

**Correlation between Naturally Occurring Caprine
Haemonchus contortus Infection and the
Packed Cell Volume, Haemoglobin Concentration,
Total Protein and Albumin**

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ABSTRACT. *Haemonchus contortus* is one of the major parasites responsible for parasitic gastritis that causes serious economic losses to the goat industry in Sri Lanka as in other tropical and subtropical countries of the world. The diagnosis of this infection is generally dependent on the number of parasitic eggs present in the faeces (eggs per gram of faeces; epg); although it is not a reliable measure of the worm burden. Therefore, in this study an attempt has been made to examine the correlation between the worm burden and selected blood parameters so as to determine whether such parameters may be used as an aid in the diagnosis of parasitic gastritis caused by the pathogenic nematode, *Haemonchus contortus*.

During a 12 month period, blood samples and abomasa were collected from 248 naturally infected crossbred goats from the Dry Zone that were slaughtered at an abattoir. Blood samples were analyzed for haemoglobin (hb), packed cell volume (pcv) and total protein and albumin contents, while the abomasa were processed to determine the lumen and mucosal worm burdens. High worm burden (1000 – 1273), demonstrated a weak negative correlation with pcv, while a moderate worm burden (500 – 999) demonstrated a weak negative correlation with hb. However, when the worm burden was low (<500) there was no correlation with the haematological parameters. Further, the worm burden did not correlate with the total protein or albumin. The results of this study indicates that although *H. contortus* is a blood sucking nematode in the abomasa of goats, the chronic form of the infection as observed in the present study appears to cause changes in the systemic red blood cell parameters and not in the proteins which are also lost during the course of the infection. Since only a weak negative correlation was observed

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between blood parameters and the different levels of worm burden, haematology appears to have only a marginal advantage in assessing H. contortus infection in the population of goats examined in this study.

INTRODUCTION

Goat husbandry provides a considerable source of income to subsistence rural farmers in tropical and subtropical countries of the world (Devendra and Burns 1983). In Sri Lanka, over 65 percent of the goat population is distributed in the dry and dry intermediate zones of the country where herds of varying sizes (25 – 300 animals per herd) are managed under extensive or semi-intensive system, primarily for meat production. Under these management systems, gastrointestinal nematodes have been recognized as a major constraint to the development of the goat industry. Studies conducted in an abattoir (Rajapakse *et al.*, 1996) and a subsequent field investigation (Paranagama *et al.*, 1997) showed *Haemonchus contortus*, *Oesophagostomum* spp and *Trichostrongylus* spp as the most prevalent species present in the gastrointestinal tract of goats in Sri Lanka. Further, these mixed nematode infections were dominated by *Haemonchus contortus*, a highly pathogenic nematode species which is known to cause significant economic losses to the small ruminant industry in the world (Rahman and Collins, 1991; Soulsby, 1982).

Clinically, the *Haemonchus contortus* infection in ruminants is manifested either as an acute or chronic infection (Soulsby, 1982). The acute form is more common among the young animals (under 6 months) and is characterized by anaemia, oedema, diarrhoea and high mortality. On the other hand, the chronic form of the infection is more common and is characterized by few numbers of worms in the abomasum and reduced weight gain. Mortality is present, but sporadic. The diagnosis of chronic haemonchus infection is based on egg and other signs that include unthriftiness, progressive loss of weight gain and lowered milk production. Quantification of parasitic eggs in faeces (epg) is used as a diagnostic test to detect the infection in ruminants but Gordon and Whitlock (1939) demonstrated that epg alone is not a reliable marker of the level of the infection. These observations were subsequently confirmed by other investigators (Brunsden, 1971; Klesius, 1988; Armour, 1989; Hanse and Brian, 1994) who showed that epg may vary with faecal consistency, age of parasites, influence of host factors such as immune status of animals and concurrent diseases. Despite these limitations, epg

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continues to provide useful information on parasitic infection when applied on herd basis rather than on individual animals (Baker, 1988).

The principal feature of haemonchus infection is its influence in altering blood parameters, since both adult and fourth stage larvae are blood suckers and cause haemorrhages into the abomasum. This has been studied in sheep and cattle (Darzi, 1975) and blood parameters are used widely as a complimentary diagnostic test, particularly in sheep. Very little information is available on the use of blood parameters as an aid in the diagnosis of haemonchus infection in goats (Dorny *et al.*, 1995; Tilhum, 1995). Therefore, in the present study, we have examined the possibility of using selected haematological parameters (packed cell volume and haemoglobin) and biochemical constituents (total protein and albumin) as indicators of *H. contortus* infection in the goats.

MATERIALS AND METHODS

Materials for this study were collected from the Colombo municipal abattoir by making fortnightly visits during a 12 month period (Jan-Dec, 1996). On each visit, around 10 goats from the Dry Zone were selected, labelled and 5 ml of jugular blood was collected in EDTA (2 mg/ml) and a further 5 ml was collected into plain glass tubes. The abomasa from the selected animals were collected at slaughter and transported along with the blood samples to the laboratory in a polystyrene container in which the temperature was maintained at 4°C.

The adult worms in the lumen of abomasum were counted as described by Ritchie *et al.* (1961). Briefly, the abomasa were opened along the greater curvatures and contents and abomasal mucosa were washed in 2 litres of tap water; four aliquots of 50 ml each from the suspension were counted. Parasites in the mucosa were counted according to the method described by Herlich (1956) using aliquots of mucosal scrapings digested in pepsin-HCl.

Blood collected in EDTA was used to determine packed cell volume (pcv) and haemoglobin (hb) concentration by the capillary microhaematocrit method and cyanmethemoglobin method, respectively (Jain, 1986). Serum harvested from blood collected in plain glass tubes was assayed for total protein (tp) and albumin (alb) using biochemical kits from Randox (Randox Laboratories, UK).

Statistical analysis

The correlation between the worm burden and blood parameters was analyzed using the Microsoft® Excel Statistical Package (Release 97, Copyright - Microsoft Corporation). In order to normalize the distribution of *H. contortus* worm burden, logarithmic transformed values of worm counts were used to examine the correlation between the blood parameters and biochemical values.

RESULTS

The worm burden (lumen and mucosal) in the 248 abomasa consisted largely of *H. contortus*. The number of worms present in each abomasum was counted and depending on the number of parasites present the abomasa were classified as those having a high (1000 – 1273), medium (500 – 999) and low (<500) worm burden. The correlation of each worm burden against the corresponding haematological (hb and pcv) and biochemical (tp and alb) parameters are mentioned in Table 1. Sixty nine of the abomasa examined did not have any adult worm.

Table 1. The correlation values between the worm burden and the pcv, hb, tp and alb values.

Worm burden of <i>H. contortus</i>	n	pcv	hb	tp	alb
0	69	-	-	-	-
1 – 499	114	0.08	0.06	0.01	0.17
500 – 999	39	0.17	0.32	0.07	0.13
1000 – 1273	26	0.45	0.31	0.01	0.07

When the *H. contortus* worm burden was less than 500, there was no correlation between the worm burden and the haematological or biochemical parameters. A weak negative correlation was observed between hb and moderate worm burden (500 - 999) and between pcv and high worm burden.

(1000 – 1273). None of the worm burdens described above correlated with tp or alb.

DISCUSSION

In this study, an attempt has been made to examine the usefulness of selected blood parameters as an aid in the diagnosis of the parasitic infection, particularly that caused by *Haemonchus contortus*. The animals examined in this study originated from different areas of the dry zone where goats are reared solely for meat production. Admittedly, the clinical history of the animals were not known at the time of examination, but in general, goats from the dry zone are not given anthelmintics, hence the parasites present in the gastrointestinal tract would, to a large extent, represent the parasites prevalent in the area. According to previous studies conducted in these areas (Rajapakse *et al.*, 1996; Paranagama *et al.*, 1997), *H. contortus* appeared to be one of the most prevalent and important nematodes affecting goats. In the experimental studies reported by Al-Quaisy *et al.* (1937), a significant reduction of pcv was demonstrated in *H. contortus* infection in goats. In the present study we have explored the possibility of using these haematological observations together with other biochemical parameters in order to determine whether the measurement of these constituents will prove to be more precise in assessing the extent of the infection. The results of our study indicated a weak negative correlation between worm burden and pcv in the goats where the number of parasites were high (1000 – 1273); The correlation of haemoglobin values in both moderate and high worm counts were weak. *H. contortus* is known to thrive in the abomasum through sucking blood from the mucosa, therefore, haematological changes reflecting anaemia can be expected with the infection. However, the degree of anaemia is dependent on the number of worms present in the abomasum. In the present study, the highest number of worms present were between 1000 – 1273, which is considered to be in the range of the chronic form of the disease (Joulsby, 1982), at which animals show only a mild anaemia. Worm burdens with higher number of parasites is likely to induce a more severe anaemia in which a better correlation may be expected. The latter speculation needs to be confirmed by further studies.

Although, *H. contortus* is known to cause mucosal damage resulting in a protein-losing enteropathy, the results of the present study did not, however, reflect this phenomenon by reduced serum protein or albumin concentrations. The latter observation may be due to the relatively low worm burden in most of animals examined to cause a significant protein reduction.

Alternatively, it may be that the goats were able to make-up for the protein losses through metabolic reserves of the host as described by Soulsby (1982).

In conclusion, *H. contortus* infection examined in this study is the chronic form of the infection in which changes in systemic red blood cell parameters were present but not in the proteins which are also lost during the course of the infection. Since only a weak correlation was observed between blood parameters and the worm burden, haematology appears to have only a marginal advantage in assessing *H. contortus* infection in the population of goats examined in this study.

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