Toxicity in beef cattle grazing *Leucaena leucocephala* in Queensland, Australia

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Introduction Improved pastures based on the leguminous shrub *Leucaena leucocephala* (leucaena) are the most productive, profitable and sustainable for beef cattle production in northern Australia. Leucaena forage contains the toxic, non-protein amino acid mimosine, which is rapidly converted to 3-hydroxy-4(1H)-pyridone (DHP) upon ingestion by grazing cattle. This is a potent goitrogen and appetite suppressant. Animals suffering severe DHP toxicity exhibit distinctive symptoms (e.g. hair loss, excessive salivation, goitre and weight loss), while subclinical DHP toxicity can suppress live weight gain by 30-50% without producing any obvious symptoms. Prior to the discovery and introduction of the DHP-degrading rumen bacteria *Synergistes jonesii* into Australia in 1982, DHP toxicity severely limited animal performance from leucaena pastures and was a major impediment to adoption. Initial rumen inoculation of cattle in Australia with *S. jonesii* successfully protected them against DHP toxicity and the bacterium appeared to be easily and rapidly transmitted between grazing animals. Consequently many scientists and graziers believed that a single inoculation of a herd with *S. jonesii*, combined with simple ongoing herd management, was sufficient to overcome the problem of DHP toxicity. However, during the 2003 drought there were several reports of severe leucaena toxicity (including animal deaths) in cattle grazing leucaena in Queensland. Toxicity was evident even in herds that had followed recommended control measures. Preliminary results are presented of a study, designed to ascertain the prevalence and possible causes of leucaena toxicity in Queensland cattle herds. Meat and Livestock Australia Limited funded this research (NBP.340).

Materials and methods Forty-four (44) cattle herds grazing leucaena were randomly tested for toxicity. Paired urine and rectal grab faecal samples were collected from 385 animals. Urinary concentrations of mimosine, 3,4-DHP and 2,3-DHP were measured using HPLC analysis (Tangendjaja & Wills, 1980). Faecal delta carbon ($\delta^{13}C$) radioisotope analysis (Jones *et al*., 1979) determined the proportion of leucaena in each animal's diet.

Results Urine of all the cattle tested contained trace amounts of mimosine, indicating none was suffering acute mimosine poisoning. However, there was considerable variation in urinary concentrations of 3,4-DHP (1-2000 ppm) and 2,3-DHP (1-1800 ppm). Herds generally fell into 3 categories of toxicity status: i) 21 herds (48%) were completely protected as animals had low urinary concentrations (<200 ppm) of both 3,4-DHP and 2,3-DHP; ii) 9 herds (20%) were unprotected as animals had high (>200 ppm) urinary concentrations of both 3,4-DHP and 2,3-DHP; and iii) 14 herds (32%) where animals had low concentrations (<200 ppm) of 3,4-DHP but high concentrations (>200 ppm) 2,3-DHP.

Detoxification processes were working efficiently in the protected herds, as these animals were consuming diets containing high proportions (mean 35±3% DM intake) of leucaena. In the remaining herds, where leucaena intake ranged from 7 to 59% of the diet, subclinical DHP toxicity occurred even though all but one grazier had attempted to introduce the bacterium to their cattle. This might reflect poor grazier understanding of effective rumen inoculation procedures and herd management strategies. The frequent observation of significant amounts of 2,3-DHP in the urine samples was most unexpected. Our current understanding of the microbial detoxification of leucaena is that *S. jonesii* is the only bacterium capable of degrading 3,4-DHP to 2,3-DHP. Once this step has occurred, *S. jonesii* and a suite of other rumen bacteria rapidly breakdown 2,3-DHP into harmless by-products. In other work, 2,3-DHP has only been observed as a transitory degradation product present in low concentrations in the urine of protected animals. We are unsure why this process was not working efficiently. Herd management practices will be correlated with herd 2,3-DHP status to determine possible causes of this phenomenon. The concentrations of 2,3-DHP measured could limit animal performance by appetite suppression.

Conclusions Leucaena toxicity is still a significant issue in Australia, as *S. jonesii* and other rumen bacteria did not adequately protect 52% of the herds tested. In addition to further research, an extension program is required to inform graziers of effective inoculation and herd management strategies that prevent mimosine/DHP toxicity.

References

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