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## EFFECTS OF *Haemonchus contortus* INFECTION ON SODIUM STATUS OF SHEEP

### EFEITOS DA INFECÇÃO DE *Haemonchus contortus* SOBRE O STATUS DE SÓDIO EM OVINOS

Enrico Lippi Ortolani<sup>1</sup>

- NOTE -

#### RESUMO

Eight five-month-old male lambs received a diet with marginal levels of sodium (0.5 g Na/kg DM); four lambs were given a single dose of infective *Haemonchus contortus* larvae (4,600 L<sub>3</sub>/head) and four were kept uninfected. The lambs were slaughtered 30 days after the infection. Sodium concentration was determined in the abomasal fluid at the slaughter. The balance between intake and faecal excretion of sodium was evaluated. Saliva was collected at days zero, 20 and 30 to determine the Na:K ratio. The mean total worm burden retrieved was 1390. The infection increased abomasal sodium concentration ( $p < 0.001$ ) and reduced faecal sodium excretion ( $p < 0.02$ ), but there was not a significant relationship between worm burden and abomasal ( $p > 0.082$ ) or faecal sodium excretion ( $p > 0.5$ ). The higher the abomasum sodium concentration, the lower the faecal sodium excretion ( $p < 0.001$ ). Apparent digestibility of sodium was similar between infected and uninfected. At the end of the experiment a slight decrease in the salivary Na:K ratio was observed, in animals of both groups, caused mostly by diet rather than the parasitism. It was concluded that although *H. contortus* infection increased the loss of sodium into the abomasum there was a greater compensatory intestinal absorption to prevent a significant change in the sodium status of sheep.

**Key words:** *Haemonchus contortus*, infection, sheep, sodium, balance, deficiency.

#### RESUMO

Oito cordeiros machos, com cinco meses de idade, receberam uma dieta com teores marginais de sódio (0,5 g Na/kg); quatro ovinos foram infectados com uma única dose de 4.600 L<sub>3</sub>/cordeiro de *Haemonchus contortus* e quatro foram mantidos como controles, não infestados. Todos os animais foram sacrificados 30 dias após a infecção. O teor de sódio foi determinado no fluido abomasal. Foi estudado o balanço entre a ingestão e a excreção de sódio fecal. A relação Na:K foi determinada em saliva colhida nos seguintes dias do experimento: zero, 20 e 30. A carga parasitária média foi de 1390 vermes. A infecção

aumentou o teor de sódio no conteúdo abomasal ( $p < 0,001$ ) e reduziu a excreção de sódio fecal ( $p < 0,02$ ), porém não ocorreu uma relação significativa entre a carga parasitária e as concentrações de sódio abomasal ( $p > 0,082$ ) ou fecal ( $p > 0,5$ ). Quanto maior o teor abomasal de sódio, menor foi a excreção fecal de sódio ( $p < 0,001$ ). A digestibilidade aparente do sódio foi similar entre os grupos infestado ou não. Foi constatada uma pequena diminuição na relação Na:K salivar, em todos os animais, ao término do experimento, causada pela dieta marginal de sódio e não pelo parasitismo. Foi concluído que, embora a infestação por *H. contortus* promovesse uma perda expressiva de sódio no abomaso, existiu, em seguida, uma maior absorção intestinal compensatória para prevenir que ocorresse um estado de deficiência desse macroelemento nos ovinos.

**Palavras-chave:** *Haemonchus contortus*, infecção, ovinos, sódio, balanço, deficiência.

*Haemonchosis* is one of the major constraints to the sheep industry in the humid tropical and semitropical areas. The *Haemonchus contortus* infection interferes directly on the productivity of sheep as well as is an important cause of death in lambs. (WALLER *et al.*, 1996). The grasses from tropical and semitropical areas are very poor in sodium and failure to supplement the diet of grazing ruminants with this element invariably leads to a status of deficiency (MORRIS, 1980). Effects of *H. contortus* infection on the abomasal environment were studied by COOP (1971). In addition to a decrease in acidity a large increase in sodium-ion concentration in the abomasal fluid within three to five days of infection was found. OOSTERHUIS (1991) diagnosed sodium deficiency in weaned lambs infected naturally with abomasal (mainly *Teladorsagia circumcincta*) and intestinal (mainly *Nemato-*

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*dirus battus*) nematodes and suggested that both infections induced the deficiency by increasing efflux of sodium into the abomasum associated with inhibited absorption of sodium in the intestinal tract of lambs with diarrhoea. Despite those studies no information is currently available as to whether *H. contortus* can interfere with sodium status in lambs. The present investigation was undertaken with the purpose of establishing the influence of the *H. contortus* on the sodium abomasal efflux and faecal excretion of sodium and on the Na:K ratio in saliva throughout the parasitism.

Eight five-month-old male Suffolk-Crioulo lambs, weaned when three-month-old, drenched at that time with levamisole (7.5mg/kgBW) and raised in concrete pen were used. The lambs were fed a diet containing: 75% of the DM of chopped napier grass (*Pennisetum purpureum* Schum), 20% wheat meal and 5% soybean meal. This diet provided a marginal level of sodium (0.5 g/kg DM). Prior to the beginning of the infection, these lambs received a free-choice mineral supplement, with 14.4% of sodium. Three weeks before infection this supplement was removed. The animals were divided in two groups of four lambs each and kept in different concrete pens. The first group was given a single dose of 4,600 infective *H. contortus* larvae; the remainder was kept uninfected. Food intake was recorded throughout the experiment. To evaluate the total excretion of faeces collection bags were attached to the animals for four days before infection (first period) and for the last four days before slaughtering (Day 30). The *H. contortus* larvae were obtained from a mono-culture maintained in the laboratory over several years. Mixed saliva was collected at days 0, 20 and 30 after the infection by a technique previously described (ORTOLANI, 1997). After slaughter, the abomasum was removed. Larvae and adult worms were retrieved by a technique described by JACKSON *et al.*, (1984). All faeces excreted in four different days of both periods were collected and weighed. Dry matter was estimated following air-drying at 103°C for 28h. Sodium was determined by flame photometry in supernatant samples of saliva, abomasum fluid and in the dry matter of faeces and feeds; potassium was determined in supernatants samples of saliva by the same method. The apparent digestibility (AD) of sodium was determined according to CHURCH & POND (1988) by the following formula:

$$AD (\%) = \frac{(g \text{ daily Na intake} - g \text{ daily Na excreted in faeces}) \times 100}{g \text{ daily Na intake}}$$

Changes within and between groups over time in salivary Na:K ratio, intake and faecal sodium

level, and apparent digestibility of sodium were compared by analysis of variance with application of the least significant difference test. Linear regression between total worm burden and abomasal sodium concentration or faecal sodium concentration or between these last two parameters were assessed by analysis of variance (SNEDCOR & COCHRAN, 1967).

There was a small variation in the total worm burden retrieved (1,240 to 1,580; mean 1,390 worms). The infection increased ( $p < 0.001$ ) sodium abomasal concentration (infected  $115 \pm 12$  mMol/L; control  $82 \pm 6$  mMol/L). However, there was no significant relationship between worm burden and concentration of sodium in the abomasal fluid ( $p > 0.082$ ). When the parasitism was established the control lambs consumed more sodium than the infected ones ( $p < 0.02$ ; infected 228mg/d, control 256mg/d, pooled standard deviation PSD 15). At the end of the experiment there was a significant reduction in faecal sodium excretion in the infected lambs as compared with the same animals at day 0 and with controls in both periods ( $p < 0.02$ ; before infection: infected 127mg/d, control 129mg/d; after infection: infected 100mg/d, control 117mg/d, PSD 7). Apparent digestibility of sodium was higher in both groups at the end of the experiment ( $p < 0.02$ ; before infection: infected 40.9%, control 38.6; after infection: infected 56%, control 54.5% PSD 4.7) compared with the values before the infection. There was no significant relationship ( $p > 0.5$ ) between worm burden and faecal sodium excretion. The higher the abomasal sodium concentration, the lower the faecal sodium excretion ( $p < 0.016$ ) (figure 1). At day 30 significant ( $p < 0.04$ ) lower salivary Na : K ratio was found (infected  $15.8 \pm 1.8$ ; control  $16 \pm 1.5$ ) in control and infected groups as compared to day zero (infected  $20.4 \pm 1.7$ ; control  $20 \pm 2$ ).

These data demonstrated that *H. contortus* infection by itself did not interfere with the sodium status in sheep as measured by changes in the salivary Na : K ratio. There was a significant de-

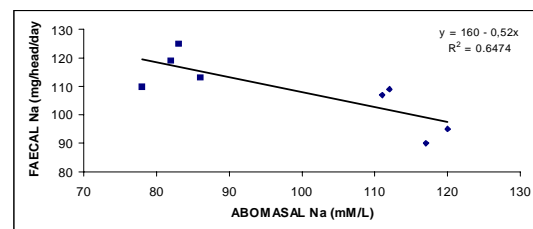


Figure 1 - Influence of abomasal Na concentration on the faecal Na excretion in control (square) and infected lambs. (lozenge).

crease in this ratio but it was not enough to induce sodium deficiency that is achieved when the ratio is less than 4 (MORRIS, 1980). The lower salivary Na : K ratio found at day 30 could be explained by the marginal Na dietary intake offered to the lambs throughout the experiment (0.5g/kg DM; requirements for growing lambs 0.07g/kg DM). Definitely, *H. contortus* infection caused increased sodium flow into the abomasum as described by COOP (1971). In spite of this apparent loss of sodium there was a response to keep the sodium status as normal as possible through an effective absorptive capacity in the intestines detected by a decrease in the amount of sodium excreted in faeces (figure. 1). Yet not only the infected lambs but also the control lambs showed an improved capacity of the intestines to absorb sodium; while there was no difference in the apparent digestibility of sodium in both groups. This clearly showed that the sodium absorption was regulated mostly by the marginal Na dietary intake rather than a consequence of parasitism. According to MORRIS (1980) sodium deficiency in ruminants led to the suprarenal gland to secrete aldosterone which increased the sodium reabsorption from the intestinal content.

In conclusion, although *H. contortus* infection increases sodium efflux into the abomasum there is sufficient absorption in the intestines to prevent a true loss of this macroelement in the faeces, avoiding a significant change in sodium status of lambs.

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