example, ivermectin binds to glutamate-gated channels in the worm's nervous system, opening them, paralyzing the worm and killing them through starvation [51].

Natural dewormers build the animal's resistance to the worm, increasing their ability to expel the adult nematodes before they are able to attach to the intestines. H. contortus has evolved to thrive in weak intestinal environments and therefore it is harder for the parasite to establish in healthy digestive systems [52]. For

Table 1: List of some recommended drugs against haemonchus in sheep.

Chemical group	Anthelmintic	Prescribed dose
IMIDAZOTHIAZOLES	Levamisole	7.5mgkg
BENZIMIDAZOLE	Albendazole 5mgkg Fenbendazole 5mgkg Oxfendazole 5mgkg	5mg/kg 5mg/kg 5mg/kg
MACROCYCLIC LACTONES(avermectins)	Ivermectin Moxidectin	0.2mg/kg 0.2mg/kg
SALICYLANILIDES	closantel	10mg/kg

Source: (bowman, 1999)

example, garlic (Allium sativum) is a known antibacterial that likely derives its success in treating for H. contortus by making the host's digestive tract healthier [54].

Treatment against H. contortus using chemical and natural anthelmintic and dewormers is one approach to managing haemonchosis. Another common practice is selective treatment. Some organizations are educating farmers to use the FAMACHA method to identify and treat only those with high haemonchosis levels using their eye color. Farmers can compare the color of their sheep's conjunctivae using a scientifically developed FAMACHA card, Redder eye colors.

Indicate healthier sheep, white colors indicate dangerous anemia levels [54-56]. Others are promoting the use of the McMaster's method, a veterinary practice for determining H. contortus egg counts in sheep feces using microscopes and grid-lined McMaster's slides [49].

Other preventative measures are being investigated to lower exposure to the nematode and to maintain low levels of infection. The application of multiple methods of H. contortus management is suggested for achieving the highest rates of resistance and resilience in flocks [47]. Two of these methods are pasture rotation and nutrient supplementation. Proper pasture rotation allows time for on-pasture larvae to die out before they can be reconsumed and for grasses to grow higher than the larvae can climb [57].

Alternate grazing of different host species and alternation of grazing and cropping are management techniques that can provide safe pasture and give economic advantage when combined with anthelmintic [58]. Studies in the wet tropical climates of several Pacific Island countries showed that peak larval concentrations of H. contortus and Trichostrongylus species occurred on pasture about one week after contamination, but fell to barely detectable levels within 9 weeks [59]. Based on this, a rotational grazing system was designed which has resulted in a significant reduction in faecal egg counts as well as the number of anthelmintic treatments needed per year.

However, in many parts of Africa, communal pastoral systems do not allow for regulated grazing as a means of lowering exposure to infective larvae on pasture. Growing human populations and livestock densities coupled with the frequent drought in some regions necessitate unregulated animal movement in search of green pasture and drinking water [60]. Exploitation of refugia through alternate grazing of cattle and sheep [58], or sheep and goats [61] to reduce pasture levels of infective larvae or dilute populations of drug resistant strains of parasites strains of parasites could be of great value in any management program.

Studies show that protein and herb supplements improve the health of the digestive tract, lessening the effects of infection and increasing host resilience [62]. Most animals develop immunity against internal parasites, which keeps the parasites from reproducing but doesn't kill them. It is young animals that have not developed immunity and those animals whose immunities are compromised that are the most affected by H. contortus [52].

Once a sheep is infected, H. contortus impairs the animal's functions by reducing its voluntary food intake and the efficiency with which its food is used [63,64]. At both of these stages, before and during infection, heightened immunity is crucial to controlling parasiticstages within the host and thereby increasing resilience and resistance [47].

CONCLUSION AND RECOMMENDATIONS

Sheep is one of the most important animals that provide farmers with food and other products and by products. One of the most noteworthy antagonistic factors to sheep farming is parasitic diseases; especially those caused by nematodes. H. contortus is one of the most important endoparasites of sheep. Haemochosis contortus cause great economic loss is shoats with causative agent of H. contortus. It takes 21 days after ingestion of its infective agent L3. Live in abomasum of shoats and cause irritation, each worm suck blood. Besides weight loss, anemic, bottle jaw, slow growth, poor wool, quality occurs. It can be identified by use of PCV, fecal egg count, worm count and identification and effective management of internal parasites cannot be accomplished by using only one management factor, it is a combination of factors that will produce the most effective defense against internal parasites. Anthelmintic should be used only to treat animals when necessary, and should be thought of a limited resource to be used sparingly. Proper pasture and animal management is a key component to managing internal parasites in sheep and goat operations plus vaccination, copper oxide, feeding condensed tannin containing forage and use parasite trapping fungi. Generally, the presences of risk factors like warm and humid, poor animal management and seasonal change leads to feed stress and other concurrent diseases that could favor the distribution of disease.

Therefore based on the above conclusion the following recommendations are forwarded:

- Animals should be kept in high plane of nutrition (management) especially sheep in poor body condition and young's in order to develop resistance against haemonchosis.
- Strategic deworming of the parasite should be focus on sheep at the beginning of the grazing period to prevent the contamination of the pasture and at end so as to prevent load of parasite in dry season.
- An appropriate control and prevention methods of haemonchosis should be designed like: rotational grazing, avoiding over flocking and zero grazing.

- Use clean feeders and continue to practice good hygiene in the pens and pasture.
- Use gravel or concrete in the feedlot area to break the worm life cycle and to prevent reinfestation.
- Try a mixed species grazing program using cattle and goats.

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