Deer velvet antler science updates

JF Ward
AgResearch Invermay Agricultural Centre

Introduction

Research into the velvet antler on farmed deer has had a major shift over the past four years. From 1994-2019 Velvet Antler Research New Zealand (VARNZ), a joint venture between AgResearch and Deer Industry New Zealand (DINZ), invested in deer velvet antler research primarily focusing on velvet antler and co-products. Broadly speaking, research focusing on the animal producing the antler, and the antler while it was on or being removed from the animal was not the main priority with the notable exception of a PhD thesis by Flint (2012). In 2020 a new industry science innovation structure between AgResearch and DINZ brought together all aspects of deer farming science and began to address some of these historic gaps and aimed to provide new product knowledge to assist marketing of New Zealand deer velvet in the healthy functional food markets.

Recent projects

Through 2020 and 2021 there was a major initiative to increase the velvet antler data on DEERSelect to facilitate new estimation of the genetic parameters of red deer and wapiti velvet antler to update the genetic evaluation (Ward *et al.* 2022). Deep records of velvet antler data were obtained from 21 red deer and seven wapiti studs providing >50,000 records on 25,087 individual animals. Mean velvet antler weights ranged from 2.71kg at two years to 5.59kg at 10 years of age, from individuals with a mean 12-month liveweight of 94.2kg. Heritability estimates for velvet antler at each age were lower than previously reported (h^2=0.33-0.44) and genetic correlations between velvet weights and liveweights were low-moderate. These lower heritability estimates on a large dataset indicate that genetic selection tools like DEERSelect have a bigger part to play in velvet antler selection than previously thought.

A key industry resource, particularly for in-market partners, the DeerVelvet Technical manual V7 (Haines and Suttie 2021) was updated from V6.3 from 2009. This manual is an excellent resource which covers the basics of velvet antler in New Zealand, summarising the history and processing of velvet antler with a major focus on reviewing scientific literature of studies relevant to human health. The human health uses and benefits sections are well categorised and summarised at a high-level including summaries from hundreds of relevant scientific publications or reports. While there is not an animal health specific component in this manual, there are many animal model experiments reviewed in the human health uses. The latest version is not currently online (only V6.3), but it is available on request from Deer Industry New Zealand.

With the development of the New Zealand velvet antler industry and the style of different antlers now present there are questions around what antler is best for what markets or are they all the same? There are two Super A antler grades Traditional (SAT) and Non-traditional (SANT). Super A Traditional is the style most-highly valued historically by the Asian markets for traditional Chinese medicinal (TCM) applications with SANT velvet antler receiving lower returns per kg. The SANT velvet antler has additional branching, palmation, main beam indentations or other non-standard features. It was considered that product composition data for these two antler styles would assist processing, market chain and value chain placement. The first study (Haines *et al.* 2021) compared the chemical compositions of powdered samples from whole antler sticks of the two different styles from 10 farms, all early-cut at <55 days post-

casting. Overall, the two antler grades were found to be very similar across proximate (i.e. ash, protein, and fat), and major minerals, with the only significant differences being in trace minerals iron ($P<0.01$) and manganese ($P<0.001$), however the magnitude of these differences was very small. One limitation of the study was that it did not investigate variation of individual antlers of the two grades but rather that of blended samples from multiple antlers. This is being addressed in a currently ongoing project investigating the influence of harvest time from antler casting on velvet composition and functionality.

This first SAT, SANT study was followed up with a study investigating the bioactive properties, specifically the effects on innate cell immunity (Heiser *et al.* 2022). The second study used powders from the same set of antlers as the first but used a hot water extract from the powders. The aim of the study was to use *in vitro* assays to investigate effects of SAT and SANT grade deer velvet antler on function of the innate immune system. There were two key components of innate immune response studied, in vitro investigations into how human blood leukocytes respond to a bacterial infection, and gene expression following a bacterial infection simulated by exposure to lipopolysaccharide (LPS). The leukocyte response was investigated by phagocytosis and respiratory burst assays and gene expression used NanoString technology. There was no-significant difference in untreated or velvet antler treated leukocytes or between the SAT and SANT grades. There was a significant difference between untreated, SANT and SAT treated LPS-stimulated leukocytes, with a significantly lower percentage of reactive oxygen species (ROS) detected for SAT ($P<0.001$), this may indicate a protective effect against oxidative damage from bacterial infection. Nineteen genes were investigated in the gene expression for the unstimulated leukocytes and Interleukin 2 and 13 (IL-2, IL-13) were significantly different from untreated control samples ($P<0.05$). Interleukin 13 was significantly down-regulated for SATand SANT, while IL-2 was upregulated for SAT. For the LPS-stimulated leukocytes there were two significant ($P<0.05$) fold change difference between stimulated and unstimulated SAT and SANT treated for IL-2 small increase in expression and Interferon-gamma (IFN-ɣ) no increase. There were significant differences ($P<0.05$) between in gene expression in thirteen of the nineteen genes investigated. These results indicated that deer velvet antler did have an effect on adaptive immunity responses, particularly T lymphocyte stimulation and that effect was to a greater degree for SAT than SANT grade antler.

In 2020 a report commissioned by VARNZ reviewed the product and scientific literature on deer velvet antler and the possible effects on conditions or activities that may cause fatigue (Thum 2020). This report recommended future research including using animal models to investigate immune system activation. Following the study of Heiser *et al.* (2022) a mouse model study was designed to investigate if SAT or SANT velvet antler supplements could decease fatigue caused by a systemic inflammation, using LPS to simulate a bacterial infection (Thum *et al. in press*). This study used the same SAT and SANT extracts as Heiser *et al.* (2022), mice received dietary supplement of, Normal (N), SAT or SANT extract 4mg/kgLW/day for 28 days, prior to an intraperitoneal dose of LPS or saline, sickness scoring, blood samples and thermographic body temperatures were taken, and sickness scoring done at 0-, 6-, 12-, and 24-hours post-exposure. Prior to LPS dose and 24-hours post, the mice were evaluated by an open field behavioural test. Following this the mice were euthanised and brain tissues fixed and stored for brain gene expression and immuno-histochemistry. There was a significant reduction in sickness score in mice supplemented with SAT and SANT compared with N diet, but there was no effect of velvet supplementation on systemic inflammation markers following LPS challenge. There was a significant reduction in cholesterol markers in male mice following the LPS challenge. There was differential expression of neuroinflammation markers, and mice supplemented with SAT and SANT had decreased microglia reactivity in the habenular nucleus dorsal hippocampus and the hypothalamus. There were differences in immunomodulatory pathways affected by SAT and SANT supplementation, but overall, both deer velvet supplements mitigated LPS-induced neuroinflammation and sickness behaviour in mice.

More recently with a lead from the National Velvetting Standards Body (NVSB) there has been research undertaken to understand if any practice changes are warranted for velvet antler harvest at the standard time (i.e. soft velvet stage). The aims of this research are to address knowledge gaps about the stag's experience in the short to medium-term post-harvest and to understand the blood loss and look for possible solutions to the low volume but visually unappealing blood presence on stag's heads that presents a risk to social licence to velvet. There have been at least two recent field trials into stag behaviour and experience following velvet antler removal, as well as a literature review and two field studies into post-harvest blood loss. The NVSB and DINZ are currently planning information dissemination and further studies, but the information dissemination plan was not complete at time of paper preparation.

Some general observations on velvet antler harvest practices as a relatively independent observer with experience on multiple farms observing a range of certified velvetters and veterinarians.

Tourniquets, there seems to be a big variety of tourniquets, sizes, thickness materials and application types. I would encourage you all to ensure that you are using effective tourniquets and application technique to stem blood flow and prevent lignocaine residue entering the antler. Stag stress, our farms, people, and handling systems are getting much better at reducing stress for our livestock. Some of the best practices I have observed appear to be low stress for the stags, for a variety of different reasons (e.g. develvetting stags in pairs).

Recovery paddock choice should be top priority for velvet antler removal. Velvet antler removal is a surgical procedure and can become quite routine for veterinarians and certified velvetters who do a lot of velvet antler harvest. However, it is far from routine for the public, or even others in agriculture and it is critical to keep this front of mind. Stags recovering from sedation and stags with visible blood on their heads is not what most people expect to see on a farm. Disturbance of the stags immediately post-velvet removal should be minimised, so for these reasons it is valuable to work with your farmers to select suitable recovery paddocks for stags after velvet antler removal. In a certification and regulatory environment, it can be too easy to focus on the negatives and forget to celebrate and share the positives. I would personally encourage proactive sharing and discussion of velveting best practice. While it is likely much of this information filters up to the NVSB they have a big job to do, and we can all play a role in helping to make velvet antler removal a better experience for the stags and people involved.

References

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