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OPTIMAL VELVET ANTLER PRODUCTION IN WAPITI AND RED DEER

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Abstract: Velvet antler production from red (*Cervus elaphus*) and wapiti deer is a major source of revenue in the New Zealand (NZ) deer industry. Grading systems allow producers to estimate when stags produce the greatest velvet antler weight without reducing quality. Development of the antler can be closely monitored during the 55-65 days of growth after casting to accurately assess optimal harvest time. Breeding and sire selection on this basis of velvet antler yield at 2 years of age and relationship between increasing liveweight and velvet antler yield as methods to improve cash returns are examined. Hybridization between red deer and wapiti substantially improved both yields and velvet antler quality. Simple routine management techniques for harvesting and storage of antler ensure that the product can be processed to the quality standards required by the oriental medicine market.

Key Words: casting, harvest, red deer, selection, velvet antler, wapiti

Résumé : La production des bois veloutés des cerfs rouges et des wapitis est une source majeure de revenu dans l'industrie des cerfs en Nouvelle Zélande. Des systèmes de classification permettent aux éleveurs de calculer le moment où les cerfs produisent le plus grand poids sans diminution de qualité. Le développement des bois peut se contrôler de près pendant les 55-65 jours de croissance après la formation pour bien calculer le meilleur moment pour la récolte. On examine l'élevage et la sélection à partir du rendement de bois des cerfs âgés de deux ans aussi bien que les rapports entre la pesanteur croissante et le rendement des bois. L'hybridation entre les cerfs rouges et les wapitis améliore beaucoup le rendement et la qualité des bois. Les techniques simples de la gestion routine pour la récolte et l'emmagasinage des bois assurent qu'on puisse traiter le produit aux niveaux de qualité exigés par le marché médical de l'Orient.

Mots-Clés: bois veloutés, cerf rouge, croissance, formation, récolte, sélection, wapiti

The annual harvest, processing, and sale of velvet antler from stags of red deer (*Cervus elaphus*), wapiti and hybrid origin contributes approximately 43% of the New Zealand (NZ) deer industry export revenue. During 1989, 160 tonnes of frozen product from NZ farms was processed, marketed, and produced a return *NZ $ 33 million, substantially above the NZ $ 14 million of the previous year.

Both an increase in product volume and quality of raw and processed velvet antler have been important factors in the NZ position as the largest exporter of velvet antler to oriental medicine markets. Exports are dependent on the major consuming nation of South Korea (54%) and the distribution and consigning market of Hong Kong (33%). The USA takes a minor share (11%) chiefly through expatriate Korean communities with a small number of diverse markets in other countries.

Korea has historically paid a premium price for what it considers to be better velvet antler products (Lee and Ch'ang, 1985). Although preference was given for velvet antler from Russian 'horse deer' (e.g. *C. e. sibiricus*), Chinese malu (*C. e. xanthopygus*), and meihualu (*C. nippon hortulorum* and *C. n. manchuricus*), a grading system based on quality was still applied. NZ red deer velvet antler was originally viewed as third in preference after Russian and Chinese velvet antler of malu type.

Recent advances in strict quality control of processing techniques, grading, and marketing have raised the profile and acceptance of NZ's product in comparison with China's. Continued dialogue between the NZ Game Industry Board (GIB) and the Korean Pharmaceutical Traders Association (KPTA) has improved the appreciation for a quality processed product and cutting demands by the Korean market. Such information is critical at the farm producer level. Market preferences for breed type, antler form, stage of cutting, degree of calcification, number of tines, length, and thickness and size of bulb of the upper parts of the velvet antler all influence quality as perceived by the market.

In addition, quality velvet antler is dependent on the skills of the farmer and veterinarian in animal handling and velvet

* 1 NZ $ = 0.60 US $ in 1991.

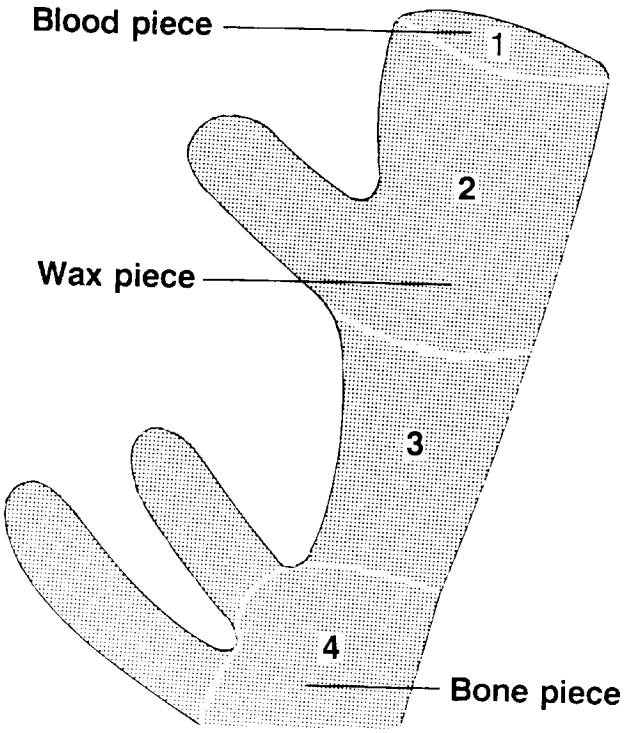

Fig. 1. Oriental systems for classifying the sections of the velvet antler.

antler removal, post cutting storage, freezing techniques, and finally, grading and sale.

As the processed product is usually sold as an individual dried antler or frozen 'green' antler, all the features that contribute to an optimum financial return are expressed by the stag itself or under direct control of the producer/farmer. Processors cannot improve velvet antler that has been cut at the incorrect stage of growth and is overgrown and calcified, or is damaged during harvest or poorly stored. Uneven blood distribution through the antler, or loss of blood from the antler resulting in poor colour after processing cannot be remedied, nor can bacterial contamination resulting from poor hygiene during and after harvest.

The grading systems (NZGIB 1989) seek to standardize the quality of antler production by classifying velvet antlers to combine like with like for the benefit of processors and producers. Grading considers species (red, wapiti, hybrid) to some extent; weight, form and number of tines and royal bulb; shape, thickness, stage of growth and presence or absence of damage; the degree of calcification is also important in grading.

Optimum velvet antler characteristics for each grade can thus be objectively described once harvested, and these characteristics referred to in selection programs for further improving production in breeding and velveting stags. In terms of maximizing returns to the farmer, the overall return is dependent on matching quality and weight.

Table 1. Calcium, phosphorus and ash contents of a single velvet antler cut at the A grade stage classified according to Oriental description of the velvet antler sections.

Velvet antler section	% of dried velvet antler weight	Composition		
		Ca	P	Ash
1	2.2	0.18	0.62	7
2	30	5.2	3.2	27
3-main beam	24	8.3	4.9	32
3-brow, bez	26	6.6	3.9	30
4	18	10.3	5.9	37
Entire	100	7.1	4.2	30

The Product

Top quality velvet antler (A grade) from red deer, wapiti, or wapiti x red deer hybrids is harvested about 55-70 days after casting date of the old hard antler stubs. The beam should be thick overall but thicker above the trez tine forming into a heavy well rounded royal bulb, with a heavy rounded trez, tine with a small or absent bez tine and a thick well rounded brow tine. No ring of calcification should be apparent on the cut surface. The antler is harvested under local or general analgesia the objective being to cut the antler in such a way that the cartilaginous matrix is as full of blood as possible. After a short period (1-1.5 hr) being hung or reclined at 15°-20° C the cut surface uppermost in a storage area free of contamination and out of direct sunlight and heat, the antler is stored at around -18° C in a freezing facility designed for the purpose. Finally it is weighed, recorded and packed in clean plastic bags to avoid freezer burn and dehydration. During freezing, care must be taken to ensure that the soft cartilaginous tissue is not deformed by packing closely, nor is blood or serum lost during the process.

These gross features of quality velvet antler are reflected in detail both histologically (Fennessy, 1989b; Goss, 1985; Banks and Newbrey, 1982) and in the Chinese (Pinney, 1981) and Korean (Yoon, 1989) systems of classifying the parts of velvet antler (Fig. 1).

Velvet antler harvested at the optimal stage for use in traditional oriental medicines is an actively growing cartilage-type tissue, heavily innervated and vascularised with regions of cell proliferation and differentiation at each growing tip of the individual tines and main antler beam. The base of the antler is beginning the process of calcification of cartilage prior to replacement by the bony tissue of the maturing antler shaft (Muir and Barrell 1983; Fennessy and Suttie 1985; Suttie and Fennessy 1991).

The pattern of differentiation of the velvet antler is reflected in its chemical composition. Table 1 presents some data for the composition of velvet antler sections according to the Chinese descriptive system [ore recent data on a larger sample of NZ top grade antler gave an overall composition of 12.1% Ca, 5.8% P,

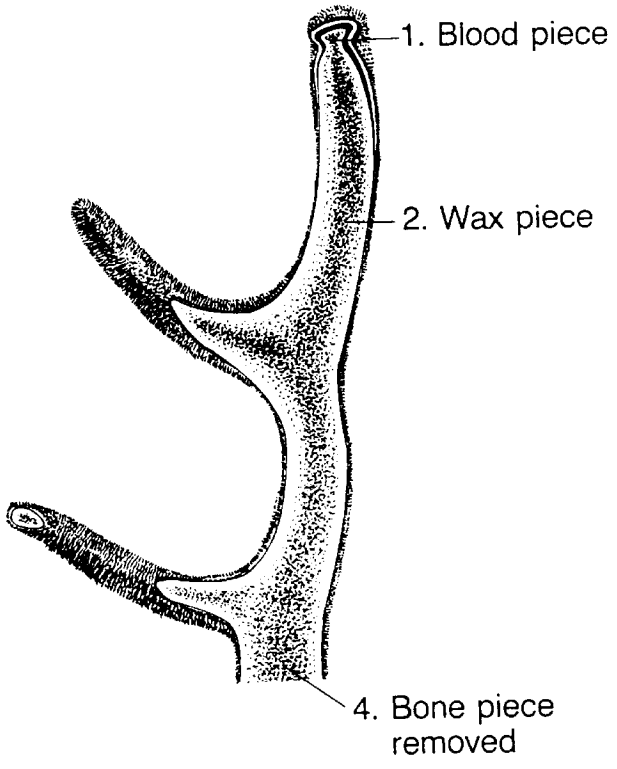

Fig. 2. Cross section of processed grade A velvet antler cut for Korean market requirements with brow tine (bone piece) removed.

and 34% ash (Fennessy, 1991)]. In processed form, an A grade antler has a clearly apparent royal bulb and main beam. The growing tip (wax piece) is a distinct, though usually partly shrunken, cap on the main beam with individual tines also losing some of their roundness during processing. In longitudinal section dried blood is evenly distributed within the cartilaginous matrix. Colour (dark red) is concentrated in the matrix of the upper beam reaches and trez tine areas with a paler gradient to the base of the antler (Fig. 2). In overgrown velvet, particularly where the brow tine shows signs of calcification, blood colour may be restricted to central regions and almost absent in the base (bone piece). Korean cutting requirements have historically required the brow and bez tines and basal antler to be removed prior to sale in Korean markets; this amounts to a weight loss of 15-28%. These lower value pieces are sold independently. This cutting requirement may change from year to year and is the subject of much discussion and negotiation annually between NZ exporters, processors and the KPTA. Such stipulations are not applied to velvet antler of Russian and Chinese origin. Lack of colour in this portion of antler is due to the differentiation of the lower parts of the antler being more advanced (brow and bez tines) than the main shaft, a feature which is often overlooked as producers aim for maximum velvet weight and growth of the main beam and royal bulb development. It has also been suggested that poor harvesting techniques that allow blood to drain from the antler before removal may be involved (Wallis, 1989).

Table 2. Trends in velvet antler production, casting dates, days of growth until harvest, liveweight (winter lean) and relative antler yield for farmed red, hybrid and NZ wapiti-type deer at 2 ages (3 years and 6 years) (G.H. Moore, pers. commun.).

	Breed Type		
	Red	Hybrid	NZ Wapiti-type1
Velvet antler yield (65 days from casting) (kg)			
3 years age	1.87 ± 0.43	2.48 ± 0.53	3.04 ± 0.42
6 years age	2.89 ± 0.52	3.78 ± 0.82	5.49 ± 0.14
Casting dates (1986 season)			
3 years age	11 Oct ± 5.7	10 Oct ± 2.53	13 Oct ± 9.5
6 years age	28 Aug ± 7.7	4 Sep ± 8.4	6 Sep ± 5.2
Days till harvest (1986 season)			
3 years age	56 ± 8	59 ± 5	64 ± 6
6 years age	69 ± 8	69 ± 9	81 ± 10
Liveweight (LW, kg)			
3 years age	129 ± 11	156 ± 12	178 ± 18
6 years age	151 ± 11	187 ± 15	233 ± 21
Relative antler yield (g/kg LW)			
3 years age	1.00	1.09	1.14
6 years age	1.00	1.06	1.23

[1] NZ wapiti-type deer are of wapiti x red hybrid origin and are probably about 56% Canadian wapiti; the hybrids are the result of matings of the wapiti-type males x red deer females.

Table 3. Velvet antler weight, days of growth and mean returns/stag for velvet antler harvested at three different stages of upper beam development (Moore and Pearse, 1984).

	Removal stage		
	1	2	3
Mean velvet weight (kg)	2.20	2.54	2.58
Mean days growth from casting to harvest	60	67	70
Range (days)	54-63	60-71	66-74
Returns/stag (NZ $)	211[1]	259	253

[1][1984 prices (AA grade NZ $ 125, A1 $ 105, A $ 100, A2 $ 90, B $ 70)].

Growth Patterns for Optimal Production

The broad features of velvet antler growth have been summarized by Fennessy (1989a). The effect of age on casting date is significant with older stags casting up to six weeks earlier than 2 year olds, although the initiation and development of tines follows a broadly similar time pattern over all ages (Fennessy et al., 1991). Velvet antler weight increases with age and a general relationship exists between liveweight and velvet antler weight within an age group. Table 2 presents mean values for casting date, velvet antler weight, days to harvest and liveweight data for red, hybrid and NZ wapiti stags at 2 and 6 years of age managed as a single cohort of stags for comparative production purposes. There is some evidence that production plateaus at 6-8 years of age then gradually declines (Fennessy, 1989a). Data from Canadian wapiti recently imported into NZ support these trends in spite of suggestions that these animals are not performing to their potential under NZ farmed conditions (Fennessy and Pearse, 1990). Wapiti yield comparatively more velvet antler per unit liveweight than red deer and take longer to grow antler while still producing premium grades.

Recent introductions of imported red deer from highly selected (for antler weight) herds in Great Britain and Germany and Eastern Europe are likely to have a profound effect on velvet antler weight of commercial red deer in New Zealand, when used in breeding programs. To date, this has been evident particularly in 2, 3, and 4 year old stags, perhaps reflecting the earlier maturity of red deer in comparison with similarly aged wapiti or hybrids coupled with the genetic superiority of some of the strains of European deer available to the NZ farmer (A. Pearse, pers. commun.). Market preferences currently favour the shorter thicker beamed velvet, which is often substantially heavier in the upper regions in preference to the longer style of hybrid and wapiti velvet, in spite of its weight. Premiums, however, continue to be paid for mature wapiti velvet with its overall greater weight, superior overall beam and lack of calcification in the basal regions at similar stags of cutting (NZ Wapiti Society, pers. commun.). This antler type demands greater care in processing but is highly regarded in the market place and is competitive with the Russian product.

As grading, and by implication returns to the producer, are primarily linked to velvet antler weight, and more recently to diameter, great importance is attached to the growth and development of the upper beam and royal bulb area. By description, the decision to harvest is made when the growing tip of the bulb flattens and may indent slightly indicating budding of the top or royal tines. The main beam continues to grow in length rapidly during this period at about 1-1.5 cm per day contributing approximately 50-60 g by weight daily in adult deer. At this years value of NZ $ 235/kg A grade, antlers have the potential to increase in value by ~NZ $ 13 per day in the critical period 55-65 days after casting. Evidence produced by Muir and Barrell (1983) show that there is an increased rate of total antler calcification at the onset of branching of the royal tines (65-70 days). In broad terms top quality antler is generally harvested around day 65 after casting in mature animals as penalties are severe for overgrown product in spite of any extra weight produced.

The producer strives to balance minimal calcification and maximal blood content at the heaviest possible weight, although there is great variability between stags and between strains. In a trial at Invermay with 5 year old red stags, antlers were removed at various stages of development to determine the

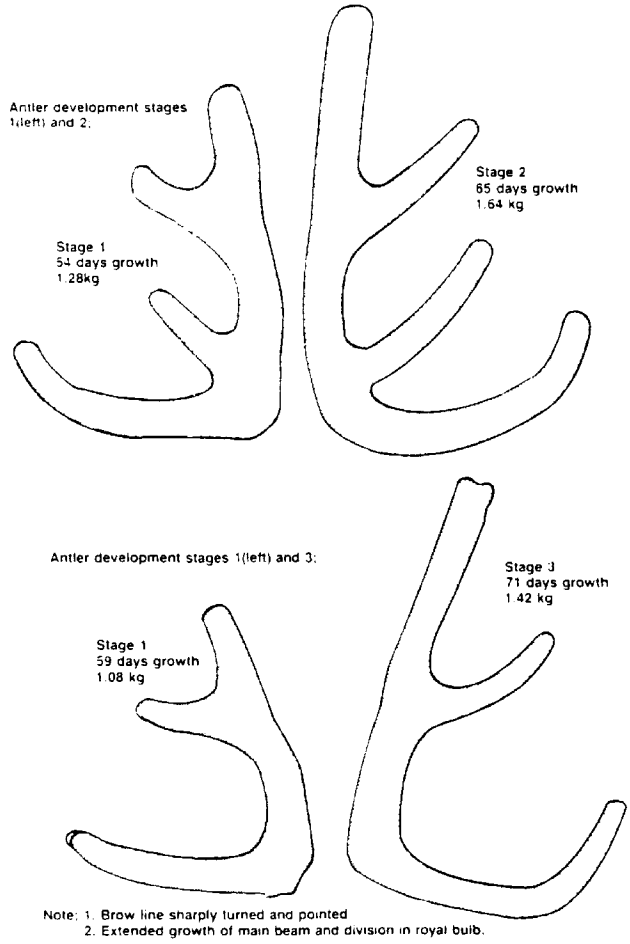

Fig. 3. Processed red deer velvet antler cut at stages 1,2, and 3 of upper beam and bulb development.

Table 4. Effect of level of nutrition at different stags of the antler cycle on velvet antler production of red deer stags.[1]

Period (trials)	Post-rut May-June	Winter June-Sept	Late winter July-Sept.	Spring casting
	1	2	3	4
Days	50	80	50	65
Velvet antler yield (kg/stag)				
Restricted	2.45	1.66	1.94	1.87
Ad lib	2.70	1.80	2.06	2.2
Relative increase with *ad lib* feeding (%)	10	8	6	17
Extra feed required to feed *ad lib*[2]				
Grain (kg/day)	.65	1.0	1.0	0.65
Cost (NZ $ 0.30/kg)	10	24	15	13
Minimum price/kg for velvet antler which is required to pay for extra feed[3]				
NZ $/kg for velvet antler	50	150	125	38

[1]Data from Invermay and published trials (both indoors and field trials).
[2]1 kg grain/day can be expected to increase liveweight gain by 1-2 kg/week.
[3]Based on a yield of 2 kg/stag for restricted stags; 1989 velvet antler price for grade A was substantially higher than any of these medium prices (in excess of NZ $ 225/kg).

difference between stags in days of growth from casting, and in velvet antler yield and resultant grading. Each stag had one velvet antler removed at Stage 1, at the first sign of development of the bulb as recommended by industry grading standards, with the other side removed either at Stage 2 or Stage 3 (division of royal tine buds at 2.5 mm and 5 mm, respectively). Antlers were independently graded, weight recorded and finally processed for evaluation (Table 3).

Antlers cut at Stage 2 returned 23% more revenue than those cut at Stage 1. The additional 7 days of growth yielded about 15% more weight with no loss in quality. Differentiation of the royal tines followed rapidly between day 67 and 70 with subsequent loss of quality due to being graded as overgrown, which was also evident from the degree of overgrown basal calcification. Weight was slightly improved but nett returns dropped. On the 1989 market returns, antlers cut after full development of the main beam to Stage 2 would have returned an additional NZ $100/stag above the $ 520 value of Stage 1 antler growth. Overgrown antlers at Stage 3 would return only NZ $ 480. Fig 3 contrasts the development of Stage 1, 2, and 3 in processed form.

It is recommended that in adult stags, where velvet is thick in the beam, that stags be examined every two or three days in order to determine the final cutting date from round day 55. The recording of antler casting dates and division of stags into smaller groups based on casting dates greatly assists the management for optimal production. Thin velvet should always be cut earlier.

As the growing antler is in a dynamic state of change, merely assessing the bulb development is not sufficient in balancing quality and optimal weight at harvest. The development of brow and bez tines can accelerate during this time with the most obvious sign being the upward flexure of the brow tine

Table 5. Cumulative velvet antler production from 2 to 5 years of age for a group of 90 red deer stags categorised according to their 2 year old velvet antler production (Fennessy, 1989a).

Rank on 2 yr old velvet antler	2 yr old velvet antler weight (kg)	Cummulative (2 to 5 years) velvet antler production (kg)
Top 1/6	2.18	11.37
Next 1/3	1.55	9.35
Next 1/3	1,29	8.47
Bottom 1/6	1.02	7.69
Overall mean (± S.D.)	1.48 (0.43)	9.11 (1.60)

Table 6. Cummulative velvet antler production from 2 to 5 years of age for a group of 90 red stags categorised according to their yearling liveweights (Fennessy, 1989a).

Rank on yearling liveweight		Yearling liveweight (kg)	Cummulative (2 to 5 years) velvet antler production (kg)
Top	1/6	119.6	10.06
	1/3	107.5	9.14
	1/3	101.6	8.88
Bottom	1/6	94.1	8.57
Overall mean (± S.D.)		105.3 (9.57)	9.11(1.60)

tip and rapid pointing. Calcification has become well developed in this area and the antler should be removed prior to this. The NZ industry advises earlier removal for highest processing quality. A good knowledge of growth characteristics of an individual stags is basic to producing this product at maximum weight of the highest quality.

Selection and Feeding

It is estimated that about 40% of the variability in velvet antler weight within the same strain is of genetic origin and therefore heritable and passed onto the progeny (Zhou and Wu, 1979). Clearly the animals must be fed well to express this genetic potential, but there is very little evidence to suggest how feeding and genetics influence the market perception of quality of antler. That remains an area for future work when other criteria for quality are defined, and implies that optimizing velvet antler returns today means cutting the antler at the appropriate stage of growth to meet market requirements at the heaviest weight possible.

Recommendations following limited nutritional work are to feed a high energy, high quality diet *ad libitum* immediately post rut through winter and continue supplementary feeding into early spring if pasture growth is slow. There is little evidence that high protein diets directly benefit velvet antler growth, although they may improve hard antler weight. Various experiments to determine the effect of level of nutrition at different stages of the antler cycle on velvet antler production of red stags are summarized in Table 4. A minimum price for velvet antler required to pay for the additional feed has also been determined.

Improvements in velvet antler production on a weight basis can be achieved by selecting sires for velvet production corrected for age and liveweight (Moore et al., 1988). Antler weight at 2 and 3 years of age is positively related to both liveweight at 15 months of age, and subsequent liveweights for seasonal antler growth.

Table 7. Comparison of various breeding options to improve velvet antler production (comparisons as 4 year olds) (Fennessy, 1989c).

Breeding option	Velvet antler production (kg) as 4 year olds				
	Breeding animals			Genetic progress/ generation	Yield of progeny
	Stags	x	Red deer hinds		
Selection within strain					
Average stags	2.5		2.5[2]	0.0	2.50
Top 3% of stags	3.6[1]		2.5	0.22	2.72
Hybridization between strains[3]					
A. Average stags	3.6		2.5	0.55	3.05
Top 3% of stags	5.2		2.5	0.87	3.37
B. Average stags	5.2		2.5	1.35	3.85
Top 3% of stags	7.5		2.5	1.81	4.31

[1]Assuming a S.D. of 0.5 kg (a coefficient of variation of 20%) and a heritability of 0.40.
[2]The hinds are average red deer in that their male progeny from mating with average red deer stags would be expected to produce 2.5 kg of velvet antler.
[3]Calculations assume no hybrid vigor; i.e progeny of average superior strain and average red deer hinds are midway between the parents; A and B represent two different strains which will hybridize with base NZ red deer.

Variation in antler weight at 2 years itself, however, accounts for more of the variation in subsequent velvet weight than does liveweight and therefore should be used in selecting 2 year old stags where velvet antler production is the objective (Table 5). Two year old antler harvest, however, is extremely variable in timing when the producer seeks to optimize returns, and therefore it is strongly recommended that hard antler casting dates and velvet antler harvest dates be recorded. Antler weight can then be adjusted for days of growth and the predictive value of velvet antler weight improved. Recent work with 2 yr old red stags at Invermay suggests that a correction factor used to adjust velvet production to a 55 day growth post casting weight is proving very successful in predicting superior velvet antler producers at 3 and subsequent years.

Yearling liveweight can also be used in selection criteria. Using the same group of stags as in Table 5, the data were recalculated on the basis of yearling (15-16 month liveweight) and show that the top 1/6 were 10% above average on cumulative velvet production (2-5 years) and 14% heavier by weight (Table 6). In a mixed venison velvet operation, culling on poor liveweight is a practical step but not as effective as 2 year old velvet antler weight.

Within a herd of red deer, a 10 kg increase in body weight is associated with a 0.1-0.2 kg increase in velvet antler weight (Moore et al., 1988; P. Fennessy, pers. commun.). This velvet antler weight-liveweight relationship can be further exploited by hybridizing between strains as large gains are possible in absolute velvet antler production. One such efficient production system involves hybridization between strains of NZ base red hinds and either the larger imported European red deer, or wapiti. These gains are quantified in terms of velvet antler production by comparing within strain selection and strain hybridization (Table 7). The quality of the velvet antler produced by such hybridization is acceptable to the market because of increased weight and thickness. There is some market evidence that favors the shorter, thicker type of velvet from British and European stags crossed with base NZ red hinds rather than the longer wapiti x red deer hybrid type, particularly at 2 and 3 years. Mature hybrid and wapiti velvet antler, however, is keenly sought and can attract 4-7% premiums (Wallis, 1989).

As the genetic merit of leading deer studs improve, further rapid progress can be expected in overall velvet antler production in weight for age and in the quality demanded by processors to best satisfy the oriental velvet antler market requirements at continued high returns to producers.

Harvesting Velvet Antler

No amount of selection, breeding and recording can compensate for poor management, harvest and storage techniques, which result in damage to velvet or for spoilage during storage prior to processing. The following summary highlights management factors important in preserving animal welfare, harvest, and optimum velvet antler returns for producers.

Animal Handling

Stags, particularly 2 and 3 year olds should be thoroughly familiar with the yards and crushes or restraints long before harvesting. With casting dates being recorded, it is appropriate to group animals in small mobs according to casting date to allow easy assessment of the stages of velvet antler development before removal and therefore it is necessary to yard only those animals ready for harvest over a 10-14 day period. Yard familiarization can be achieved during early spring as they cast. Older animals will naturally thereby be grouped separately from younger and later developing stags.

Overcrowding in yards is the primary source of antler damage, particularly in young animals due to rearing and boxing with the front feet, or with stags being under crowd pressure, lowering their heads in large milling groups and suffering breakage. A spacious pre yard entry pen allows ample room for quick drafting into smaller groups of 3-5 animals. Stags should not be left on their own for extended periods unless tranquillized as they easily become stressed.

Raceways and entrances to crushes should have sufficient width at head height to avoid contact of antlers with walls or entrances, and crushes should be well positioned in yards so that little effort is needed to encourage the stag to enter. Short curving raceways from a central drafting arena utilise the stags' natural desire to move around corners. Subdued lighting in these pressure areas seems to assist. Yards should be thoroughly checked prior to the season for broken gates, latches, projections and broken fence wires. Red, hybrid and wapiti stags all exhibit different natures when yarded. Where practical, each type should be kept separate for velvet harvesting to avoid behavioural confrontation and an inconsistency in handling approach. Aggressive or nervous flighty animals should be culled as these animals can initiate further disruption in an established group.

Deer respond well to a simple established routine if velvet antler harvest is conducted at a similar time each day by one or two deer handlers that the stags are familiar with, and who have good rapport with the overseeing veterinarian. The task becomes non-stressful and efficient and large numbers can be handled under such a routine.

Hot, unsettled weather or the heat of the day should be avoided, as should velveting if rapid weather changes - thunder or storms - are forecast. Stags are also likely to become upset by high winds. Visitors or outside disturbances during velveting should be discouraged and, above all, the procedure must be conducted with respect and regard for animal welfare. There are important legal and ethical requirements to be observed in antler removal techniques and producers have a responsibility to observe these at all times (Wilson, 1989).

Post-harvest care of stags demands similar thought and care. Shade and ample fresh drinking water are required particularly during summer. Stags recovering from sedation should be encouraged to leave the yards as soon as is practical after tourniquet removal. They must be checked frequently for signs of recumbency, bloat or distress. Tourniquets need be applied for only 15-20 min postharvest but should be checked for excessive bleeding after tourniquet removal. Fresh air and clean conditions promote rapid healing of the cut surfaces. Normally no postoperative antibiotics, fly repellents or dressings are required. Damage to coronets by leaving tourniquets on or poor cutting techniques can be permanent and costly.

Harvest

Hygiene is paramount, both for equipment and the harvested antler. Veterinary advice on the safe storage of sedative and anaesthetic drugs, including a strict procedure on coping with a drug emergency should be known to all those involved in harvest, and these procedures revised at the start of each season. Saws, tourniquets, recording tags and storage facilities should all be on hand at the commencement of harvest. For antler removal a fine toothed stainless steel saw is advised and should be washed and disinfected between use. Cutting should be parallel to the coronet 5-10 mm above it and begun from the outside of the antler towards the centre. If the animal is only lightly sedated, or held in a crush, then local anaesthetic administered direct to the main nerves, or via ring block at the base of the pedicle, must be given time for the full effective pain block to develop over 4-5 min. The head must be firmly restrained to prevent any sudden movement of the animal which may tear the velvet skin. The antler should also be fully supported during cutting. Sedated stags can occasionally instinctively react to sudden movement or loud noise and can easily damage themselves or antler with involuntary action. If stags are lying on pen floors, these should be clean to prevent contamination of the cut antler, or exposed eyes and mouth. If stags have been recumbent for some time, the uppermost antler can become rapidly drained of blood and the head should be tilted and antler held down for some time prior to removal to ensure the matrix is blood filled. The entire operation should take the time required for care rather than large numbers and high throughput.

Tranquillizing, anaesthetizing and reviving stags is a skilled operation which can use some potentially dangerous drugs and requires a good knowledge of anatomy and veterinary techniques particularly when injecting stags. Advice and instruction is mandatory and velveting must be done under veterinary supervision.

Handling and Storage

After removal velvet antler should be held for cooling in a clean shaded insect proof area, reclined cut end uppermost on a slope of 15-20° C to allow contained blood to be evenly distributed through the antler. Velvet is also commonly hung upside down on racks until cool and then frozen in an upright position. If this occurs for too long blood can pool in the upper region and create processing problems. Great care must be taken to avoid deforming the bulb or tine-shape during freezing to ensure the antler is presented in true form for grading. Frozen velvet antler should be stored in airtight plastic bags and handled subsequently with the due care that a valuable edible medicinal product demands. Attention to detail from all points of animal selection, grouping and handling and harvest techniques with an established simple routine ensure that these on-farm breeding and feeding programmes are rewarded. Ultimately a knowledge of the changing market requirements for style and quality must be known each season and assessed stag by stag during the 55-70 days of velvet antler growth after casting by close observation of antler shape, bulb and tine development and making the correct time based decision to harvest. Maximum weight, lack of calcification and highest contained blood content are thus optimized. These principles hold in NZ irrespective of the strain or sub-species.

In time, further objective measurements will be developed that reflect increasing demands for quality from processors and market sources. The impact of genetics and nutrition will then warrant further investigation in understanding the roles of growth regulation, development of calcification and ultimate size of velvet antlers. New Zealand's market position will only be maintained in the face of increasing volumes of product offered to a basically single market if producers in turn breed the appropriate style of velvet and ensure attention to detail during harvest and handling. Velvet antler will continue to be a major factor in the growth and returns of the NZ deer industry.

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