New Zealand Journal of Zoology, 2009, Vol. 36: 479–487
1175-8821 (Online); 0301-4223 (Print)/09/3604–0479

Abstracts of papers and posters presented at the 36th Conference of the New Zealand Society for Parasitology, at Massey University, Palmerston North, 23–24 October 2008

The ecology and evolution of parasite transmission in a changing world

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Natural ecosystems are under siege on all fronts, with processes ranging from species invasions to climate change directly altering their biotic composition and functioning. Parasites in those ecosystems face unprecedented challenges including rapid changes in host abundance and the sudden appearance of potentially new host species. Their ability to respond will depend in large part on the flexibility of their infection strategies and transmission routes. I will use native New Zealand trematode species as model parasites to illustrate how variable transmission strategies really are within species. Using a combination of molecular tools and experimental approaches, we have shown that the plasticity in trematode transmission strategies depends both on genetic determinism and plastic responses to external signals. Our findings challenge the dogma of rigid life cycles and restricted host specificity. The intraspecific flexibility seen in trematodes should allow them readily to track, and adjust to, changes in host availability resulting from ecosystem-wide environmental impacts.

Effects of parasitism on gastrointestinal mucins of sheep

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Mucins play important roles in host-pathogen interactions, influencing host resistance and establishment of infection, as pathogen recognition sites and as a source of nutrients. They are highly glycosylated molecules and changes in monosaccharide composition during parasitism have been reported in pigs, mice and rats. There are no data on sheep gastrointestinal (GI) mucin modifications after infection with nematodes. Experiments were designed to examine the effects of parasites on GI monosaccharide component of mucins of sheep: (1) non-infected; (2) sheep infected with 10 000 *Haemonchus contortus* and slaughtered 21 days post infection (p.i.); (3) sheep infected with 15 000 *Ostertagia circumcincta* and slaughtered 28 days p.i. Mucus was scraped off the surface of the abomasal fundus. Gel filtration and CsCl density gradient centrifugation were used to purify the mucins. Mucins were hydrolysed in 2*M* HCl to release monosaccharides that were quantified with a HPAEC CarboPac-PA20 column. Four monosaccharides that were detected in mucin glycoproteins were fucose, glucosamine, galactosamine and galactose. In uninfected animals, the predominant

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Z09022; Online publication date 13 November 2009
Received 25 June 2009

hexose was galactose (40.9) with smaller proportions of glucosamine and galactosamine (24.6 and 21.9 respectively). Fucose (12.6) approached a significant decrease in *H. contortus* infected (6.3) and *O. circumcincta* infected sheep (8.3). Galactosamine was lower in infected animals than in worm-free sheep. There was no difference in the proportion of galactose between uninfected and *H. contortus* infected animals (40.2) whereas it increased in those *O. circumcincta* infected (62.9). The study showed that parasitism caused changes in the ratio of hexoses and hexosamines in gastrointestinal mucins of sheep.

Recovery of L3 *Haemonchus contortus* larvae from grass samples—where do they go?

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A common problem with estimating the contamination of pasture with sheep parasitic larvae is obtaining an accurate estimate of the population from a plot sample. Even if the plot correctly representated the whole pasture, recovery of worms using standard methods can vary from 20 to 80%. Experiments were carried out to assess the loss of worms at each step through the process of larval recovery from standardised grass samples. A counted number (100, 500 or 1000) of fluorescently-labelled *Haemonchus contortus* larvae (L3) was incubated on grass overnight and then recovered by baermannisation for 4–48 h. The baermannising solutions included water, bleach 0.13%, Triton X100 (1% or 0.5%) or Pyroneg 0.4%. To identify points within the technique where larvae might be lost, larvae remaining in pipettes, beakers and different layers of the baermannising solution were counted. The highest recovery (50%), while maximising consistency, was with 500 larvae and baermannisation for 48 h in water. Higher recovery, but greater variability (30–90%) was obtained using the bleach solution. Treatments such as adding detergents Triton X100 or Pyroneg had little effect (20–45%) on improving recovery. Flushing pipettes with water after each handling process of the larvae reduced the loss by only 1% and siliconising the glassware to avoid adhesion to the glass surface by 2%. The 40% not recovered are likely to be left on grass. Overall the most consistent method for worm recovery was baermannising using siliconised glassware, for 48 h at room temperature.

Effect of excretory/secretory products of abomasal parasites on epithelial tight junctions

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The presence of abomasal parasites is thought to be associated with an increase in the permeability of the gastric epithelium. Epithelial permeability is regulated by junctional complexes between adjacent cells. The most apical component of this junctional complex is the tight junction which functions as a paracellular diffusion barrier. Any disruption of tight junctions results in impaired barrier function and an associated increase in epithelial permeability. To investigate the effect of abomasal parasites on the integrity and barrier function of epithelia, Caco-2 cell monolayers were exposed to the excretory/secretory products (ES) of adult *Ostertagia* (*Teladorsagia*) *circumcincta* and *Haemonchus contortus*. Changes in epithelial barrier function were monitored by measuring transepithelial electrical resistance (TEER) and tight junction integrity was visualised using immunofluorescence localisation of the tight junction-associated proteins, occludin and zonula occludens-1 (ZO-1), by confocal microsopy. Under control conditions, occludin and ZO-1 were localised to a continuous pericellular ring around individual cells when viewed from the apical sur-