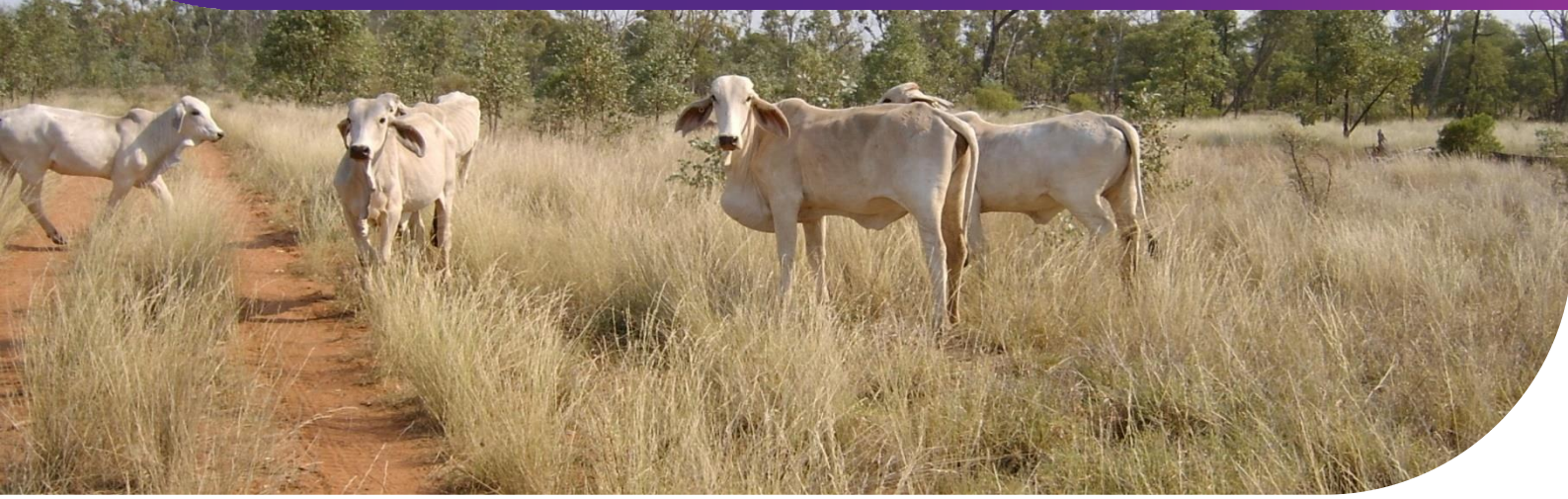

Improving beef production through management of plant toxins

Consumption of poisonous plants does not necessarily equal poisoning; our research aims to prevent uptake of toxins from the rumen

The economic impact of plant toxins on the Australian cattle industry has been variously quantified in terms of animal deaths, production losses and control measures ranging from several million dollars for such individual plants as Lantana and Georgina gidgee, to $50 million in bad years for Pimelea poisoning. Less readily quantitated but equally important are the detrimental impact of significant poisoning events on animal welfare and also on emotional wellbeing of producers.

Responses of livestock to acute poisoning by toxic plants are generally readily apparent when stock die. However, stock deaths are often not the major industry impact of poisonous plants, with a high proportion of associated economic loss being the effect in preventing realisation of potential production. More insidious and harder to identify and/or quantify is the sub-acute chronic poisoning of stock which can result in productivity losses through poor weight gain and reproductivity inefficiencies. The causes of such productivity deficits are often poorly understood in extensive production systems, but nutritional factors are significant contributors both through nutrient deficiencies and also the consumption of plant material containing toxins (particularly in prolonged dry periods).

Plant toxins can have wide ranging animal impacts, depending on their chemical structure and have the potential to contribute to ill thrift through specific toxicosis such as Pimelea poisoning and pyrrolizidine alkaloid associated liver disease, and reproductive losses through abortion and teratogenic effects, or calf losses associated with premature births, weak calves, or failure to suckle. The extent of this plant toxin contribution to reproductive losses in northern Australian pastures is ill-defined but may well contribute to the high incidence of unexplained calf loss in this region.

Devising strategies to deal with diverse plant toxins is not easy, as the chemical action and target organ varies considerably, and the **best line of action is prevention rather than remedial treatment.**

In pasture systems, it is difficult to prevent consumption of poisonous plants, other than by total removal from the pasture, which is generally not possible. However, plant consumption does **not** necessarily equal uptake of the toxin, and our approach is to devise strategies to bind or breakdown the toxin in the rumen **before** absorption into the animals' circulatory systems.

Queensland Alliance for Agriculture and Food Innovation (QAAFI)

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QAAFI is a research institute at The University of Queensland supported by the Queensland Government via the Queensland Department of Agriculture and Fisheries.

Studies in Pimelea Poisoning

Native Pimelea plants present a highly deleterious problem for cattle producers throughout inland pastoral lands of Australia. Consumption of these poisonous pasture plants causes a unique and remarkable poisoning syndrome in cattle, which has been historically referred to as St George disease and Maree disease. Pimelea poisoning of cattle is typically associated with diarrhoea, oedema of the head and brisket, and a rapid decline in live weight and body condition. The responsible toxin simplexin acts by causing pulmonary venule constriction leading to heart failure and excessive fluid accumulation, as well as acute diarrhoea. Limited management solutions are available and most effected stock die.

Some individual cattle are anecdotally recognized as less susceptible to Pimelea plant toxins, and this increased “resistance” is frequently attributed to previous low dose exposure to the toxin and subsequent enhancement of rumen microbial capacity to deal with or degrade the toxin.

Our current research project conducted in collaboration with Diane Ouwerkerk and her team at the Queensland Department of Agriculture and Fisheries seeks to capitalise on this natural rumen response by isolating microbes capable of degrading the Pimelea toxin simplexin (for use as preventative probiotics) and investigating toxin absorbents and/or biopolymers to foster toxin-degrading microbe populations.

Polyhydroxyalkanoate biopolymers are water insoluble, stable under rumen pH and degrade via a surface erosion mechanism, making them ideal candidates as novel delivery systems to provide timely low-dose toxin release and encourage beneficial microbes to propagate. These biopolymers can be extruded into various shapes and demonstrate promise as biodegradable rumen bolus delivery systems. Biochar and bentonite absorbents have also been tested in the laboratory and now in animal studies for their capacity to bind the toxin and prevent absorption from the rumen.

Pimelea simplex, one of the culprit poisonous Pimelea plant species

Researcher Profile

Professor Mary Fletcher

Prof Mary Fletcher is a natural product organic chemist and leads the Natural Toxin group within the Centre for Animal Science, QAAFI at the University of Queensland.

Prof Fletcher's research focus on the identification and chemical analysis of natural toxins in a range of plants, fungi and agricultural products. Such toxins can form residues in agricultural products and pose a risk to both livestock and human consumers..

Toxins of particular interest include mycotoxins, pyrrolizidine alkaloids, indospicine and simplexin.

Prof Fletcher is based at the Health and Food Sciences Precinct (Coopers Plains, Brisbane) and her current research is focussed on minimising the impacts of plant toxins on Australian livestock production.

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