The Ability of Nitrogen Fertilisers to Break the Lifecycle of Gastro-intestinal Nematodes

by

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Current gastrointestinal nematode (GIN) control relies heavily on chemical anthelmintic, targeting nematodes within the host ruminant. Most of the lifecycle occurs outside of the host so targeting the free-living population may be a successful approach to parasite control. Nitrogenous fertiliser application has been shown to reduce *T.colubriformis* egg hatch and larval development with evidence to suggest the effects may be universal, but little research has been conducted beyond the sheep host in ruminants. Further, the mechanisms through which this phenomenon occurs are not known, an understanding of which may assist in refining potential use of this approach to break the lifecycle of parasitic nematodes.

This series of experiments investigated the universality of urea treatment on egg hatch and larval development across several ruminant hosts. Hatching of deer and horse nematodes was reduced from 94% at 0% urea to less than 16% in 20% urea ($P<0.001$). Recovery of larvae in a development assay was reduced by up to 90, 100 and 94% following the topical application of liquid urea for deer, horse and *Nematodirus* parasite species, respectively, although there was variation between species regarding the amount required to achieve the desired effect. Despite apparent species variation in the sensitivity to urea, the inhibition of egg hatching and reductions in larval recovery appear to be universal across the ruminant GINs examined here.

Studies into the mechanisms included the time of exposure to urea, reversibility of the effects and the importance of osmolality. Although larvae still appeared to develop normally within the egg, the exposure time required for 50% of eggs to remain unhatched when exposed to a 10% urea solution for *Trichostronglyus colubriformis* was 7.5 ± 0.9 hours. Further, this effect was irreversable with no further hatching once eggs were washed and incubated in water for a further 168 hours.

It was postulated that osmolality may be a driver behind hatch inhibition instead of toxicity to components within urea fertliser. Solutions of urea, salt and glucose prepared to 1500 ± 50 mmol/kg (equivalent to 10% urea solution) reduced hatch by 90, 100 and 100%, respectively ($P<0.001$), suggesting the mechanism of inhibition of egg hatching may

be associated with osmolality, rather than a direct toxic effect of urea. Although further studies are required to determine the suitability of this approach in the field, the results of this series of experiments suggests the application of urea or substances with a similar osmolality have the potenital to assist in breaking the parasite lifecycle through interrupting larval development outside the host.

Keywords: Urea, gastrointestinal nematodes, egg hatch, larval development, exposure, irreversible osmolality, hatch inhibition.