PASTURE MYCOTOXIN IMPACT ON DARK CUTTING

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Abstract – King Island grass fed cattle (n=3,185) processed at a mainland Tasmanian abattoir in groups (n=66) between March-June 2015 were evaluated to determine which on farm factors impacted the incidence of dark cutting. Survey of mycotoxin prevalence revealed a high level of potentially toxic agents across all farms sampled. Total Ergot Alkaloids and FumonisinB1 had a negative impact on dark cutting rate per group (P<0.05).

Key Words – Beef, Meat Quality, Mycotoxin

I. INTRODUCTION

Beef meat with a high ultimate pH (>5.7) is classified as dark cutting and non-compliant under the Meat Standards Australia grading system. The high pH results in an inferior product quality, faster rates of spoilage and consumer rejection, which costs the Australian beef industry up to $55m per annum in lost revenue [1]. Dark cutting is caused by low muscle glycogen concentration at slaughter. Muscle glycogen at slaughter is dictated by quantity stored on farm via nutrition minus quantity catabolised due to stress and muscle contraction in the pre-slaughter period [2]. The annual dark cutting incidence in Australia is approximately 5.9% per annum and in grass fed cattle in southern Australia, the incidence of dark cutting increases when metabolisable energy and protein decline [2]. High incidences occurred in cattle grazing perennial ryegrass (*Lolium perenne*) dominant, short, declining in nutritional quality and at highest likelihood of *Neotyphodium lolii* endophyte presence [3]. Concentrated in the crown and reproductive tissue, *N.lolii* forms a symbiotic relationship with ryegrass providing vigour and pest resistance via the production of alkaloid mycotoxins. *N. lolii* produces hundreds of different alkaloids, of which many are potentially toxic to grazing livestock and result in an array of adverse effects including neurological and behavioural changes, increased muscle contraction, reduced feed intake and reduced growth rate [3]. Thus we hypothesise that cattle grazing pastures with high mycotoxin concentrations will have an increased incidence of dark cutting.

II. MATERIALS AND METHODS

Groups (n=66) of pasture fed cattle (n=3,185) of varying sexes, ages and breeds, were shipped to slaughter between March and June at the same processing plant. Animal and management factors were recorded for each group. A 500gram sample of pasture sward (n=66) were collected via random grab samples and freeze dried. Pasture quality and minerals were analysed using Near Infra-red and Wet Chemistry (Dairy One, Ithaca, New York, USA). Mycotoxin analysis was conducted by Biomin at Romer Labs, Singapore. The method was as described by Hafner *et al* [4], using a high-performance liquid chromatography-electrospray ionization-mass spectrometry using an Eksigent ultraLC100-XL HPCL coupled to an Applied Biosystems 5500 Qtrap mass spectrometer [4]. All carcasses were graded by qualified Meat Standards Australia graders where ultimate pH must be ≤5.7 to be eligible for grading. The combined total of ineligible carcasses based on pH were used to generate a percentage of dark cutting per group. A negative binomial regression analysis in STATA was performed to give the relative risk for environmental, management and pasture impacts on dark cutting.

III. RESULTS AND DISCUSSION

The pastures tested were perennial ryegrass (*L. perenne*) dominant, with approximately 80% having undergone no pasture renovation in the last 10years. There was a high prevalence of mycotoxins detected in the pastures (Figure 1). 100% of cattle had exposure to ≥ 3 major families (Ergot alkaloids, β-trichothecenes, α-trichothecenes, Aflatoxins, Fumonisins and Zearalenone) and 20% had exposure to all six. Ergot Alkaloids were detected at highly toxic levels in 91% of pastures and Zearalenone metabolites medium-high risk in 14% of all pastures whereas the other families were all considered low risk. BIOMIN considers Ergot concentration high risk to beef cattle when they are >400PPB and Zearalenone medium-high risk >200PPB. Total Ergot Alkaloids and FumonisinB1 were negatively associated with dark cutting ($P<0.05$). Those groups grazing pastures higher in total Ergot Alkaloids and FumonisinB1 had higher incidence of dark cutting. Available pasture (kg DM/Ha) had no impact on incidence of dark cutting.

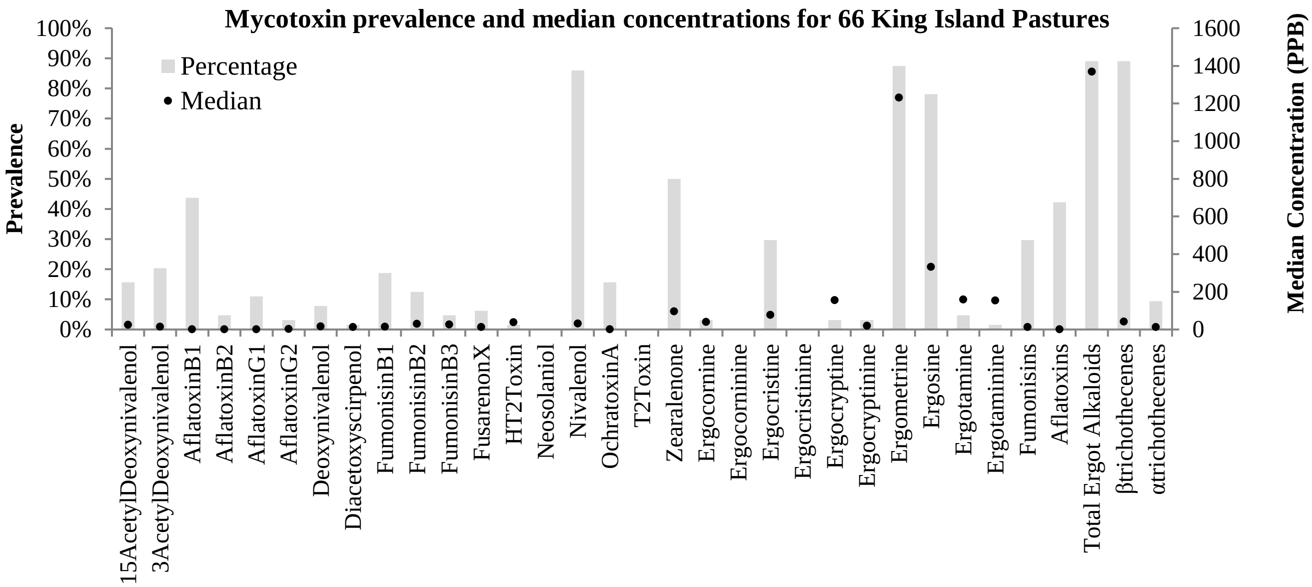

Figure 1. Prevalence of farms with exposure to mycotoxins and the median concentration detected.

Evaluating the impact of pasture mycotoxins in a commercial survey trial presents many difficulties. Random sampling in a paddock may not capture the true mycotoxin exposure present. Further when there is little variability in mycotoxin exposure across the groups it makes it challenging to determine what the true impact on production is. Finally dose response risk levels of low, medium and high need to be interpreted with caution as they consider the effects of a single mycotoxin insult only, not what interactive impacts of multiple mycotoxins on physiology may be.

IV. CONCLUSION

Characterising the true impact of mycotoxins consumed by grazing cattle on the incidence of dark cutting is challenging. This survey identified high mycotoxin prevalence in *L. perenne* dominant pastures from commercial beef properties plus highlighted that exposure is impacting dark cutting. Care must be taken interpreting mycotoxin levels in the pastoral setting as they may not represent the true magnitude of production impact especially when there are multiple toxins present [3]. Further research is required to determine cost-benefit analysis of mycotoxin mitigation strategies in the commercial setting.

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