ASPT2 ORAL PRESENTATIONS

AUTHORS

TITLES

Deer antler regeneration: A system which allows the full regeneration of mammalian appendages

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Abstract [Full Presentation]

Annual antler renewal is an example of epimorphic regeneration and offers a unique opportunity to explore how nature solves the problem of mammalian appendage regeneration. However, a detailed study of this unique process has been lacking. In the past 2 years, we have taken different approaches to investigate it. These approaches include morphology, histology, immunohistochemistry, *in situ* hybridisation and *in vitro* study. Through these studies we have established and tested our three hypotheses: 1) Antler regeneration may not be a blastema-based process. 2) The growth centres in a regenerating antler are built up through the proliferation and differentiation of cells in the distal periosteum/perichondrium of a pedicle stump. Therefore, antler regeneration may be a stem cell-based process. 3) The process of antler regeneration may recapitulate that of first antler generation, in that they both go through the same three types of ossification and the changes in ossification type may be mainly caused by mechanical pressure. In conclusion, the evidence supports the idea that although deer antler regeneration is an example of epimorphic regeneration it is not a blastema-based process, but rather a stem cell-based process. Distal pedicle periosteum provides the only cell source for antler regeneration. Antler regeneration histologically recapitulates the first antler generation. We believe these findings would greatly enhance our current knowledge in antler biology and the regeneration research field in general.

Keywords: deer antler, pedicle, epimorphic regeneration, blastema, wound healing

Local regulation of antler growth

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Abstract [Full Presentation]

Deer antlers are nature's most dramatic example of mammalian regeneration and therefore understanding the mechanisms that control their development could lead to the development of strategies that can be used to improve the regenerative capacity of humans. Our research explores the hypothesis that the local signalling pathways that regulate skeletal development in the embryo are recapitulated during the annual cycles of antler regeneration. Factors that we have identified as having potentially important roles in antlers include parathyroid-hormone related peptide (PTHrP) and retinoic acid (RA). PTHrP is synthesised locally in antler tissues and acts on cells of the chondrocyte lineage to regulate their differentiation. It also promotes the differentiation of osteoclasts (bone resorbing cells). It does this in part indirectly, through receptor activator of NF-κB ligand (RANKL), but also by a RANKL independent mechanism that is likely to involve a direct action on osteoclasts which express the PTH/PTHrP receptor (PPR). We have also studied the localisation of other molecules associated with PTHrP signalling in the developing limb; Indian Hedgehog (IHH) and TGFβ1. We show that these molecules show a very similar pattern of expression to PTHrP and PPR, particularly in bone forming cells (osteoblasts), which suggests that these molecules may be important regulators of their differentiation. A function of TGFβ1 *in vivo* may be to stimulate production of PTHrP since in cultures of osteoblast progenitor cells TGFβ1 increases the synthesis of PTHrP. Retinoic acids (RAs) have been shown to be important regulators of both limb bone development and limb regeneration in newts. Antler tissues contain several RAs, including *all-trans*, 9-*cis*, and 4-*oxo*-RA. RAs are most likely synthesised locally as retinaldehyde dehydrogenase 2 (RALDH2), a RA synthesising enzyme, is present in antler, particularly in cells of the osteoblastic lineage. These cells also express retinoic acid receptors RARα and RARβ, and *in vitro* RA increases ALP in cultures of mesenchymal cells which indicates that one of its roles is to induce osteoblast differentiation. RA treatment also promotes the formation of osteoclasts *in vitro*. These results indicate that PTHrP and RA may be key regulators of the transition from cartilage to bone in the regenerating antler. They also provide further evidence that regeneration in adult mammalian tissues is likely to be regulated by factors that also control skeletal development in the embryo.

Keywords: deer, osteoclasts, osteoblasts, regeneration, parathyroid hormone related peptide, indian hedgehog, transforming growth factor β, retinoic acid, retinaldehyde dehydrogenase 2.

The expression of PTHrP and the PTH/PTHrP receptor in growing red deer antler

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Abstract [Full Presentation]

Antlers grow at a rate unparalleled in mature mammals and in a manner similar to that of bone development in the fetus. Such rapid growth requires precise synergistic control of the development of both antler compartments, namely trabecular bone and antler skin (velvet). Current knowledge of antler growth and development is limited and does not include specific understanding of how such rapid tissue growth is coordinated and maintained. The aim of this study was to localise parathyroid hormone related peptide (PTHrP) and its principal receptor, the parathyroid hormone/parathyroid hormone-related peptide receptor (PTH/PTHrP receptor) in the developing bone and skin of the antler ("spiker") of 1 year old red deer, using light microscope immunohistochemistry and *in situ* hybridization. Strong, overlapping and specific expression of both PTHrP and its receptor was seen in developing osseocartilaginous structures within the antler, including mesenchyme, chondrocytes, osteoblasts and osteocytes, confirming and extending current understanding of the central role that PTHrP plays in the co-ordination of bone development and growth. We also observed a marked expression of both PTHrP and the PTH/PTHrP receptor in the underlying layers of velvet epidermis. The presence of PTHrP within nuclei and the PTH/PTHrP receptor on keratinocytes suggests both autocrine and intracrine involvement of PTHrP in the growth of epidermis and epidermal appendages. This has significant implications for the understanding of skin growth and undoubtedly contributes to the unique visual and histological appearance of velvet. The findings support the concept that signalling of PTHrP, by interaction with the PTH/PTHrP receptor, plays a key role in the growth of both antler compartments. Such control is important for co-ordination of the processes of cell division and differentiation required for the rapid expansion of antler tissues.

Keywords: parathyroid hormone related peptide; PTH/PTHrP receptor; autocrine; intracrine; mesenchyme; chondrocyte; osteoblast; osteoclast; keratinocyte; dermis; epidermis*; in situ* hybridization; immunohistochemistry

The distribution of growth factors and their receptors in growing red deer antler

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Abstract [Full Presentation]

Periosteum of early antler buds grafted beneath the skin can give rise to a small antler at the site of grafting. This antler becomes covered in velvet, is shed at the end of the growing season and will regrow the following year [Goss RJ and Powell RS (1985) Journal of Experimental Zoology 235: 359-373]. The development of antler velvet is primarily determined by the underlying osteogenic antler tissue to which it is attached. We therefore hypothesise that a paracrine process is central to communication between the osseous compartment and the skin. We have sought to identify a mechanism for this cross-talk by visualising the distributions of a number of growth factors and their receptors in the growing antler. These include EGF and the EGF receptor (EGFR); FGF2 and the FGF receptors FGFR1, FGFR2 and FGFR3; BMP2, BMP4 and BMP14, and the BMP receptors, BMPRI and ACTRII. These signalling systems have been identified in osteogenic cells and are known to play important roles in skin development and growth. To date, regulation of the growth of antler skin has not been attributed to any one of these systems. We have used light microscope immunohistochemistry to determine the distribution of these growth factors and their receptors in relation to development in both the osseous compartment and integument of antler. The patterns of expression were similar in all systems in that these growth factors and also their receptors were expressed on the surface of cells in the epidermis and associated dermal appendages, sebaceous glands and hair follicles, but at lower levels in the dermis. In the osseous compartment, they were localised on the surface of cells of the mesenchyme, chondrocytes, osteoblasts and osteocytes. There were significant differences in the patterns of immunoreactivity which were specific to each signalling system: EGFR was absent from superficial layers of epidermis and expressed at low levels in mesenchyme, chondrocytes and osteoblasts when compared to its ligand, EGF. Nuclear staining for FGF2 and all three of its receptors was apparent in sebocytes, suggesting that it has an intracrine function in sebaceous glands. Intense staining was evident for FGF2 and FGFR1 on the endothelial cells of blood vessels in both the dermis and in early mesenchyme. ACTRII was expressed weakly in osteocytes compared to other BMPs and their receptors. We conclude that these signalling systems are all widely distributed in growing antler but in a pattern which suggests they have a predominantly autocrine function, similar to that seen in early fetal development of bone and skin.

Keywords: EGF, EGF receptor, FGF2, FGF receptors, BMP2, BMP4, BMP14, BMP receptors, integument, epidermis, mesenchyme, chondrocyte, osteoblast, osteocyte, intracrine, autocrine, paracrine, immunohistochemistry.

The role of adrenal androgens in antler growth of castrated fallow deer (D*ama dama*): Possible stimulation of adrenal secretion of testosterone by stress

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Abstract [Full Presentation]

Recently we have reported spontaneous mineralization and sequestration of antlers in castrated fallow deer (*Dama dama)*. In the present study we tested two interrelated phenomenona: 1) the role of androgens (particularly testosterone) in the regulation of antler growth and 2) the role of stress-induced ACTH secretion in antler mineralization. Blood samples from twelve surgically castrated fallow bucks were taken regularly, starting approximately 12 months after surgery (February) and continued at two-weekly intervals till the end of September. During handling, the bucks were weighed and the entire lengths of their antlers were measured. The time between February 16 and September 9 is referred to as a "Period with no treatment". Then the bucks were divided in two equal groups. One group was given 0.5 ml of a solution containing 50 µg of ACTH, intramuscularly (ACTH group). 0.5 ml of physiological saline was administered to the second group (Control group). The period of ACTH treatment started on September 22, when the first ACTH/control application was performed. Four further doses were applied at two to three day intervals. After this time the amount of ACTH was doubled to 100 µg and four additional injections at 2-3 day intervals were administered. Blood sampling, animal weighing and antler measurements were performed one week after the last application of ACTH and then on eight further occasions at two-week intervals. The study finished on February 8, one year after the experiment began.

During the "Period with no treatment" antler growth correlated significantly with testosterone levels. This finding further supports the concept of stimulatory effects of low concentrations of androgens on antler growth.

While ACTH administration seemed to cause a short-termed elevation in testosterone levels, surprisingly, no effects on cortisol concentration were detected. There was a sharp, significant increase in testosterone levels after treatment in both, ACTH and Control groups, however. In view of these findings, we hypothesized, that an increased frequency of handling caused a stress response in the Control group, resulting in the secretion of adrenal testosterone. As a consequence, by the end of the observation, all six bucks of the ACTH group and four of the six deer of the Control group mineralized their antlers and the process of velvet shedding followed.

Keywords: antler growth, castrates, fallow deer, *Dama dama*, testosterone, stress, ACTH, adrenal gland

Welfare assessment of a non-chemical method of providing analgesia for humane velvet removal

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Abstract [Full Presentation]

The requirement for natural and chemical free velvet products has raised concerns over the current use of lignocaine as an analgesic agent because of the potential for residues in the harvested antler. Effective analgesia is crucial for the continued commercial removal of velvet antler and a number of non-chemical alternatives to lignocaine have been investigated. Evaluation has centred on the quality of analgesia and humaneness of application, usually in comparison to lignocaine. One method which has shown considerable promise in both these areas following a great deal of scientific scrutiny is based on high pressure compression of the pedicle. This paper describes the development and evaluation of a method of compression analgesia and presents some new data on behavioural changes following velvet-removal using either compression or lignocaine for analgesia. The data support the conclusion that the method is a safe and effective non-chemical alternative to lignocaine.

Keywords: red deer, velvet removal, compression, lignocaine, behaviour, analgesia, welfare

Velvet antler analgesia: A review of Massey University research

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Abstract [Full Presentation]

This paper reviews a series of investigations of the efficacy of local anaesthetics for velvet antler removal. Using Lignocaine hydrochloride (2%) the most effective procedure is a high dose ring block around the antler pedicle. Mean time to onset of analgesia was 30-36 seconds. Lower doses and most regional blocks were less reliable. Using a ring block, mean time to onset was similar for mepivacaine (2%) but delayed for bupivacaine (0.5%). Studies replicated in yearling and adult stags produced similar results.

Mean duration of analgesia was 92 minutes after lignocaine, 270 minutes after mepivacaine, and 270-460 minutes, depending on formulation, after bupivacaine. Combinations of long- and short-acting local anaesthetics provided no synergy for duration, but mixtures with lignocaine tended to provide more rapid onset of analgesia.

These studies confirm that rapid onset, reliable and repeatable analgesia of prolonged duration is achievable using injectable local anaesthetics. This research has defined "best practice", for adoption as the compliance standard in quality assurance programmes for velvet removal.

Keywords: velvet antler, analgesia, efficacy, local anaesthetic, lignocaine, bupivacaine, mepivacaine

Research in analgesic techniques for antler removal - Canadian studies

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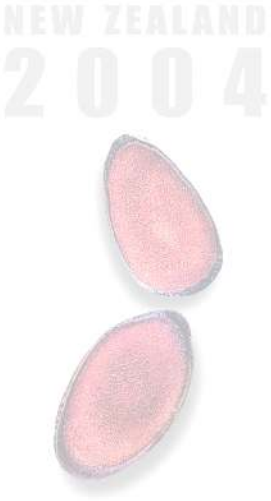
Abstract [Full Presentation]

The purpose of the reported experiments was to compare the effectiveness of lidocaine ring block anesthesia (LA) and electroanesthesia (EA) or pedicle compression (CA) for antler removal in elk and red deer given a long acting tranquillizer to remove handling and restraint stress. In two separate experiments, thirty-two male elk were given 1 mg/kg body weight of zuclopenthixol acetate; the next day, they were restrained in a hydraulic chute, provided with electroanesthesia (n=16, experiment 1), pedicle compression (n=16, experiment 2), or a lidocaine ring block (n=16) and had their antlers removed with a saw. Behavioural response to antler removal was scored. Heart rates (HR) and arterial pressures were measured by a catheter connected to a physiological monitor. In experiment 1 significantly more ($P = 0.032$) animals responded to antler removal in the EA group. Heart rate increased significantly over time with EA, but not with LA. Heart rate increased from baseline significantly more in the EA group immediately prior to antler removal ($P = 0.017$), immediately post antler removal ($P = 0.001$), and at 1 min post antler removal ($P = 0.037$). In experiment 2, during application of LA and CA, mean HR and systolic arterial blood pressure increase were greater in the CA group ($P < 0.05$, and $P = 0.05$, respectively). On antler removal more behavioral responses occurred in the CA group ($P = 0.02$). Mean HR increased for both treatment groups when antlers were removed ($P < 0.01$). It was concluded that application of CA may be painful, and that CA and EA were not as effective as LA for analgesia for velvet antler removal.

In a third experiment twenty-seven, 2-year-old red deer stags were randomly allocated to control, LA, or CA treatment groups and used to compare changes in HR and arterial blood pressures due to the application of CA or LA and subsequent antler removal during a minimal plane of halothane anesthesia that permitted somatic and physiologic reaction to a noxious stimulus. Respiratory rate, HR, arterial blood pressures and somatic responses were continuously recorded and compared over three, 4 minute periods: baseline, after application of analgesia, and after removal of a single antler. Heart rate fell during observations in all groups with no significant differences between groups. In the control and LA groups arterial blood pressure was not different from baseline during the application and removal periods, nor between treatment and removal periods. The CA group arterial pressures were significantly higher than baseline during both the application and removal period and higher after antler removal than during treatment. In the control and LA groups, comparisons of the arterial pressure over the combined experimental period did not differ. The CA group arterial pressure was significantly greater over the combined experimental period than both the LA and the control group. One of 9 animals responded somatically to lidocaine injection and 3/9 to compression application. Eight of 9 control animals, 0/9 of the LA group, and 2/9 of the CA group responded somatically to antler removal. More animals responded to antler removal in the control group than in the CA ($p=0.015$) or LA ($p<0.001$) groups. It was concluded that the application of CA to the antler pedicle is a noxious

stimulus. Also, when compared to LA, compression offers less effective protection against the noxious stimulation of antler removal.

Keywords: elk, red deer, antler, antler removal, neuroleptic, electroanalgesia, compression, lidocaine, ring block



Antler removal studies: Canada

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Abstract [Full Presentation]

As discussed previously (Duncan and Frazer, 1997) an assessment of animal welfare is often best measured through a multi disciplinary approach rather than examining any single methodology. In the aforementioned trials such a multi disciplinary approach was utilized including measurements of adrenocorticoid parameters (salivary cortisol), physiological responses (infrared thermography) and ethological responses (animal behaviour). The response from these parameters can be used to distinguish the stressful nature of the velveting process under different analgesic techniques. In this respect the data from the current studies suggest that the use of electrical analgesia or the organic removal is likely the most stressful. By comparison, the lidocaine treatment elk displayed stress responses which were lower in magnitude but still somewhat higher than or the same as the compression ring treated elk.

Key Words: velvet antler; humane removal

Stress responses of elk (C*ervus elaphus canadensis*) and reindeer (R*angifer tarandus*) to removal of velvet antler

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Abstract [Part of Presentation]

The relative efficacy of pain management procedures for the humane removal of velvet antler from elk (*Cervus elaphus canadensis*) and reindeer (*Rangifer tarandus*) has been the subject of six (6) studies. Pain management techniques have included lidocaine (LIDO), electrical analgesia (EA), hand-tight tourniquet compression (TC) and high-tension compression (COMP). Control groups have included removal of antler without pain control, so-called 'organic' removal (ORG), restraint without removal (SHAM), and the insertion of an ear-tag without anaesthetic (TAG). Adrenocortical responses to velveting were assessed using measures of salivary cortisol in samples collected Pre-cut and Post-cutting of antler. Metabolic responses were assessed by infrared thermographic analysis of radiated temperature from the lachrymal gland region of the eye. The data presented examine mean levels between sampling times, the relationship between concentrations in different samples and the relationships between concentration and restraint time and time in barn. Treatment effects were examined by comparisons of mean levels, correlation coefficients and receiver-operating characteristic (ROC) curves. In general, painful procedures (ORG, EA and TAG) were associated with higher levels of adrenocortical activation. Treatments such as LIDO and COMP were less associated with stress responses. The combined data from six (6) studies of stress responses of deer to velvet removal indicated that the COMP technique had efficacy for pain control and may be less associated with stress responses than LIDO.

Keywords: velvet antler, pain management, salivary cortisol, infrared thermography, receiver-operating characteristic (ROC) curves

Study of glycosaminoglycans-rich antler products as safe and therapeutic nutraceuticals

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Abstract [Full Presentation]

Deer farming commenced as a viable industry in Alberta since 1970. It has rapidly emerged as an alternative form of animal agriculture. Velvet antler is the product that the industry has offered relative to the rapidly expanding market between the agrifood and health sectors. There is a lack of scientific data and public awareness regarding velvet antler. Today's health conscious consumers in the West are interested in using antler nutraceuticals. The newly emerging functional food market in North America has created an enthusiasm among producers and researchers to develop value-added antler nutraceuticals. The opportunity for developing nutraceuticals out of deer antlers appears vast with strong demand in North America. The purpose of this initiative is to look at antler beyond its traditional herbal medicinal practices, to scientifically verify many claimed health benefits, to commercially explore Alberta produced velvet antler for nutraceutical uses in the North American health/food market. It must be scientifically validated first. Scientific validation of health claims and establishing stringent production and quality standards of antler nutraceuticals from Alberta grown velvet products will be focused in this initiative.

Keywords: velvet antler; nutraceuticals; agrifood; health; osteoarthritis

Toxicological evaluation of New Zealand freeze dried deer velvet powder

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Abstract

The toxicity status of deer velvet antler must conclusively be demonstrated to Western consumers who, unlike people in Eastern countries, do not have the benefit of millennia of use to support its safety. Our previous studies have shown that NZ deer velvet powder, which was dried by a traditional style hot-water dipping method, was not toxic in acute and 90-day subchronic toxicity tests in rats (*Food and Chemical Toxicology*, 38: 985-90, 2000). In recent years, however, the freeze-drying processing method has greatly gained in importance in NZ. This development has largely been driven by the preference of the US consumers for freeze-dried product. Over the last six years, a research programme has been conducted at the School of Pharmacy, University of Otago to evaluate the safety and efficacy of NZ freeze dried deer velvet powder. Results from our general toxicity studies, which include acute, 90-day subchronic, 8-month and reproductive/development toxicity tests, suggested that NZ freeze dried deer velvet powder was safe when administered orally to rats at a high dose level (1000 mg/kg). In this presentation we will report findings from these studies and a general discussion that will include issues related to nutraceuticals safety and public (including health professional) acceptance for their use.

Keywords: velvet, freeze-dried, healthfood, neutraceutical, safety, toxicity

Velvet activity index (VAI™): a quality index for deer velvet and deer velvet products.

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Abstract [Full Presentation]

Consumers of healthfood products expect to be able to compare the quality, and likely relative efficacy, of similar products from a variety of manufacturers. This has not been possible for deer velvet products because of a lack of a suitable quality standard. In this paper, a new standard is proposed, which combines measures of the water-soluble and of the organic solvent-soluble fractions of deer velvet products into a single index, the Velvet Activity Index (VAI™). The VAI™ is readily determined with good precision and is suitable for use with a wide variety of product forms, including extracts. It reflects deer velvet quality and commercial value much more reliably than the current *de facto* standard, ash content. In future it is proposed that the VAI™ be adopted for use as a quality indicator in the Industry Agreed Minimum Standards programme for New Zealand deer velvet products.

Keywords: VAI™, velvet, products, composition, activity, quality, index, protein, lipid, gel filtration chromatography, ash

Comparative studies on pharmacognostics and pharmacology of Chinese wapiti (*Cervus Canadidas*) and New Zealand red deer (*Cervus elaphus*) velvet antlers

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Abstract [Full Presentation]

There is very little data comparing the composition and efficacy of velvet antler from different species and different countries. Any existing comparisons are confounded by crucial variables which influence efficacy including stage of velvet development at removal and stag age. The present study offered the opportunity to compare samples of velvet antler from China and New Zealand where stag age and time of removal since casting of the previous hard antler could be controlled. Variables remaining included species, nutrition and processing method. The gross and microscopic morphology of the velvet antlers was compared and found to be very similar between the samples. The chemical composition was also similar but Chinese wapiti may have been slightly more calcified at the time of removal. A toxicity test revealed no significant differences between the samples. Velvet antler from both species was equally potent at elevating peripheral red and white blood cells in anaemic mice. There were no significant differences either on the stimulation of mouse abdominal macrophages, swimming duration or cold tolerance although both samples performed significantly better than control treatments in all experiments. Overall this study revealed that the performance of Chinese wapiti velvet antler was almost identical to that of New Zealand red deer velvet in a series of tests conducted on samples which were controlled for age of stags and stage of development at removal.

Keywords: Chinese wapiti, New Zealand red deer, velvet antler, comparison, efficacy

Profiling genes expressed in the regenerating tip of red deer (*Cervus elaphus*) antler

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Abstract [Full Presentation]

A database of genes expressed in the tip of regenerating red deer (*Cervus elaphus*) antler was constructed to investigate the molecular profile of this well known traditional Chinese medicine material. A total of 4,516 expressed sequence tags (ESTs) consisting of 930 unique genes (378 clusters and 552 singletons) were examined in the present study. Identification of genes related to extra cellular matrix, cell cycle, and cell dynamics provides not only valuable insights into the molecular mechanism of antler growth, but also plausible explanations for the potential biological activity of velvet antler. Of particular interest are the 22% of ESTs that have been determined as either hypothetical proteins or uncharacterised cDNA. This research highlights the fact that regenerating deer antlers are an exciting model to discover new genes and genetic pathways for cartilage, bone, blood vessel, neural and skin development.

Keywords: gene expression, ESTs, antler, red deer

Deer velvet processing in New Zealand

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Abstract

As the Velvet antler Industry in New Zealand is relatively new, it is characterised by continual and rapid change and constant improvement. Features include the continuing development of the NZ farmed deer industry, velvet antler quality and size and a growing appreciation of new markets, new products and new opportunities

Quality processing relies on key partnerships between farmers, purchasing agents, processors and the market. The New Zealand industry has developed formal processes to ensure quality of the final product including industry codes for animal welfare, food safety, product identification, handling and storage and processing. A standard industry code of grading ensures consistency in product specification.

Within the factory, there is strict adherence to the specific steps involved in processing and associated quality control and production efficiency. A mixture of traditional techniques, modern oven cooking and air drying and freeze drying are described. Understanding of specific temperature based critical processing steps have allowed the development of a high volume, reduced time operation and yielding a consistent high quality, high bio-activity product. Key partnerships in processing between our traditional trading customers and their traditional skills and knowledge integrated with the NZ wide quality assurance systems and formal processing techniques have been critical.

New areas of use, further sophistication in processing techniques and continuing improvement in the antler produced on farm are all important components of a profitable and exciting future. Quality systems at all steps in the transformation of deer antler to final whole stick or sliced product or extract are the key to that future success.

Key words: deer, velvet antler, processing, grading, traditional processing, modern processing, quality, quality systems

Research on chemical composition and efficacy of velvet antler in Korea

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Abstract **[Full Presentation]**

We present the progress of Korean deer and deer related study. Study confirm that improvements to velvet production by nutritional means are small, and points out management issues such as diet change that affect potential productivity of deer farms. A study determined the effects on blood composition from different feed sources. There were especially large differences in composition of cholesterol, glucose, urea and minerals due to feed source. Also several researchers have been heavily involved in determining the variation of velvet content by feeding and have carried out several experiments on the variation of velvet production composition by different feed sources and nutrition level. Results indicate that body and velvet composition may greatly vary with feeding condition and thus it is partly possible to control velvet quality with feed sources.

Keywords: deer farming, velvet antler production, blood constituent, feeding behavior, clinical efficacy

Velvet antler processing, from the Chinese perspective

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Abstract

Velvet antlers of sika and wapiti deer species have been used as Traditional Medicines either alone or in combination with other herbs for thousands of years in China. China was the first country in the world to farm deer, and has more than two hundred years of history of velvet processing. In this paper, we briefly review Chinese velvet processing history, currently used methods and the trend towards further velvet processing techniques. Velvet antler processing in China has evolved from the beginning to today through three distinguishable stages: Primitive processing, traditional water boiling and natural wind drying and modern methods. Three main velvet processing methods currently co-exist in China: traditional processing method, vacuum freeze-drying and microwave and far infrared oven processing. Each of these methods has advantages and disadvantages. Future velvet processing techniques in China will focus mainly on the maximisation of the potency of active substances in antlers after processing. Discoveries of novel or unique active molecules from velvet antler will greatly facilitate the establishment of these new techniques.

Key words: deer antler, velvet processing, vacuum freeze-drying, microwave and far infrared

Composition of Chinese velvet antler

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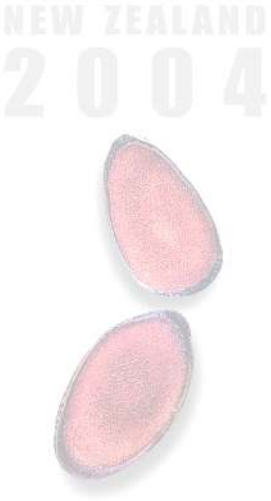
Abstract

Deer velvet antlers have been widely used as Traditional Medicine in China and other Southeast Asian Countries for thousands of years. Pharmacological effectiveness of velvet antler relies on its complex composition. Since early last century, Chinese scientists have been working on velvet composition analysis and identified a variety of substances from velvet antlers. These include amino acids, cholesterol, phospholipids (which includes lysophosphalidyl choline, phosphatidyl choline), minerals, hormones, collagen, proteoglycans, chondroitin sulfate, glucosamine sulfate, GAGS, keratan sulfate, dermatan, hyaluronic acid, growth hormones and growth factors, nucleotides, prostaglandins, polyamine and gangliosides. In this review, we have collected and sumarised the published velvet composition data from China. Based on this summary, individual researchers can avoid the repetition, identify the gaps and synergize the effort to further explore novel or unique velvet substances. Any new discoveries on velvet antler composition would not only promote velvet industry, facilitate the establishment of new antler processing methods, but also identify new opportunities for clinic usefulness.

Keywords: deer, antler, velvet, composition, active substance



Russian velvet research

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Abstract

The Russian Deer Velvet Industry is based on breeding of two deer species: maral deer (*Cervus elaphus sibiricus* Severtzov) and spotted deer (*Cervus nippon hortrulorum*). At present, the total number of velveting stags is 90,000 animals, which annually give 114-116 tons of raw and 41 tons of processed velvet. Quality of deer velvet depends on the stage when it is cut. The general chemical composition of maral and spotted deer velvet is as follows: moisture – 11.6-11.9%; dry matter – 88-88.3%; ash – 34-35.5%; organic matter – 52.8-54.0%; fats – 3.16-3.74%; total nitrogen – 9.6-9.8%. There are no significant differences between the chemical compositions of maral deer velvet and spotted deer velvet. The predominant lipids fractions in deer velvet are phospholipids, sterols and free fatty acids. The chemical components of deer velvet antlers can be grouped into five major categories. Firstly, there are mineral substances that include microelements and show high biological potency in the form of chelates and ionic complexes. The second group comprises the amino acids; 100 g of deer velvet flour contains 30-40 g of amino acids. The third group contains six peptides and one lipopeptide. The fourth group comprises the lipid fraction; 100 g of deer velvet extract contains 1.8 g of lipid. Nucleic acid bases comprise the fifth group of biologically active substances.

Keywords: deer velvet, Russia, composition, maral, spotted deer

The effects of New Zealand deer antler velvet supplementation on body composition, strength, and maximal aerobic and anaerobic performance

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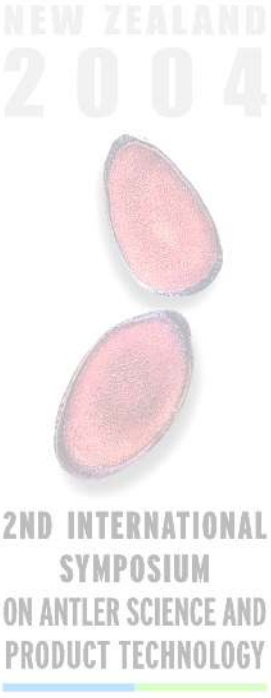
Abstract [Full Presentation]

In the present study, we investigated the physiological and potential performance enhancing effects of New Zealand Deer Antler Velvet (NZDAV) supplementation in men. Thirty-two males between the ages of 18 and 35 with at least 4 years of weight lifting experience were randomly assigned using a double-blinded procedure into either a placebo or NZDAV treatment group. Placebo group members received sugar pills and the NZDAV group received 1500 mg NZDAV once in the morning and immediately prior to bed-time. Random assignment was done in matched pairs (1 placebo; 1 NZDAV). Prior to and immediately following the 10-week supplementation use, each subject participated in a series of measurements. These procedures included the measurement of maximal aerobic capacity ($\dot{V}O_2max$), maximal power output on a cycle ergometer, a determination of maximal strength (1-RM) for the bench-press and squat, a comprehensive blood chemistry profile, body composition analyses (DEXA), and a 3-day dietary recall. Of the original 32 subjects recruited for this study, 56% of the subjects completed all aspects of the study properly which was evenly divided between the two treatment groups leaving the placebo group n = 9 and NZDAV group n = 9 subjects. At the start of the study, there were no significant differences between the groups in their respective body composition profile variables. In the NZDAV group, DEXA % body fat ($p = 0.04$), DEXA Fat Wt ($p = 0.07$), and Trunk-to-limb Fat Wt ratio ($p = 0.02$) either significantly declined or neared significance. According to the results for the placebo group, only the 1-RM values for this group's absolute bench (Pre: 123.2 ± 24.0 kg; Post: 128.3 ± 27.5 kg, 4.1% ; $p = 0.04$) and squat (Pre: 150.5 ± 28.2 kg; Post: 156.6 ± 30.4 kg, 4.1% ; $p = 0.04$) 1-RM improved after the intervention period. When normalized for kilogram of total body weight, the placebo group did not show any significant differences for the 1-RM measurement in both the bench and squat. In contrast, the NZDAV showed a significant improvement in the 1-RM values in absolute terms and relative to total body weight. In absolute terms, the 1-RM for the bench press increased 4.2% (Pre: 120.0 ± 23.6 kg; Post: 125.0 ± 25.7 kg; $p = 0.02$) while the squat 1-RM improved 9.9% (Pre: 159.3 ± 42.7 kg; Post: 175.0 ± 43.5kg; $p = 0.002$) in NZDAV group. In contrast to the placebo group, when 1-RM values were expressed relative to total body weight, the bench press and squat also significantly improved 4.0% and 10.1%, respectively ($p = 0.02$) in the NZDAV. One of the most interesting findings of this study was the fact that there was also a significant improvement in aerobic capacity in the NZDAV treatment group. In liters • min^{-1}, $\dot{V}O_2max$ increased significantly by 9.8% from the pre- to posttreatment period (4.30 ± 0.45 to 4.72 ± 0.60 liter • min^{-1}; $p = 0.002$). When expressed relative to total body weight in kilograms, $\dot{V}O_2max$ remained significantly elevated 9.4% (46.5 ± 8.1 to 50.0 ± 8.9 ml • kg^{-1} • min^{-1}) following the training-supplement intervention. This study's results

suggest that NZDAV may have positive effects on body composition and strength/power in resistance training men.

Keywords: deer antler velvet, strength training, performance, aerobic power, anaerobic power



A review of dose levels of deer velvet products in relation to efficacy

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Abstract [Full Presentation]

Deer velvet has been used in Traditional Chinese Medicine for millennia and has a growing market as a Western Dietary Supplement. In addition an alcohol extract of deer velvet, Pantocrin, has been developed in Russia. The way in which deer velvet is taken varies markedly in Asia, where it is typically combined with other medicinal products, compared with the dietary supplement where ground velvet is frequently taken alone as a capsule. The dietary supplement business has frequently requested advice on effective doses for proven therapeutic effects but no dose response studies using deer velvet have been attempted in a Western nation. Variations in deer velvet quality, method of preparation, clinical endpoint and length of treatment have all hampered analysis of effective dose and meant that there has been no robust advice on dose.

The present review draws data from a variety of studies and sources and expresses various measures of clinical effectiveness in terms of milligrams of deer velvet powder equivalent. The review concludes that 1500-3000 mg/day (i.e. about 20-40 mg/kg/day) of deer velvet powder equivalent is required in a person for a performance improving effective response.

The data are presented as a preliminary guide prior to future specific dose response studies. Individuals should consult a medical practitioner before taking any deer velvet product, and consumption should be discontinued if any side effects are experienced.

Keywords: deer velvet powder, Pantocrin, clinical trials, dose efficacy

Antler and angiogenesis

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Abstract [Full Presentation]

Angiogenesis is the process by which blood vessels grow and occurs in both physiological and pathological situations. The antler is highly unusual in that it contains vascularised cartilage. Little is known of the factors that might cause the growth of blood vessels in antler or whether angiogenic extracts can be isolated from deer antler. Here we have examined the angiogenic potential of antler at 55-60 days of growth. Blood vessels were detected using immunohistochemistry for alpha smooth muscle actin. The angiogenic growth factor VEGF and its receptor KDR were detected in the antler. VEGF-121 and VEGF-165 splice variants were both sequenced from the antler tip and *in situ* hybridisation for VEGF mRNA detected transcript in the precartilage region and in association with the vascular channels in the upper cartilage region. KDR mRNA was found only in the precartilage region. The angiogenic and chondrogenic factor pleiotrophin was sequenced from antler. *In situ* hybridisation for pleiotrophin revealed large amounts of transcript for pleiotrophin within the antler. Within the dermis and cartilage regions the transcript was associated with blood vessels. The chondrocytes of the precartilage region contained large amounts of pleiotrophin mRNA. This finding is compatible with pleiotrophin having potentially both an angiogenic and a chondrogenic effect. Extracts derived from antler were also produced and were shown to cause the proliferation and migration of endothelial cells *in vitro*.

The results thus indicate that both VEGF and pleiotrophin are likely to be playing a role in the angiogenesis seen within the antler. This research lays the foundation to discover what other factors drive this rapid angiogenesis and overcome the normal propensity of cartilage to be avascular. The antler also provides an exciting source tissue for the production of extracts with potent angiogenic activity.

Keywords: vasculature, angiogenesis, antler, VEGF, pleiotrophin, actin

Velvet deer products as new nutragenomic sources: The Russian perspective

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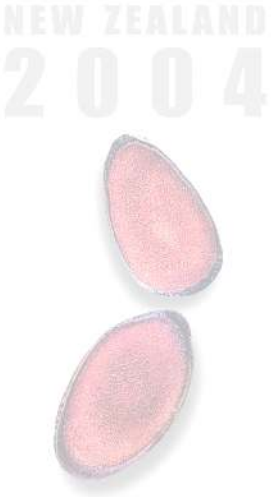
Abstract [Full Presentation]

There has been a tremendous progress in the depth of understanding of many biochemical processes at cellular and molecular levels, while improvements in analytical methods and instrumentation in nutragenomics has often exceeded our expectations. Though many of the secrets and laws of biological mechanisms are being fully understood, often the question of the effects of a long-term use of new chemicals or natural product formulations that emerge to the markets remain to be exactly uncovered.

Velvet deer products in various forms have been among the most frequently used health-promoting components in Oriental medicine. To date Russian and Siberian traditional health care system is based on combinations of modern and traditional practices. In addition to the chemical preparations, Russian and Siberian traditional medicinal preparations are based on animal byproducts, plants and fungal origins.

The objective of this manuscript is to present a glimpse of new developments in the processing, formulations, and applications of velvet deer products in Russian health care system, nutragenomics, sports nutrition, space research programs, and other pharmacological applications. The latest development in the new areas of applications, such as space research programs, improvement of adaptogenic mechanisms, improvement of general wellbeing, enhancement of memory and mental activity, and perspectives of quality control and product identification in Russia are presented.



Antler market update – North America

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Abstract [Full Presentation]

Chronic Wasting Disease (CWD) has destroyed most markets for North American antler and antler products. Trade barriers have closed access to Korean, Chinese, New Zealand and Australian markets. In 2003, some borders were still open to velvet and a Toronto based Hong Kong buyer purchased Canadian velvet in Saskatchewan for the following prices: Grade A - $33-$40 CDN /kg ($15-$18/lb), Grade B - $28.50 CDN /kg ($13/lb), Over grown - $22 CDN ($10/lb). North American consumers have not over-reacted to the potential health risks posed by prions in elk and deer products. Sales of processed nutraceutical product have not fallen as far as expected but some smaller farm gate suppliers have become discouraged and have stopped offering product. Canadian processors and marketers whose business was largely in the US have suffered badly from disease control strategies and barriers. The immediate future depends largely on the reopening of the US border to Canadian product. Breeding stock and velvet producers who are downsizing or exiting the industry have placed some of their animals on the market and elk bulls are now worth $1000 to $1500 at auction. A decrease in the price of "high wire" hunt packages has kept hunt participants interested in hard antler trophy hunting. Basic hunts for white-tailed deer and elk range from $1,800 to $10,000 US for a 3-day hunt depending on the desired antler size and relative luxury of the hunt farm arrangements. Future domestic North American sales for soft antler depend on the strength of industry marketing efforts and export sales depend on the re-opening of trade borders in Korea and China.

Key words: velvet antler, markets, CWD, nutraceutical, trade barrier

Development of the Chinese deer farming industry and the market for deer velvet

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Abstract

Through the review of Chinese deer farming history, we know when and why Chinese started to farm deer and to develop it to today's status. Velvet production is the main reason for farming deer in China. People use velvet antler for health and well being, which is why velvet antler has a world market. We are confidence that velvet antler as either a Traditional Medicine or food supplement will have a bright future.

Keywords: China, deer, farming**,** velvet antler, antler production**,** market