THE EFFECT OF REMOVAL TECHNIQUE ON VELVET ANTLER COLOUR

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Introduction

Velvet antler has been removed commercially from farmed stags in Asia for hundreds of years and in NZ for over 20 years. In the initial stages of deer farming in NZ, sales of frozen and unprocessed velvet were often at the farm gate directly to Oriental business men These people were the sole contacts NZ farmers had with the international antler process industry and frequently were the only source of information on production standards and product quality. In NZ the industry has matured to the extent that very little antler is exported in a frozen or unprocessed state and the majority is dried (processed) in NZ prior to export. Much of the drying is carried out by expatriate Korean or Chinese nationals In the principal world market place for velvet antler, South Korea, product from NZ must compete with that from Russia and China. Although NZ holds up to 65% of the market in terms of quantity, NZ antler is perceived by the marketplace as being of lower quality than that from Russia. Consequently NZ antler is worth US$300/kg compared with US$500/kg for Russian. Although many of the reasons for the preference for Russian antler are traditional, the market perceives that NZ antler is less 'effective' than Russian product and hence of lower value and quality

The GIB funded research programme at AgResearch Invermay seeks, as one of its goals, to increase the understanding of what represents quality of velvet antler. To this end we have consulted widely with the velvet antler industry as a whole to determine possible factors which might influence quality. Two points have emerged, both of which result from observations made by velvet processors and buyers These not only represent possible quality indicators but point also to reasons why NZ velvet is appraised poorly in comparison with competition in the South Korean marketplace. Unfortunately the points are somewhat contradictory; on the one hand NZ velvet is coloured a deeper shade of red than Russian velvet but at the same time processors indicate that currently NZ velvet has a reduced blood content, compared with previous years, in the early stages of the industry. It is clear that the marketplace is suspicious of the red colour of NZ velvet and feel that it may be 'doctored' by, for example the addition of pig blood. Processors, who preserve frozen antler for export, attempt to produce an even colour throughout the core of velvet product because after removal blood and hence red colour tends to pool in the antler tips. To do this velvet is repeatedly exposed to hot water. When velvet processing began in NZ processors required several immersions (dips) to cause 'blood' to appear at the cut surface of the antler. All indications now are that many dips are required to produce the same blood rising effect. Processors feel that present velvet removal and handling techniques result in less blood in the antler to start with This necessitates longer processing time to redistribute the blood, which has settled in the antler tip when it was inverted after removal, throughout the antler So the 'antler colour enigma' is that although NZ antler has a brighter red colour than Russian, as perceived by the marketplace, processors in NZ feel that there is insufficient blood to easily redistribute throughout the antler.

In deciding to investigate the reasons for specific patterns of colour intensity and distribution in the antler we were conscious of several factors Firstly Russian deer are a different sub

species of red deer than those from NZ and secondly processing techniques vary tremendously both within NZ and overseas. Further we had no access to frozen or fresh Russian antler so no detailed comparative analysis could take place. In the light of these factors and because there were no published studies for reference, we decided to investigate the possible reasons for the processors observations that there was a low level of blood in NZ antler before processing. Velvet antler removal, on an industry basis, has changed since the first deer farms in NZ began. Stags are quieter, are handled in better facilities, veterinarians are more familiar with analgesia systems for deer and overall post harvest handling of velvet has improved. It is possible that improved handling and effective analgesia have resulted in less blood in the antler by lowering stress and hence blood pressure and blood flow around the time of antler removal. Likewise post harvest treatment of antler could influence the distribution of blood and, in a complex manner, interact with the initial quantity of blood to produce the pattern observed by the processors

The aim of the pilot studies described in the present manuscript was to investigate the effect of type of drug for analgesia and the time the stags had to wait in the yards prior to antler removal on colour after processing. It is acknowledged that it is not clear that 'antler colour' and 'antler quality' are synonymous but as this is the indication the marketplace chooses to use it must form the basis at least of a scientific evaluation

Materials and Methods

Investigations were carried out at two locations, AgResearch Invermay and Mount Hutt Mid-Canterbury.

Trial 1 Invermay

Animals and Treatments

Thirty 3-year-old red deer stags, from whom records of live weight and antler production had been kept, were maintained under standard deer husbandry conditions on pasture. In August, before antler casting, they were allocated to one of six treatments (see below) as follows, with n=5 per treatment.

1. Local anaesthetic, restraint in a crush, immediate antler removal.
2. Local anaesthetic, restraint in a crush, held in yards for four hours before antler removal.
3. "Rompun"* and local anaesthetic, immediate antler removal.
4. "Rompun" and local anaesthesia, held in yards for four hours before antler removal.
5. "Fentazin"* and local anaesthesia, immediate antler removal.
6. "Fentazin" and local anaesthetic, held in yards for four hours before antler removal

In addition, within each stag, one antler was randomly allocated to local anaesthetic applied in a ring block and the other to local anaesthetic applied as a modified specific nerve site block.

Treatment Details

* see detail next page

All drugs were administered by a veterinarian experienced in velvet antler removal.

Local anaesthetic ("Lopaine", 2% lignocaine HCl, Ethical Agents Ltd) was injected sub-cutaneously either as a standard ring block (10 ml/pedicle) or a modified nerve block technique· injections were given over the zygomaticotemporal and supraorbital nerves and a third injection was given caudal to the pedicle and overlying the zygomatic process of the temporal bone over the auriculo-palpebral branch of the facial nerve, which innervates the antler in about 20% of red deer

"Rompun" (10% xylazine HCl Bayer NZ Ltd) was given at a dose of 1 mg/kg i.m. so that full recumbency was induced Yohimbine HCl at a dose of 0.25 mg/kg was given after antler removal to reverse the sedative effects of "Rompun".

""Fentazin"" (0.4 mg fentanyl citrate, 50 mg xylazine HCl and 3 2 mg azaperone/ml Parnell Laboratories Ltd) was given at a dose of 1 ml/70 kg i.m. so that full recumbency was induced Contran H (1% Yohimbine and 0.01% Naloxone Parnell Laboratories NZ Ltd) (at a dose of 1 ml/40 kg reversed the effects of "Fentazin".

Procedure

The day on which each stag cast its previous hard antler buttons was recorded When more than a day elapsed between left and right antler casting, the date of the first antler casting was used to calculate subsequent harvest date. Antler removal took place 60 $\pm$ 1 days later and the procedure was as follows. The group of stags was brought into the yards at 8am and those animals which were to have velvet removed that day were drafted. Stags which were to have antlers removed immediately were separated from these which were allocated to a four hour hold- over period in the yards. Stags to be held were given adequate space but were neither fed nor given access to water After these stags had been separated antler removal took place from those which were allocated to 'immediate antler removal' as follows. The stags were identified with their drug treatments and administration of "Rompun" and "Fentazin" took place. While drug treatments were taking effect, stags to be treated with local anaesthetic in the crush were restrained and treated as described above Velvet antler removal took place four minutes after local anaesthetic had been administered. A flexible rubber tourniquet was placed around both pedicles during the period between local administration and velvet removal. The antlers were removed with a medium tooth meat saw After removal the antlers were inverted, allowed to cool and placed in a freezer. After the stags which had been treated with "Rompun" or "Fentazin" were recumbent, local anaesthetic was given in the same way as described above and tourniquets were applied Velvet removal and post harvest handling was also as described above All recoveries from drug treatment were uneventful

Antler Processing

All antlers were frozen at -20°C until processing When required for processing antlers were cut into pieces (upper main beam, lower main beam and tines) and skinned. The antler pieces were dried in a large capacity freeze-drier (Cuddon Ltd). The antlers were dried in two batches. Although both batches were supposed to be carried out at 30°C, due to a technical problem one batch has carried out at 30° and one at 20°. Serendipitously antlers had been randomly allocated to drying batch.

The dried antlers were cut into 1cm discs perpendicular to the vertical axis of the main beam with a band saw fitted with a 18mm fine blade.

Trial 2 Mount Hutt

Animals

108 rising three year old stags were maintained under standard husbandry condition on pasture. Prior to antler removal they were allocated to one of six treatments (see below for details) with n=18 per treatment.

1. Local anaesthetic only, antlers removed in a workroom-type hydraulic restraint device.

   1.1 LHS ring block, RHS ring block n=6.
   1.2 LHS ring block, RHS regional block n=6.
   1.3 LHS regional block, RHS regional block n=6.

2. Local anaesthetic (regional block) and low dose xylazine; antlers removed in a workroom-type hydralic restraint device.

3. Local anaesthetic (regional block) and low dose xylazine, antlers removed in a "mak" crush as follow

   3 1 Head-up in crush n=9.
   3.2 Head-down in crush n=9.

4. Local anaesthetic (regional block) and xylazine; antlers removed sitting or standing in the pen.

5. Local anaesthetic (regional block) and "Fentazin" combination; antlers removed sitting or standing in a pen

6. Local anaesthetic (regional block) and carfentanil/xylazine combination; antlers removed sitting or standing in a pen.

Treatment Details

Drugs: All drugs were administered by a veterinary surgeon experienced in velvet antler removal.

Local anaesthetic ("LOCAL") was injected in the same manner as for Trial one at Invermay.

Xylazine ("XYLASE INJECTION", Parnell Laboratories Ltd) was given at varying dose rates i.m. depending on temperament and the weight of the stag, providing a total stag dose of between 1.5 and 2.0 ml of xylase

Fentanyl ("Fentazin") was given at varying dose rates i.m. depending on temperament and the weight of the stag, providing a total stag dose of between 0.6 and 0.8 mls of "Fentazin".

Carfentanil ("THIAZINE 50 & WILDNIL COMBINATION") was given at varying dose rates i m. depending on temperament and the weight of the stag, providing a total stag dose of between 0.5 and 0.75 mls of the drug combination

Procedure

Stags selected for velveting were drugged according to their treatment allocation and treated as above.

Velvet antler removal took place approximately 4 to 6 minutes following the treatment with local anaesthetic. Immediately (seconds) before the antler was removed a rubber tourniquet was applied around both pedicles. The antlers were removed using a medium tooth meat saw either in a workroom crush or in a pen as per allocated treatment.

Following removal the antlers were inverted, graded and weighed Once cooled the velvet was frozen inverted in a large walk-in freezer

All recoveries from drug treatment and antler removal were uneventful.

Drug Manufacturers

1. Xylase Injection:

   Xylazine hydrochloride 20 mg/ml

   Parnell Laboratories NZ Ltd
   233 Porchester Road, Takanini, Auckland

2. Thiazine 50 & Wildnil Combination

   Xylazine hydrochloride 50 mg/ml
   carfentanil 50 µg/ml

   Techvet Laboratories Ltd
   184 James Fletcher Drive, Otahuhu, Auckland

3. "Fentazin" Injection:

   Fentanyl citrate 0.4 mg/ml
   Azaperone 3.2 mg/ml
   Xylazine hydrochloride 58.3 mg/ml

   Parnell Laboratories NZ Ltd

4. Local:

   Lignocaine hydrochloride BP 20 mg/ml

   Techvet Laboratories Ltd

All antlers were processed at a commercial drying plant.

Colour Measurement

Reflectance measurements were made with a Lab Scan 6000 scanning reflectance visible spectrometer (Hunter Associates Inc.) which had 0° illumination, adjustable beam diameter and 45°C viewing geometry with the specular component excluded The instrument was calibrated with a white standard supplied by the manufacturers and conforming to the National Bureau of standard's perfect white. An IBM XT microcomputer performed all colour calculations from the digitised spectral data. Each antler disc was arranged in a numbered sequence from tip to base, and tines - from tip to base. Each disc was placed over a 10 mm diameter open circular port with a 6 mm illuminated spot (area) in the horizontal upper surface of the sensor module. Ten reflectance spectra over the wavelength range 400-700 mm, were obtained for different but overlapping regions approximately 10 mm apart and averaged, and their CIELAB (Commission International d' Eclairage) co-ordinates, L*, a*, b* values which correspond to the visually perceived colour attribute of "lightness" on a scale between white and black, and colours according to their red versus green and yellow versus blue attributes, respectively, recorded for the CIE standard source D65 and the CIE 10° standard observer (Figure 1). From a* and b*, the hue angle was calculated.

Biometric Analysis

The antler was analysed in anatomically defined sections by ANOVA (Figure 2). Only 18 of the 108 antlers from Mount Hutt, sampled evenly between treatments were available for statistical analysis at the time of writing this manuscript.

Results

Invermay

There was no significant overall effect of drug treatment on L or hue, but there was an individual significant difference in hue for section 2 (Figures 3 and 4). This comparison revealed that local only antlers tended to have a greater red colour than those from stags given other drug treatment. There were no significant effects of holding treatment on L or hue (Figures 5 and 6) In contrast the temperature the antlers were dried at had major effects on L and hue (Figures 7 and 8). Antlers dried at 20° were overall significantly more red and darker than those dried at 30°C However the patterns of colour within the antler varied. The section 1 (antler tip) values were significantly more red and darker for the 30° antlers and those dried at 20° and there were no significant differences due to drying temperature in colour in the tines (Section 3, 7 and 9).

Mount Hutt

There were no significant differences due to drug treatment on antler lightness or colour (Figures 9 and 10). Overall antlers were darker and more red viewing from the tip (Section 1) to the base (Sections 6 and 8). There was a trend that the local only antlers were redder and darker than all other treatments, but this was not significant

Although no statistical comparisons are possible between Invermay and Mount Hutt antlers it appears, by inspection, that the antlers are of similar colour (hue) but the Mount Hutt antlers are darker

Discussion

Overall it is clear that neither drug nor holding treatment had a major effect on antler lightness or red colour. Although there was a trend toward increased `redness' in velvet from stags from whom velvet had been removed with local anaesthetic only this was not significant overall. The trend could be explained by the known blood pressure reduction effect of xylazine. Whether this modest effect could result in the changes observed by processors is not known and requires further work. Post harvest handling was not considered in the present study.

It is difficult to compare the two processing techniques of freeze drying at Invermay and the commercial process used with Mount Hutt antlers due to differences in collection method and location but broadly speaking freeze dried velvet antlers were lighter than those commercially processed, particularly near the tips (Sections 1-3). This contrast may be due to process temperature.

Within the freeze dried antlers there was a highly significant effect of temperature. The cooler temperature resulted in darker, redder antlers As these antlers were cut in sections for drying there was no possibility of colour redistribution. Consequently the colour pattern observed represent differences due to processing temperature It appears that the main beam (Sections 1, 2, 4, 5, 6 and 8) is more sensitive than the tines (Sections 3, 7 and 9) to processing temperature because there were no significant difference in either lightness or colour hue. Processing temperature represents the most likely cause of colour variation between antlers.

The present results provided limited support for the concern of the processor that heavy drug use for chemical restraint use accounts for increased difficulty in antler processing since the inception of the antler production industry. Likewise limited `stress' by holding the stags in the yards did not influence colour. Although these preliminary results will require confirmation, other sources of variation in farming practice and techniques should be studied. These include stag age, tourniquet application and possibly stag genotype. It is also possible that a modest change in antler blood content, which scarcely influences measured colour after processing, has a greater effect on the ease of processing of the antler as perceived by the processor. This may mean that improvements in antler processing techniques can take place. The over-riding factor from the study is that higher temperature influences colour. It is highly likely that Russian antler is perceived to be less red and less dark because it is cooked longer. This hypothesis requires to be tested

Acknowledgement

We gratefully thank the owners and staff of Mount Hutt Deer Farm, Taimex Trading and National Deer Horn.

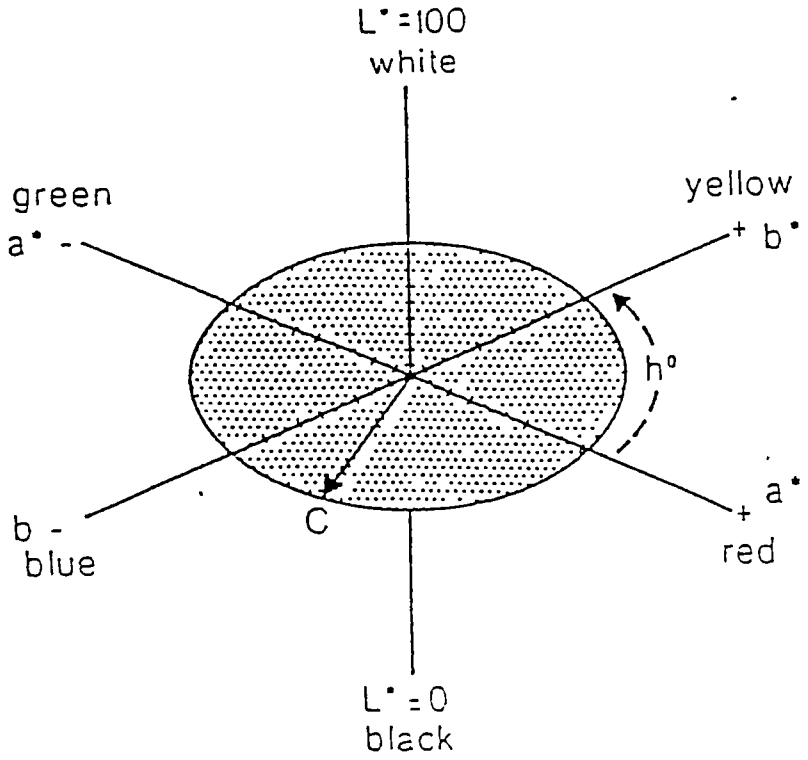

Figure 1 **CIELAB colour space.**

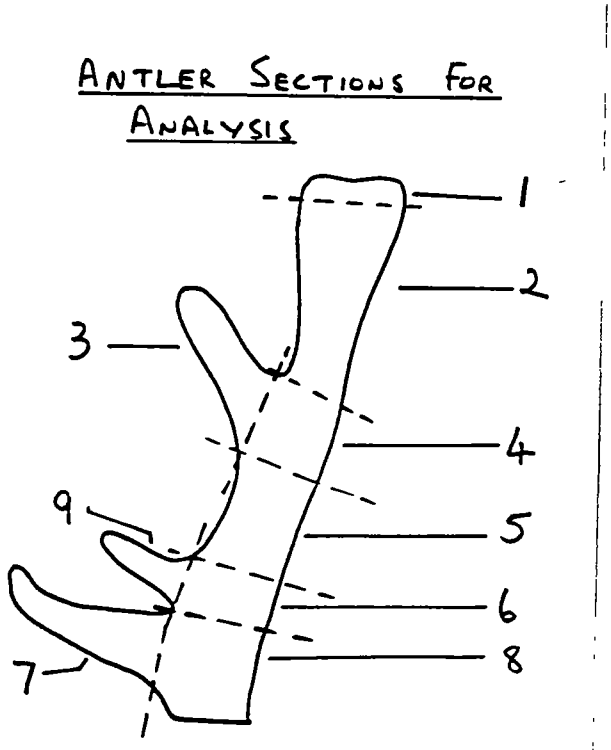

Figure 2 **Antler sections for analysis.**

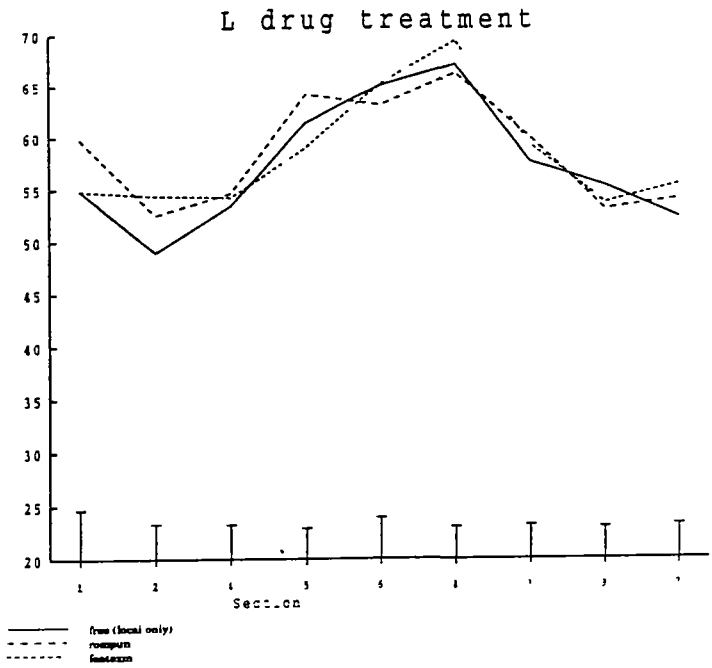

Figure 3 The effect of drug used for velvet antler removal on lightness after freeze drying. Section refers to the components outlined in Figure 2. Bar is the standard error of the mean. 'Free' indicates the drug used was local only. "Rompun" and "Fentazin" indicate they were used for sedation. Lightness is a scale from 0 to 100 with 0 = black and 100 = white

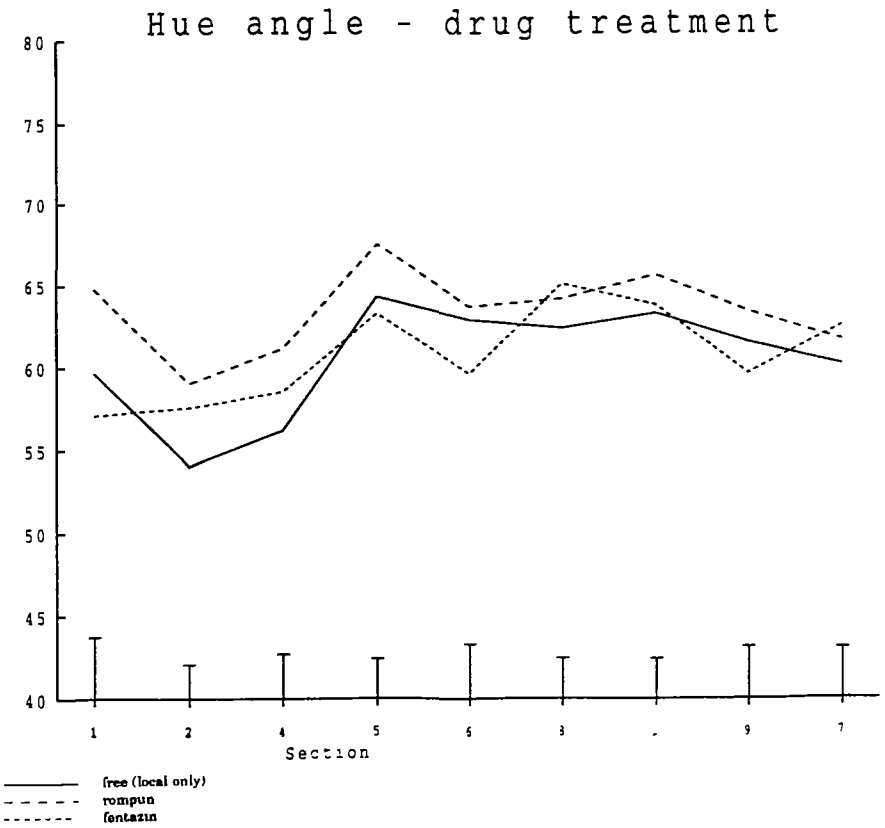

Figure 4 The effect of drug used for velvet antler removal on hue angle (colour) after freeze drying. Hue angle is on a scale from 0-90 where 0 = red and 90 = yellow. Thus lower numbers are redder. Remainder of legend is as for Figure 3.

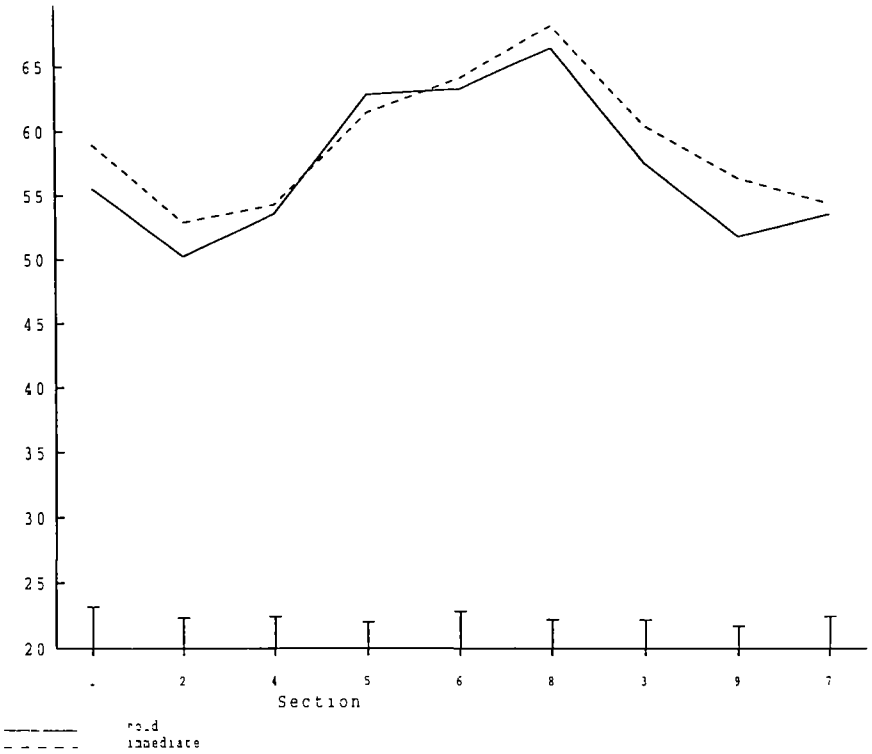

Figure 5 The effect of holding stags in the yards for four hours before velvet antler removal on lightness after freeze drying. Hold means stags were kept in yards for 4 hours prior to antler removal Immediate mean stags had antlers removed as soon as they entered the yards Remainder of legend as for Figure 3

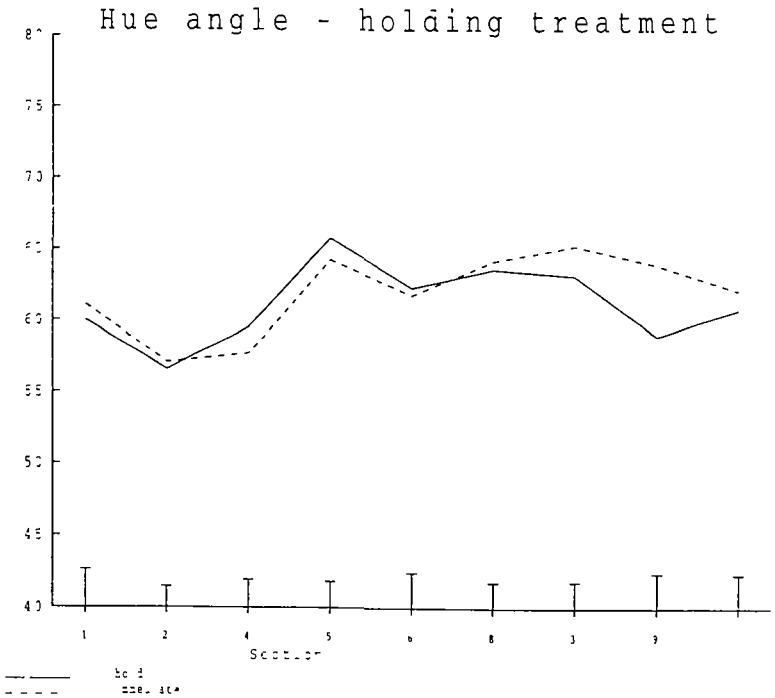

Figure 6 The effect of holding stags in the yards for four hours before velvet antler removal on hue angle (colour) after freeze drying Remainder of legend as for figures 4 and 5

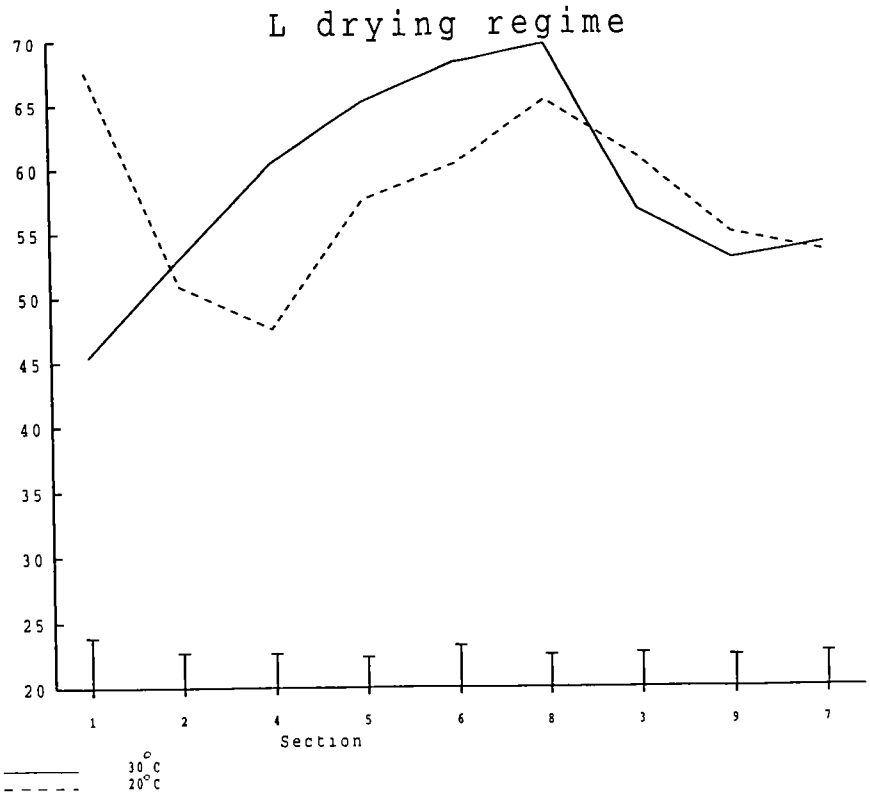

Figure 7 The effect of temperature of drying in antler lightness. Remainder of legend as for Figure 3

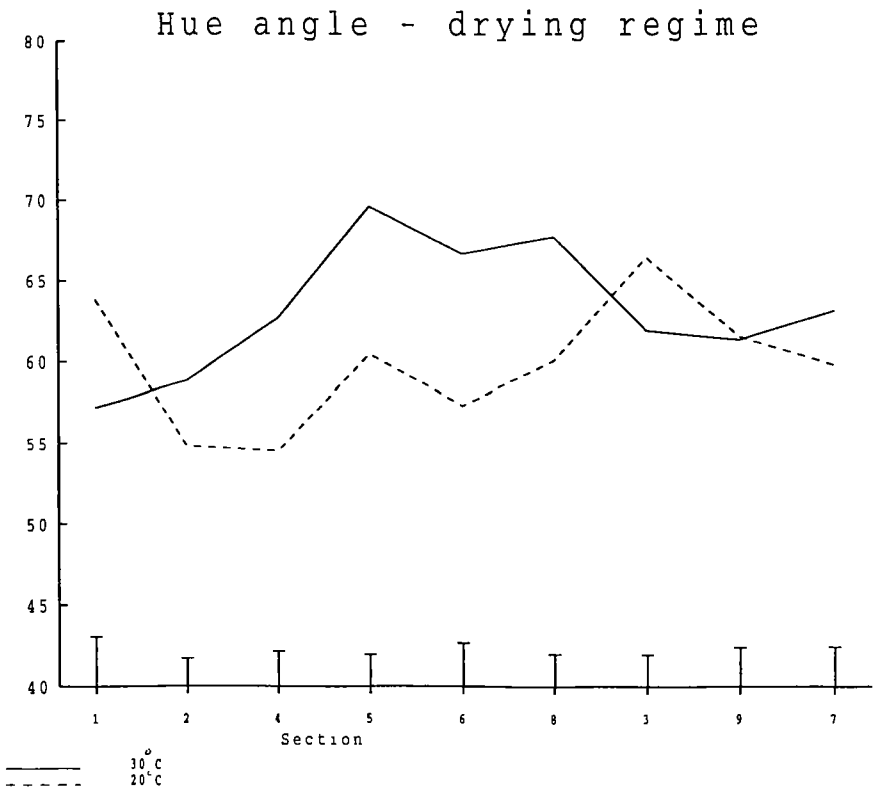

Figure 8 The effect of temperature of drying on hue angle (colour). Remainder of legend as for Figure 4

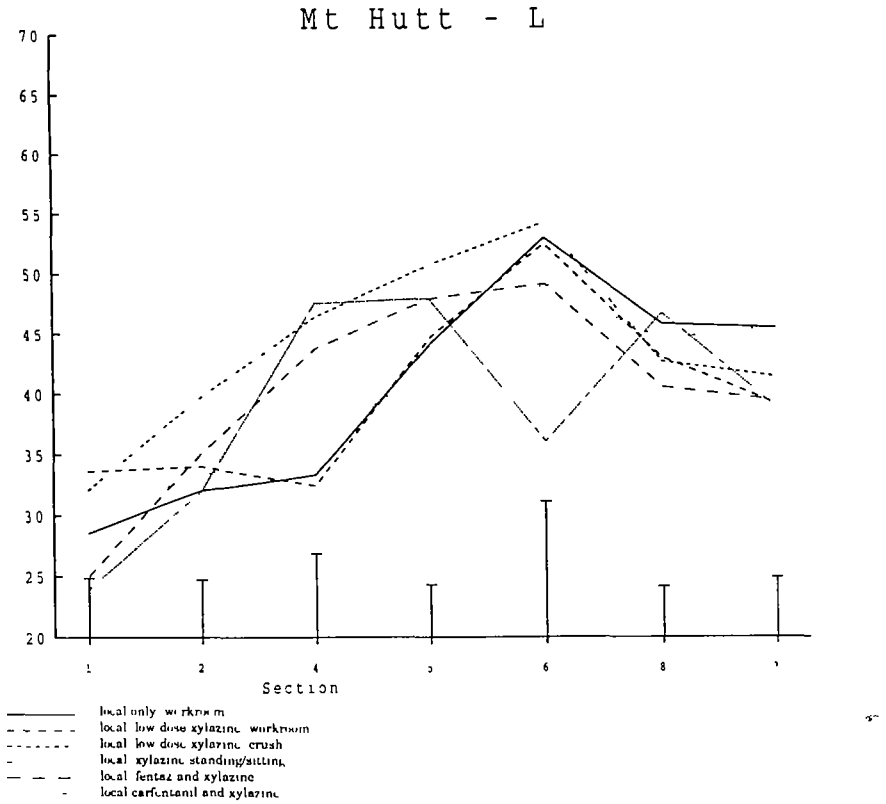

Figure 9 The effect of drug treatment (Mount Hutt) on antler lightness after a commercial drying process Remainder of legend as for Figure 3

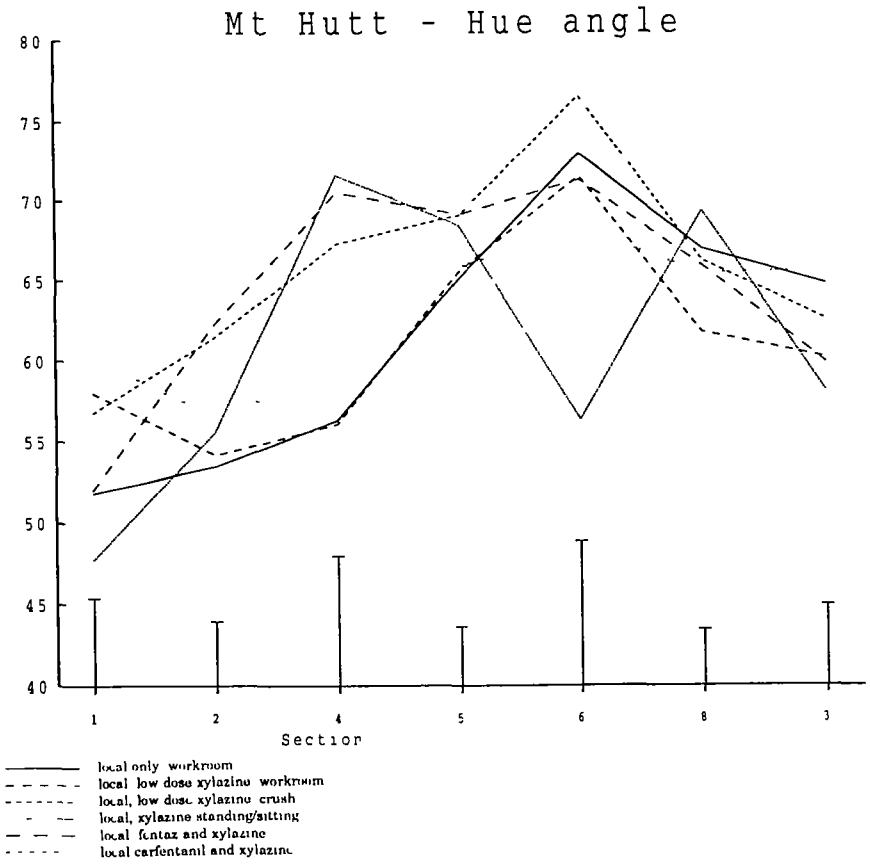

Figure 10 The effect of drug treatment (Mount Hutt) on hue angle (colour) after a commercial drying process Remainder of legend as for Figure 4