

VELVET ANTLER RESEARCH NEW ZEALAND LTD

AgResearch Ltd and Group Research Holdings
Ltd
Joint Venture Company

Review of Activities

May 2002

INTRODUCTION

Velvet Antler Research New Zealand Ltd (VARNZ) is a joint venture between the Game Industry Board and AgResearch Ltd. It was established in 1994 with the twin objectives of:

- Undertaking research on deer velvet and co-products, and
- Controlling and managing the outputs of such work for the benefit of the New Zealand deer industry.

Since 1994, the research outputs required of VARNZ have shifted as new opportunities and challenges have arisen.

After eight years of operation, the directors of VARNZ believed that a thorough review of VARNZ's activities was warranted.

The directors decided that a two sided approach to the review was required:

1 External Review

A review of VARNZ's mode of operation and the results obtained has been conducted by an independent third party, Dr Peter Molan, who is an internationally renowned and leading researcher on the effects of manuka honey. Manuka honey is an animal based product and the natural product industry has been through a process of proving its therapeutic benefits. Its industry background therefore has elements in common with deer velvet.

In his review Dr Molan expresses a positive opinion on the research undertaken. He also provides specific suggestions for other experiments and future directions of activity.

2 Internal Review

The principal purpose of this was to try and quantify the benefits that VARNZ has provided to its stakeholders over time.

The cost/benefit analysis part of the internal review indicates that the VARNZ research programme has provided financial benefits in excess of their cost. However, we note that this outcome relies heavily on the assumptions as to economic benefit (type and value). While the directors believe these assumptions are reasonable, we leave it to readers to form their own view.

Also included are:

- A commentary on the VARNZ programme from the directors and executive called "**The VARNZ Research Programme: Past, Present and Future**".
- A **Research Map** which provides a summary outline of the VARNZ research programme. It details how velvet research has progressed and how the various research areas and trials have linked and evolved over time.

This review process has been a positive discipline for directors and executive to re-evaluate the VARNZ programme. However, the directors of VARNZ also conducted this review to communicate the path that VARNZ has taken and what the future could hold, and for this reason it is being distributed to its stakeholders.

The directors of VARNZ would be pleased to receive stakeholders' views on the programme and its directions.

Thank you for taking the time to read it.

Andrew Thomson

Chairman
Velvet Antler Research New Zealand Ltd

May, 2002

EXTERNAL REVIEW OF VARNZ RESEARCH WORK THAT HAS BEEN CARRIED OUT ON DEER VELVET

Peter Molan BSc (Hons), PhD

Dr. Molan is Associate Professor of Biochemistry, and Director of the Honey Research Unit, at the University of Waikato. His research work has covered a wide range of topics, and he has published 64 papers in refereed scientific and medical journals. For the past 20 years he has been working on the therapeutic properties of honey, heading the work that discovered the unique antibacterial properties of manuka honey, and being responsible for devising the 'UMF' rating of this activity to differentiate it in the market-place. It is through his research work and his activities making the public and health care professionals aware of the properties of honey that honey has become widely accepted around the world as a respectable therapeutic agent. His work on honey has been recognised by the award of an MBE by the Queen, and the Silver Medal for Science and Technology by the Royal Society of New Zealand.

1 Summary

My opinion is that a clear direction in the research, logically following the needs of the industry, can be seen in the work that has been carried out in and for New Zealand on the production and properties of velvet. All of this work has been carried out thoughtfully and rigorously and thus is likely to be well accepted. The work on management of farmed deer, handling techniques for velvet, meeting Korean quality standards, finding new measures of quality, seeking ways of detecting the authenticity of "velvet" products, developing the most humane methods of removing velvet, demonstrating that velvet is safe to consume, and demonstrating that velvet has physiological and therapeutic effects was very necessary, although testing on experimental animals creates a risk to market acceptance of the product. The work investigating the physiological mechanisms of control of antler growth can be justified, although it does not appear to have led to any ways of increasing velvet production or quality. The recent research looking for various growth factors or molecular genetic evidence of their expression in growing antlers could be considered a "shot in the dark" approach that has a low chance of giving a commercially useful outcome (*i.e.* identifying the components responsible for the physiological and therapeutic actions of velvet). However, it has led to some useful findings, and is now focused on what promise to be valuable healthcare products. It could also lead to the finding of a unique marker for velvet that would allow authenticity to be determined.

Some specific comments are included on experiments carried out, with suggestions for extending some of these to get more conclusive results. Specific suggestions for other experiments that could be worthwhile carrying out are also given, such as increasing bioactivity by avoiding heating.

Some recommendations for the future direction of activities are made:

- Obtain incontrovertible evidence for the various health-enhancing and therapeutic effects traditionally attributed to velvet, to prove to potential purchasers in non-traditional markets that it is likely to be effective, to demonstrate in all markets that New Zealand velvet is of superior quality, and as a means of establishing authenticity of velvet products.
- Optimise processing procedures to minimise any loss of the various bioactivities in velvet.

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- Develop, for as many of the bioactivities of velvet as possible, assays using chemical or cell-culture techniques, to give evidence of effectiveness and measures of quality that can be presented to the public.
 - Chemical identification of bioactive components would enhance the credibility of velvet and would aid in gaining its registration as therapeutic products.
 - Investigate the amount and nature of the antioxidants in velvet, as these may account for some of the observed physiological actions of velvet.
 - The work on the growth physiology of velvet, if continued, should continue to be carried out with funding from FRST and not the industry.

2 Findings and opinion

I have read through the very large volume of literature supplied consisting of copies of reports and published papers describing the research carried out in New Zealand and Asia for GIB and VARNZ and reviews by New Zealand researchers of relevant published research carried out by others elsewhere in the world.

A clear direction in the research, logically following the needs of the industry, can be seen in the work that has been carried out in and for New Zealand on the production and properties of velvet:

- The work on management of farmed deer was important to be able to optimise production and provide scientific evidence to dispel some myths that could have led to unnecessary feed cost.
- The work on handling techniques for velvet to obtain the best colour was important to allow production of velvet that would be in highest demand in traditional markets and thus fetch highest prices.
- The work on meeting quality standards set or mooted by Korean authorities was essential to be able to maintain a major export market. Although these standards are probably of no value in protecting consumers, and can easily be met by adulteration, the ability for exporters to comply with import standards is essential.
- The work seeking ways of detecting mislabeling of the species of origin of velvet and misrepresentation of other powders as powdered velvet was important to be able to protect the market for velvet. However, it needs to be continued to establish methodology that has sufficient certainty and reliability to be able to be sure of winning cases taken to a court of law.
- The work finding new measures of quality was important in overcoming with hard evidence the belief by Asians that New Zealand velvet is inferior. Establishing quality indicators based on bioactivity also hopefully could lead to their adoption as regulatory standards which would be far more meaningful and much harder to achieve by adulteration.
- The work devising the best method of producing extracts of velvet was important to get a product with the highest amount of activity. However, there is scope for extending this work beyond measurement of extraction of just some of the activities, to ensure that all types of bioactivity in velvet are optimally extracted.
- The work developing the most humane methods of removing velvet, and demonstrating that the deer do not suffer pain in or after the process, is critically important to overcome the very likely protests and calls for boycotts that could be expected from the increasing numbers of people objecting to farming practices.
- The work investigating the physiological mechanisms of control of antler growth is more of academic interest, but can be justified, as it is from a good understanding of mechanisms that rational approaches to new products and applications can be made. So far the knowledge gained in this area does not appear to have led to any ways of increasing velvet production or quality, but commercially valuable advances do sometimes come as spin-offs from basic research.

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- The microbiological and toxicological work demonstrating that velvet is safe to consume is critically important, to reassure consumers not familiar with velvet as a traditional medicine that it is a safe product. The information gained from this work is also necessary to gain approval from Ethics Committees for trials on animals and humans, as well as to reassure consumers not familiar with velvet as a traditional medicine.
 - The research carried out to demonstrate that velvet has physiological and therapeutic effects is very important for establishing new markets in Western countries and increasing the market in Asian countries where there is now a marked interest in evidence-based functional foods and self-administered medicines.
 - Research carried out on experimental animals is useful to establish that velvet has particular physiological effects, but it is important that any experiments carried out do not involve any discomfort to the animals because of the sensitivity of Western markets to testing on animals. This is especially so for a product aimed at the Western ‘natural medicines’ market, as the consumers in that market seem to be particularly opposed to testing on animals.
 - The recent research looking for various growth factors or molecular genetic evidence of their expression in growing antlers could be considered a “shot in the dark” approach that has a low chance of giving a commercially useful outcome (*i.e.* identifying the components responsible for the physiological and therapeutic actions of velvet). Even where it leads to discovering a component that may be responsible for a physiological effect of velvet, it still remains to be proven that the factor is in fact responsible for that effect. However, it has led to some useful findings of what promise to be valuable healthcare products. Furthermore, it is of value to use in parallel with physiological studies when focused on particular effects. Even as an unfocused study it could be of value in leading to the finding of a unique marker for velvet that would allow authenticity of “velvet” products to be determined, but a very wide range of tissues would have to be tested to ensure that it were in fact unique.

All of this work has been carried out thoughtfully and rigorously and thus is likely to be well accepted. (However, some of the Korean research is not well reported.)

3 Specific comments on experiments carried out

Before organised trials are carried out on people it is advantageous to run pilot trials in which an effective dose rate can be determined. The pilot trials require much smaller numbers of participants than are needed to be able to prove an effect with high statistical significance, but can give a good indication of which dosages work and do not work, so that the full trials carried out are not a waste of money by failing to show a result because dosage is too low.

Testing of velvet for inhibition of growth of tumour cells is of little value unless it can be demonstrated that velvet has **selective** cytotoxicity (*i.e.* that it is not, or is less, cytotoxic to cell lines other than tumour cell lines).

Is the immunopotentiality that in cell culture experiments was concluded to be achieved by velvet a true activation of the immune response or just the results of growth factors making the cells in culture multiply? (Test for stimulation of cytokine production to determine this.) The immunostimulatory effects observed should not be attributed just to the presence of cytokines in velvet - many substances stimulate multiplication of leukocytes (*e.g.* lipopolysaccharides, glycosylated proteins).

When fractionation experiments fail to show activity there is an alternative explanation to the conclusion that there are multiple factors involved: the bioactives may have been lost, by irreversible adsorption to chromatographic media or by denaturation. (Testing of all the fractions recombined will show whether there are multiple factors involved or if the activity has been lost.)

Could velvet stimulate the production of endogenous nandrolone? Although unlikely, it is a possibility that should be considered before concluding that velvet will not cause the detection of nandrolone in athletes.

In the experiment testing velvet for an aphrodisiac effect the age of the participants was not reported. Its best chance of showing an effect (and its best potential market) would be with aging males. This would fit in with an effect being seen in rats, where sexual activity is seasonal so there is scope for increase in the “off season”.

The effects of enhancement of muscle performance could well be due to antioxidant activity, which can suppress the inflammatory response. (The reactive oxygen species produced in inflammation serve to recruit and activate more inflammatory cells, giving a self-amplifying response. Antioxidants break this feedback cycle of amplification.)

4 Suggestions for future experiments

Could more bioactivity be retained if heating were avoided altogether in the drying process? The need for heating as a pasteurisation process could possibly be obviated by aseptic removal of velvet antlers. Surface sterilisation and use of sterilised cutters is one way that could be investigated. The use of heated cutters is another, which would have the advantage of cauterising the antler stump and the open end of the cut velvet. (This would also be a way of sealing in the blood so that the antler could be laid on its side to get an even distribution of blood.)

5 Recommendations for future direction of activities

1. It is important to establish, with incontrovertible evidence, that velvet has the various health-enhancing and therapeutic effects attributed to it in traditional Chinese medicine. There are various reasons for doing this:
 - For Western markets and non-traditional Asian markets the research will provide evidence that a traditional medicine actually has a rational mechanism of action and is likely to be effective.
 - For all markets it will be a means of establishing the superior quality of New Zealand velvet.
 - It will serve to overcome the problem of determining the authenticity of competing “velvet” products on the market. Even if a “suspect” competing product were genuine velvet, lack of bioactivity would show it was of no value. (An appropriately educated public would seek to buy the activity in velvet products, not just the product.)

Assays should be run that will prove the presence in velvet of activities that would account for **all** of the health-benefiting properties that traditional Chinese medicine attributes to velvet. This will involve a large amount of research work, so prioritisation is recommended with a view to the greatest likely return in the marketplace. Experiments with humans or animals should also be run to demonstrate that oral intake of velvet gives the identified health-enhancing and therapeutic effects, thus showing that the bioactives are actually absorbed from the gut.

2. Investigate processing procedures to determine if and where there is any loss of each of the bioactivities in velvet. Devise alternative procedures to minimise any loss of each of the bioactivities.
3. Develop good assays, using chemical or cell-culture techniques, for as many of the bioactivities of velvet as possible. The reasons for this are:
 - the results of experiments using these assay techniques can be presented to the general public as evidence of therapeutic/physiological effects, without the negative connotation of experiments being carried out on animals
 - the assays can be readily carried out on large numbers of samples and thus can be used in quality assurance procedures in processing/manufacturing of velvet products
 - the results obtained from these assays can be used to promote New Zealand velvet as having superior quality
 - assays that can be readily carried out on large numbers of samples will be very useful for research identifying the components of velvet responsible for the various bioactivities.
4. Chemical identification of the components responsible for each of the bioactivities would enhance the credibility of velvet as a therapeutic/performance-enhancing agent, and would aid in gaining registration with health authorities of velvet products as therapeutics. Chromatographic fractionation of velvet and assay of the fractions for each bioactive being sought will allow each bioactive to be isolated so that its molecular structure can be found. (It is important to use quantitative assays, and to keep a “balance sheet” to ensure that any molecule isolated accounts for all of the activity, and is not just a minor component of the activity that has been isolated.)
5. Investigate the amount and nature of the antioxidants in velvet. Research findings to date have given indications that antioxidant activity may be responsible for some of the effects observed, such as the paradoxical finding that velvet is anti-inflammatory yet is immunostimulatory. The extreme importance of antioxidants in health protection (especially in preventing all degenerative conditions) is only just starting to be realised, as is the large difference in effectiveness between various antioxidants in penetration to and action in different sites in the body. It would add to the appeal of velvet as a health-promoting product if it is found that it has high levels of antioxidant activity of a type that is particularly effective in health protection.
6. The research using molecular genetic techniques in a “shotgun” manner warrants low priority. It has a much lower chance than fractionation studies of identifying the components actually responsible for the bioactivities seen in velvet (as opposed to components that have such activities but may not be present in sufficient quantity, or may not survive processing, or may interact negatively with other components). Any findings likely to come from this work that would be useful for determining the authenticity of velvet products would be redundant, anyway, if velvet products come to be marketed with standardised content of bioactives, as assays of bioactivity would show if the product were mislabeled (or were of inferior quality even if genuine velvet). However, there is a place for molecular genetic techniques when used in parallel with fractionation and physiological studies focused on particular bioactivities.

VARNZ INTERNAL REVIEW OF COMMERCIAL BENEFIT 1988 – 2000

Jimmy Suttie, Collier Isaacs & Grant Shackell

1 Introduction and Summary

As part of the review process, the directors of VARNZ have attempted to quantify the benefits VARNZ has provided its stakeholders over time. To do this, a three step process has been undertaken:

- 1 Research results and benefits have been noted and put into three categories.
- 2 Estimates of the value of the benefits from this research to the New Zealand deer velvet industry have been made. These estimates rely heavily the on assumptions made. As such, the authors have tried to be conservative to provide a realistic result. The benefits of the research programme have been related to velvet export earnings and the cost of the research subtracted providing a benefit to the velvet industry.
- 3 Financial and statistical analyses have then been undertaken to make the results more robust.

This review follows these 3 steps.

The key outcomes of the review were that the benefit from the programme has resulted in a mean nominal benefit of \$17.5 million and Net Present Value of \$21.2 million¹ from a \$10.1 million investment.

The authors acknowledge that these outcomes rely heavily on the assumptions made. However, even if we assumed that the benefits were only a quarter of those estimated by the authors, the benefits of the programme in Net Present Value terms were still \$10.5 million.

2 Background

VARNZ is a joint venture between the Game Industry Board and AgResearch Ltd. It was established in 1994 with the twin objectives of:

- Undertaking research on deer velvet and co-products and
- Controlling and managing the outputs of such work for the benefit of the New Zealand deer industry.

AgResearch and its fore-runners from MAF have been carrying out research on antlers since 1976, and the GIB has contracted research to AgResearch since 1990-91. VARNZ has conducted research on deer velvet since 1994. An Internal Review was carried out by Jimmy Suttie and Collier Isaacs to give stakeholders an analysis of value for money. The Review outcome was presented in preliminary form to VARNZ in December 2000. The assumptions used in the review have been verified and the analysis was extended in March 2002.

¹ Net Present Value is a method which discounts all the cash inflows and outflows over the life of the project to their present value. The choice of discount rate reflects the cost of capital.

It was felt prudent to include pre-1994 costs in analysing the cost/benefit ratios, as much of the platform for future development was leveraged from the earlier years. Estimates, separated from bulk financial reports, for research costs were available from 1988-1990, with detailed financials from 1991. Consequently 1988 was selected as the start of the cost/benefit analysis.

3 Methods & Assumptions

3.1 Categories of research results and benefits

All research undertaken by the GIB, AgR and VARNZ from the late 1980's was consolidated and described. It was then broken down into one of three categories, as follows:

- a "Pure science" programmes, being those programmes which constitute the AgResearch contribution to the joint venture and which are funded through FRST.
- b "Industry Good" programmes which are funded from NZGIB contribution to the joint venture. These are designed to provide general industry benefit, e.g. research programmes to establish that New Zealand velvet is safe and also those relating to velvet removal which are designed to establish that stags are not harmed by velvet removal.
- c "Revenue potential" programmes designed to yield commercial benefit and which may provide a specific source of income to VARNZ, (e.g. through licence or royalty income).

On pages 13 to 20 there is set out a brief description of each item of research, its benefit and the category a,b or c (as described above) to which it belongs.

Given the large volume of information, the research and benefit information has been greatly summarised on the following pages.

Results and Benefits of Industry Programmes

	1990-91	Benefits
	Science/Market Issue	
Category b	- Existing Russian, Chinese, Korean, Japanese Information on composition was available– None on New Zealand velvet Information was “Big Picture” in nature and not market related	- Provided Comparative Data
	- Comparative New Zealand analysis took place on Russian and Chinese (i.e. alternative suppliers) – Minerals – Protein (Proximate Composition) – Fat	- New Zealand velvet was compared favourably to competitors
	1991-92	Benefits
Category b	- More antlers were analysed from China	- Improved robustness of data
	- Koreans began to develop standards using – Free Amino acids – Gangliosides	- Identified Korean ‘gangliosides’ were in fact sphingomyelins and that they were not a sound ‘quality’ measure
	- Analysed New Zealand velvet for Free Amino Acids and gangliosides - Regardless of comparative data, Koreans said New Zealand velvet was not good quality. There were no standard measures of efficacy which made comparisons with competitors impossible	- Collaborated with University of Canterbury to develop assays - Developed cell growth assay and proved that velvet stimulated cell growth
Category c	Started cell culture techniques for efficacy measurement. This led to the development of a range of velvet extracts for testing efficacy	- Concluded extracts had commercial potential longer term

	1992-93	Benefits
Category b	- Comparative Composition Added Reindeer, which was/is a cheap competitor to the comparative data	- Provided information to show Reindeer not the same as main velvet varieties
	- Finished sphingomyelin work and provided to Koreans	- Convinced Koreans that gangliosides were not a good quality measure
	- Velvet removal techniques required scientific justification and continuous improvement: - Need for objective pain measures - Need to substantiate current techniques - Need to evaluate alternatives to chemical techniques	- Electro stimulation system developed for pain measurements - Substantiated current techniques - Started investigating pressure techniques
	- Having identified measure of efficacy started to identify variables effecting efficacy: Two likely variables: - Stage of growth - Processing	- Found major effects on both - Used data to explain complexity of velvet efficacy system
Category c	<p>Extracts</p> <ul style="list-style-type: none"> - Identified potential value in different standardised extracts (no powder available forms) - Concentrated extract research on two likely “winners” at lab scale: <ul style="list-style-type: none"> - H₂O - Alcohol 	- Commercial potential

	1993-94	Benefits
Category b	<ul style="list-style-type: none"> - Effects processing on Efficacy - Completed work 	<ul style="list-style-type: none"> - Proved processing technique has significant effect on efficacy of velvet - In general the more heat the lower the efficacy
	<ul style="list-style-type: none"> - Colour - Traditional market perception that colour = efficacy - Perception from New Zealand processors that colour of New Zealand velvet deteriorating 	<ul style="list-style-type: none"> - Commenced investigation of drug, time of tourniquet application, time to freezing, and microbiological effects
Category c	<p>Extracts</p> <ul style="list-style-type: none"> - Researched pilot scale at IRL. 	<ul style="list-style-type: none"> - Developed product - Aqueous extract - Alcoholic extract

	1994-95	Benefits
Category b	<ul style="list-style-type: none"> - Potential drug residues: <ul style="list-style-type: none"> - Concerned about potential perception problems with the use of chemical analgesia. 	<ul style="list-style-type: none"> - Developed lignocaine assay - Used with MAF's xylazine assay
	<ul style="list-style-type: none"> - Colour: <ul style="list-style-type: none"> - Traditional market perception that colour = Efficacy - Perception from New Zealand processors that colour of New Zealand velvet deteriorating 	<ul style="list-style-type: none"> - Refuted this perception - Information published to industry as came to hand
	<ul style="list-style-type: none"> - Specific cell culture (efficacy) <ul style="list-style-type: none"> - Techniques to measure efficacy and quality - Indicate likely commercial products/clinical trial areas 	<ul style="list-style-type: none"> - Work completed but not commercialised, due to cost of tests - Immune and anti inflammatory assay developed
	<ul style="list-style-type: none"> - Diagnostic products <ul style="list-style-type: none"> - Response to Korean regulations concerns about proving velvet extract contained velvet 	<ul style="list-style-type: none"> - Quality Measures <ul style="list-style-type: none"> - Antibodies + lipid + protein profiles - Antibody work not successful
Category c	<ul style="list-style-type: none"> - Extracts <ul style="list-style-type: none"> - Researched pilot scale at IRL 	<ul style="list-style-type: none"> - IRL completed work - Aqueous extract - Alcohol

	1995-97	Benefits
- Category b	- Removal effects on colour – ongoing	- Published results
	- Drug residues	- Assays refined
	- Specific cell culture - Immune - Anti inflammatory - Growth – refined	- Data reported – used to support velvet use
	- Clinical trials: Aim to prove efficacy of velvet by trials in market - - ROK - Anti cancer drug side effects - Stamina - Osteoporosis - - NZ - rat growth - - China - discussion only	- Provided positive outcomes – information released to Koreans OMD’s and western (ROK) pharmacists - Demonstrated oral effectiveness of velvet - Chinese Malu vs. NZ comparison - Toxicity - Immune function - Composition
	- - Diagnostic products	- Preliminary development of quality measures - Lipid profiles - Protein profiles Forerunners of Quality Marker standards
	- Removal techniques - Compression induced analgesia - Evaluation of Electro Analgesia	- Spiker rings for velveting approved for use in 1998 - Electro analgesia technique proved unsuitable

Category c	<ul style="list-style-type: none"> - Extracts - Commercialisation of extract techniques 	<ul style="list-style-type: none"> - Company licensed to use extract in April 1997
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	1998-00	Benefits
Category b	<ul style="list-style-type: none"> - Diagnostic products/active ingredients: US requirement for markers and standards related to function/efficacy - Specific lipids 	<ul style="list-style-type: none"> - Markers and quality standards under development
	<ul style="list-style-type: none"> - Ash data - Needed to be able to manage ROK ash standards 	<ul style="list-style-type: none"> - Data used for <ul style="list-style-type: none"> - Identifying trimming %'s - Dispute ROK proposed standards - Provide sliced access input
	<ul style="list-style-type: none"> - Clinical Trials <ul style="list-style-type: none"> - Toxicity - No safety data for velvet – western market issue - Demonstration of clinical effects - Need to provide clinical trial data to substantiate velvet use - Exhaustive investigation and consultation on topics - Athletic performance 	<ul style="list-style-type: none"> - Oral toxicity data <ul style="list-style-type: none"> - Acute - Sub-chronic - Reproduction & developmental - Otago¹ - Otago² - Muscle damage - USA (underway) <div style="margin-left: 100px;"> <p>} On dried and freeze dried powder</p> <p>} Positive results used extensively by GIB and Companies</p> </div>

	<ul style="list-style-type: none"> - Velveting techniques 	<ul style="list-style-type: none"> - Spiker rings for velveting approved for use in 1998
		<ul style="list-style-type: none"> - NAWAC approval for compression analgesia in mature stags sought in 00

	1990-94 Programme	Benefits
Category a	<ul style="list-style-type: none"> - Feeding/selection <ul style="list-style-type: none"> - protected protein - hybrid velvet production 	<ul style="list-style-type: none"> - Developed product that increased velvet production - Commercially viable when velvet >\$70/kg
	<ul style="list-style-type: none"> - Growth mechanisms (antler tip) <ul style="list-style-type: none"> - Pedicle growth – Identify substances which differentially regulated pedicle/antler generation and regeneration - Cell culture <ul style="list-style-type: none"> - Investigate within cell mechanisms of growth - Potential to develop pathways of cell development - Known factors only - Molecular Biology – to identify growth regulation substances in velvet 	<ul style="list-style-type: none"> - Can now look at substances responsible for effects - Became evaluation system for extract quality – but very expensive screening tool - Identified known growth factors involved. Have moved onto identifying unknowns
	<ul style="list-style-type: none"> - Gene mapping – contribution to building of deer gene map 	<ul style="list-style-type: none"> - QTL's

	1994/98 Programme	Benefits	
Category a	<ul style="list-style-type: none"> - Growth mechanisms (antler tip) <ul style="list-style-type: none"> - Pedicle growth <ol style="list-style-type: none"> 1. Identification of substances which differentially regulated pedicle/antler generation and regeneration 2. Lineage tracing <ul style="list-style-type: none"> - Cell culture <ul style="list-style-type: none"> - Investigate within cell mechanisms of growth - Potential to develop pathways of cell development - Known factors only - Molecular Biology <ul style="list-style-type: none"> - To identify growth regulation substances in velvet 	Continued from 94/98	<ul style="list-style-type: none"> - Can now look at substances responsible for effects - Stem cell identification – cells which produce substances responsible for effects <p>Became evaluation system for extract quality – but very expensive screening tool</p> <ul style="list-style-type: none"> - Identified known growth factors involved
	<ul style="list-style-type: none"> - Gene mapping <ul style="list-style-type: none"> - Contribution to building of deer gene map 		<ul style="list-style-type: none"> - QTL's
	1998/00 Programme	Benefits	
Category a	<ul style="list-style-type: none"> - Angiogenic growth <ul style="list-style-type: none"> - Determine factors responsible for rapid growth of velvet - How does a blood vessel keep up with +2cm per day growth 	<ul style="list-style-type: none"> - Potential human health treatment - Wound healing applications 	
	<ul style="list-style-type: none"> - Novel gene expression (Antler EST programme) 	<ul style="list-style-type: none"> - New: <ul style="list-style-type: none"> - Therapeutics/Functional Foods - Markets 	
	<ul style="list-style-type: none"> - Cell co-culture <ul style="list-style-type: none"> - Cells which will secrete authentic bioactive molecules - Moved to musk cells 	<ul style="list-style-type: none"> - If velveting was banned and could produce velvet factors <i>in vitro</i> 	

3.2 Estimates of the Value of the Benefits to the New Zealand Deer Velvet Industry

The cost of the research was identified and a benefit was attributed. Given only the extract research provided a 'commercial' return (through licence fees), the benefits of the other research have been based on estimating a proportional benefit based on industry export earnings. That is, the benefit was estimated to be a percentage of total export earnings for the year.

Assumptions have been made on a conservative basis. However, recognising the subjective nature of these assessments, the analysis described later provides a range of estimated impacts between estimates being overstated by a factor of 4 (ie reducing the impact by 4 times) or understated by a factor of 2.

The assumptions made in attributing these percentages and the logic underpinning them are as follows:

A Comparative composition etc

The data from this work is used extensively in all of the GIB velvet promotional material to date and is widely used by companies. It has been used extensively in seminars in Korea, China, Taiwan, USA and NZ. It was estimated that collectively this work has returned on average approx. 2% per annum on export earnings from 1993 to date.

B Processing/Stage of Growth Effects on Bioactivity

Knowledge on the effect of processing and stage of growth at removal has been assumed to give at 1% benefit on velvet revenue. The fact that freeze dried velvet is more bioactive has been a very useful finding for the dietary supplement business in the USA. The stage of growth research has provided guidance to producers to cut early, which was reinforced by the grading/ash structures. This had significant relevance for the Korean market, enabling New Zealand product to meet ash requirements more easily than New Zealand suppliers.

C Extract

The extract has provided a return from license fees of \$50,000 per annum for five years.

D Specific Assays and Cell Culture

This information prevented Korean regulatory authorities from introducing inappropriate quality assurance standards in the mid 1990s. Cell culture work provided widely quoted indications of deer velvet's immune potentiation activity.

This research was estimated to be worth 4% in 1995, as the research was widely disseminated in Korea. It has been of diminishing significance since then as the USA market has increased in significance and clinical efficacy research has become more established.

E Nutrition and Selection

The nutrition and selection work was funded from AgR. It was estimated to be providing a 0.25% per annum on export earnings over the last 10 years. Much of this work underpinned current velvet stag management, nutrition and time of velvet harvest.

F Removal Technique on Colour

This work, published in 1995 and 1996, outlined best practice for removal technique and storage to maximise the colour of velvet. While it would have ongoing benefits, it has been estimated to provide a 1% return in these two years only.

G Animal Welfare

The work on velvet removal underpins the continued ability to legally remove velvet from farmed deer in New Zealand. The benefit of this work has been estimated to be a 5% return from 1996 to date. This reflects the potential risk that velveting might have been stopped due to welfare concerns.

H Clinical Trials

This work aimed to prove that velvet was effective, firstly in traditional markets and then moved on to prove that it was safe and effective for western consumers. The results of the work have been used in Korea since 1997 and more recently in the USA. It is estimated that the benefits would be approx. 2% per annum collectively. The Chinese work has not been used as yet. It is therefore identified as a cost. There are ongoing benefits of this work but these have not been accounted for in this analysis.

I Angiogenic Growth

This work, funded by FRST, is investigating blood vessel development in velvet. The work originated in the antler growth work funded by FRST. At this stage it is closer to 'pure science' but has application in such areas as wound healing. Given there has been no commercial return to date it has been identified as a cost.

J Novel Genes

This investment is included in antler growth. Identifying novel genes in antler is very likely to provide therapeutic products longer term. No potential benefit has been included in the analysis and it is only identified as a cost.

K Antler Growth

This FRST funded programme underpins the majority of the other programmes. It is difficult to attribute a direct benefit to this work hence the cost. However, it is critical to recognise that the majority of the other research for which benefits have been estimated would not have been possible without this underpinning science. This has been the benefit of linking industry and FRST funding.

L Tech Transfer

This work involved applying research data in the area of protected proteins to commercial production of velveting stags' diets. The launch of the 'diet' coincided with the Korean economic crisis. The 'diet' was not economic at low velvet prices. It would be currently but the commercial partner has not re-launched the product. This programme was FRST funded.

M Grading

This work looked at how the composition of velvet changed by stage of growth and grade. This information provided the basis for challenging Korean grading/access changes. The benefit was estimated at 0.25% per annum for three years commencing 1998.

The benefits of the research programme have been related to velvet export earnings and the cost of the research subtracted providing a benefit to the velvet industry. This is detailed in Appendix 1.

3.3 Financial and statistical analyses

An analysis is shown as Appendix 1 and detail to the methods of analysis are outlined in Appendix 2.

This shows that nominal and discounted benefits of the entire programme from 1988-2000 using assumed benefits and the range of benefits presented in the table was \$17.5M and NPV \$21.2M for a \$10.1M nominal investment. So for every \$1 invested by AgResearch and GIB, \$2.12 of benefit to the New Zealand deer industry has resulted.

Appendix 1

VARNZ Benefit to Deer industry

Discount rate	7%
Discount Year	2000
Benefit	\$15,366,215
NPV Benefit	\$18,396,458

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Disc factor	2.25	2.10	1.97	1.84	1.72	1.61	1.50	1.40	1.31	1.23	1.14	1.07	1.00
Export \$	\$12,826,990	\$30,571,029	\$48,117,841	\$51,481,425	\$61,722,172	\$47,300,518	\$59,481,787	\$45,856,477	\$61,873,414	\$ 48,708,389	\$ 23,198,744	\$ 26,158,483	\$ 34,291,818
A Grade \$	\$168	\$228	\$247	\$161	\$183	\$130	\$140	\$160	\$135	\$98	\$60	\$50	\$160
Production	122	170	240	307	412	460	496	558	594	592	455	455	446

Contribution to TOTAL		
0.13%	0.25%	0.50%
0.25%	0.50%	1.01%
0.50%	1.00%	2.01%
1.00%	2.00%	4.02%
1.50%	3.00%	6.03%
2.00%	4.00%	8.04%
2.50%	5.00%	10.05%

ASSUMPTIONS	Benefit % gain													
Comparative Composition							1.00%	3.00%	1.00%	1.00%				
Processing and Bio Activity											1.00%	1.00%	1.00%	1.00%
Stg of growth and Bio Act											1.00%	1.00%	1.00%	1.00%
Extract														
Specific assays and cell culture								2.00%	4.00%	2.00%	1.00%	0.25%	0.25%	
Nutrition and selection	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
Removal technique on colour									1.00%	1.00%				
Animal welfare									5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Residues														
Clinical trials - Korea										1.00%	2.00%	1.00%	0.50%	
Clinical trials - NZ													1.00%	1.00%
Clinical trials China														
Angiogenic growth														
Novel genes														
Antler growth														
Technology transfer														
Grading											0.25%	0.25%	0.25%	

Benefit \$														
Comparative Composition	\$0	\$0	\$0	\$0	\$0	\$473,005	\$1,784,454	\$458,565	\$618,734	\$0	\$0	\$0	\$0	\$0
Processing and Bio Activity	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$487,084	\$231,987	\$261,585	\$342,918	\$0
Stg of growth and Bio Act	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$487,084	\$231,987	\$261,585	\$342,918	\$0
Extract	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$0
Specific assays and cell culture	\$0	\$0	\$0	\$0	\$0	\$0	\$1,189,636	\$1,834,259	\$1,237,468	\$487,084	\$57,997	\$65,396	\$0	\$0
Nutrition and selection	\$32,067	\$76,428	\$120,295	\$128,704	\$154,305	\$118,251	\$148,704	\$114,641	\$154,684	\$121,771	\$57,997	\$65,396	\$85,730	\$0
Removal technique on colour	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$458,565	\$618,734	\$0	\$0	\$0	\$0	\$0
Animal welfare	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,093,671	\$2,435,419	\$1,159,937	\$1,307,924	\$1,714,591	\$0
Residues	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Clinical trials - Korea	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$487,084	\$463,975	\$261,585	\$171,459	\$0
Clinical trials - NZ - safety	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$261,585	\$342,918	\$0
Clinical trials China	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Angiogenic growth	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Novel genes	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Antler growth	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Technology transfer	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Grading	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$57,997	\$65,396	\$85,730	\$0
Total	\$32,067	\$76,428	\$120,295	\$128,704	\$154,305	\$591,256	\$3,122,794	\$2,866,030	\$5,773,291	\$4,555,526	\$2,311,878	\$2,600,452	\$3,136,264	\$ 25,469,289

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Disc factor	2.25	2.10	1.97	1.84	1.72	1.61	1.50	1.40	1.31	1.23	1.14	1.07	1.00
Export \$	\$12,826,990	\$30,571,029	\$48,117,841	\$51,481,425	\$61,722,172	\$47,300,518	\$59,481,787	\$45,856,477	\$61,873,414	\$ 48,708,389	\$ 23,198,744	\$ 26,158,483	\$ 34,291,818
A Grade \$	\$168	\$228	\$247	\$161	\$183	\$130	\$140	\$160	\$135	\$98	\$60	\$50	\$160
Production	122	170	240	307	412	460	496	558	594	592	455	455	446

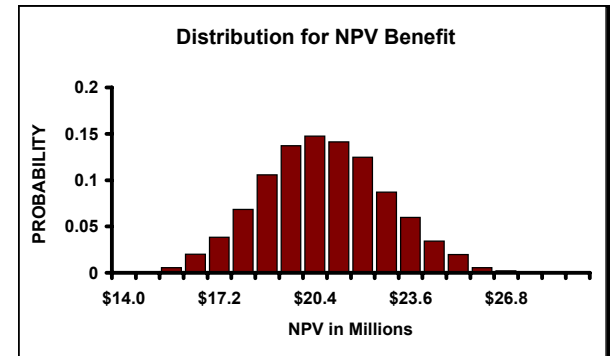
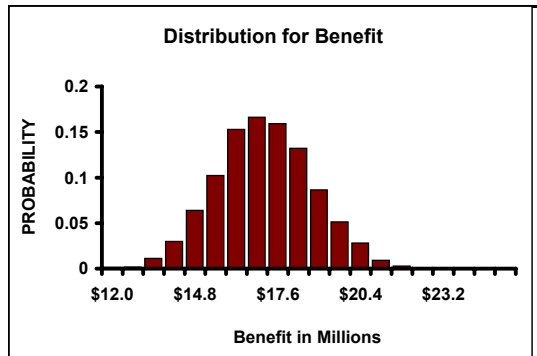
Cost \$

Comparative Composition				\$30,000	\$60,000									
Processing and Bio Activity					\$189,000	\$463,000	\$207,000	\$386,750						
Stg of growth and Bio Act														
Extract														
Specific assays and cell culture								\$143,530	\$171,300	\$336,175	\$301,200	\$119,557	\$113,245	
Nutrition and selection	\$100,000	\$100,000	\$100,000	\$200,000	\$200,000	\$200,000	\$200,000	\$200,000	\$119,400	\$81,700	\$98,000	\$52,256	\$167,652	
Removal technique on colour							\$194,000		\$146,600	\$88,000				
Animal welfare									\$20,300	\$109,100	\$100,500	\$119,090	\$25,000	
Clinical trials - Korea									\$145,000	\$44,780	\$52,522			
Clinical trials - NZ - safety									\$89,885	\$24,530	\$40,084	\$227,472	\$210,960	
Clinical trials China										\$11,250	\$31,228			
Angiogenic growth												\$43,035	\$9,954	
Novel genes														
Antler growth			\$120,000	\$330,000	\$330,000	\$330,000	\$330,000	\$695,596	\$374,200	\$275,300	\$447,900	\$433,082	\$404,487	
Technology transfer											\$10,449			
Grading										\$60,875	\$88,130			
	\$100,000	\$100,000	\$220,000	\$560,000	\$779,000	\$993,000	\$931,000	\$1,225,876	\$1,066,685	\$1,031,710	\$1,170,013	\$994,492	\$931,298	\$10,103,074

Net Benefit

Comparative Composition	\$0	\$0	\$0	-\$30,000	-\$60,000	\$473,005	\$1,784,454	\$458,565	\$618,734	\$0	\$0	\$0	\$0	\$3,244,758
Processing and Bio Activity	\$0	\$0	\$0	\$0	-\$189,000	-\$463,000	-\$207,000	-\$386,750	\$0	\$487,084	\$231,987	\$261,585	\$342,918	\$77,824
Stg of growth and Bio Act	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$487,084	\$231,987	\$261,585	\$342,918	\$1,323,574
Extract	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$250,000
Specific assays and cell culture	\$0	\$0	\$0	\$0	\$0	\$0	\$1,189,636	\$1,690,729	\$1,066,168	\$150,909	-\$243,203	-\$54,161	-\$113,245	\$3,686,833
Nutrition and selection	-\$67,933	-\$23,572	\$20,295	-\$71,296	-\$45,695	-\$81,749	-\$51,296	\$114,641	\$35,284	\$40,071	-\$40,003	\$13,140	-\$81,922	-\$240,035
Removal technique on colour	\$0	\$0	\$0	\$0	\$0	\$0	-\$194,000	\$458,565	\$472,134	-\$88,000	\$0	\$0	\$0	\$648,699
Animal welfare	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$3,073,371	\$2,326,319	\$1,059,437	\$1,188,834	\$1,689,591	\$9,337,552
Clinical trials - Korea	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$145,000	\$442,304	\$411,453	\$261,585	\$171,459
Clinical trials - NZ - safety	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$89,885	-\$24,530	-\$40,084	\$34,113	\$131,958	\$11,572
Clinical trials China	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$11,250	-\$31,228	\$0	\$0	-\$42,478
Angiogenic growth	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$43,035	-\$9,954	-\$52,989
Novel genes	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Antler growth	\$0	\$0	-\$120,000	-\$330,000	-\$330,000	-\$330,000	-\$330,000	-\$695,596	-\$374,200	-\$275,300	-\$447,900	-\$433,082	-\$404,487	-\$4,070,565
Technology transfer	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$10,449	\$0	\$0	-\$10,449
Grading	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$60,875	-\$30,133	\$65,396	\$85,730	\$60,118
Total Net Benefit NOMINAL	-\$67,933	-\$23,572	-\$99,705	-\$431,296	-\$624,695	-\$401,744	\$2,191,794	\$1,640,154	\$4,706,606	\$3,523,816	\$1,141,865	\$1,605,960	\$2,204,966	\$15,366,215
Total Net Benefit DISCOUNTED	-\$152,997	-\$49,616	-\$196,136	-\$792,921	-\$1,073,342	-\$645,112	\$3,289,292	\$2,300,401	\$6,169,400	\$4,316,826	\$1,307,321	\$1,718,377	\$2,204,966	\$18,396,458

Simulation of Industry Benefit 2000 Dollars		
Run on 08.04.02		
Simulations 1		
Iterations 5000		
	Nominal	NPV
Minimum	\$12,184,150	\$14,158,680
Maximum	\$24,236,750	\$29,760,290
Mean	\$17,509,830	\$21,120,980
5% Perc	\$14,890,270	\$17,713,860
50% Perc	\$17,473,690	\$21,059,020
95% Perc	\$20,247,430	\$24,623,060



APPENDIX 2 @RISK ANALYSIS

A financial analysis tool called “@ risk analysis” has been used to make the model and its results more robust.

@ risk analysis is a spreadsheet based computer programme which calculates the benefits of investment and presents them as a straight cost/benefit or calculates a net present value (NPV). For the purposes of this analysis the discount rate was 7% and the NPV is expressed in year 2000 dollars.

The @ risk analysis also takes the assumptions that have been made and assumes they were either understated or overstated to allow for the variable nature of the assumptions. Two ranges of benefit were used:

- Half and double the benefit. That is, if the benefit was 1%, then the range was 0.50-2%.
- Quarter and double. That is, for a 1% benefit the range was 0.25-2%.

The analysis is run 5000 times² and the distribution of benefits is calculated. From this, the minimum, maximum and mean benefits can be calculated, with a probability of achieving a specific benefit.

The benefits are calculated as the assumed benefit multiplied by the export value of deer velvet in that year. The costs are the actual value of the work.

Additional analyses are given in Table 1. These show the benefits to the industry if the range of a quarter and double are used. Table 1 then shows the results to the industry if certain pieces of research had not been undertaken so that the industry did not benefit from their results.

The mean estimate of overall benefit is positive in all cases, indicating that the programme had value even if conservative assumptions are used. In addition the sensitivity analysis indicates that, using the assumption in the present review, the welfare removal research had the highest impact. If all three of the leading programmes had not been carried out, there was a small risk of a negative benefit.

² The application makes changes to the different assumptions within the range being considered. These vary the sensitivity and impact of the different assumptions.

Table 1: Cost/Benefit analysis in NZ\$M. The conservative analysis used a quarter of the assumed benefit as the minimum estimate (as apposed to a half in the illustrated example). The remaining four analyses were carried out to attempt to measure the consequence if any or all of the three leading research programmes had not taken place.

Cost/Benefit Analysis Assuming Only A Quarter of the Estimated Benefits Accrue to the New Zealand Deer Industry							
	Nominal Benefit				NPV		
Analysis	Min	Mean	Max		Min	Mean	Max
Conservative	9.5	16.5	23.2		10.5	19.8	28.3
Value if Clinical Trials were not done	10.5	16.4	24.1		12.1	19.8	29.9
Value if Composition work was not done	6.1	13.0	19.9		6.3	14.8	23.9
Value if removal (welfare) work was not done	2.4	6.7	10.8		2.3	8.2	13.8
Value if Clinical, Composition and Welfare work were not done	(0.2)	3.3	7.0		(1.5)	3.3	8.5

All reviews of this nature are only as good as the assumptions used to generate them. The assumptions have been explained, and some sensitivity analyses carried out. With all but the most stringent assumptions, this overall programme delivered a positive benefit. The benefits, as listed in summary form, provide evidence of tangible outcomes. Thus the programme has delivered tangible, measurable outcomes which have added value to the deer velvet industry.

Taking year 2000 as the cut off is also a conservative step as this is before any benefits have accrued from the growth physiology or novel gene discovery components of the programme. In addition, the clinical trials in New Zealand and the safety testing have not as yet given the benefits which could be expected from the investments.

The analysis of the effect of removal (welfare) research is interesting as arguably deer velvet removal could have been banned if adequate data to show that the process was ethically friendly had not taken place. This means that some of the research in the VARNZ programme took place not to advance new sales but rather to guard the industry we have. This is a crucial context with which to view the overall performance of the programme.

Taking an alternative approach to Table 1 and @ risk analysis, it is also meaningful to ask “What could have been the outcome if we had not conducted this research?” Two scenarios are considered.

Scenario 1: Welfare

Scenario: If research had not been conducted on velvet welfare, velvet removal techniques could therefore not be categorically proven to be humane. Negative publicity could have resulted which may have caused consumer concern.

Outcome: Velvet removal could possibly have been banned until techniques could have been proven to not cause harm or pain to the animal. The research would have taken two seasons to complete and velvet exports may have been banned during that time.

Industry Impact: Two seasons’ export earnings which is conservatively \$70 million.

Scenario 2: New Zealand Velvet Considered Illegitimate

Scenario: If the comparative compositional work comparing New Zealand velvet to Russian and Chinese velvet had not been conducted, New Zealand velvet’s efficacy and legitimacy may have been questioned and categorised as being similar to reindeer horn.

Outcome: New Zealand velvet could have been banned along with reindeer horn as being inappropriate for traditional Korean medicine. Comparative compositional work would have been required before New Zealand velvet was allowed to be exported to Korea

Industry Impact: One season’s export earnings which is conservatively \$35 million.

Review of
VARNZ Internal Review of Commercial Benefit 1988-2000

May 2002

Review of
VARNZ Internal Review of Commercial Benefit 1988-2000
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1. INTRODUCTION

Polson Higgs & Co have been engaged to undertake an independent review of the report *VARNZ Internal Review of Commercial Benefit 1988-2000*.

Two sources of information have been used in our review:

1. the Report itself;
2. personal discussions with one of the Report's authors, Dr Jimmy Suttie.

In preparing this review we have relied upon the accuracy of information contained in the Report as it relates to the research activities undertaken by VARNZ between 1988 and 2000, the cost of that research and the volume and value of deer velvet exports over that period.

We have not audited or reviewed the information that has been relied upon and neither we nor our employees accept any liability in relation to this review, in that regard, to any person.

The focus of our review is on the validity of the assumptions and methods that have been used to estimate the financial benefits resulting from VARNZ's research.

2. SUMMARY OF CONCLUSIONS

Our review of the report *VARNZ Internal Review of Commercial Benefit 1988-2000* has identified three key findings:

1. There are no objective models for measuring the effect of research output on export sales of New Zealand deer velvet and, as a consequence, the Report has been based on assumptions about financial benefits which are largely the subjective judgement of its authors.
2. Notwithstanding the above finding, the authors appear to have adopted conservative assumptions about the financial benefits that could be expected to arise from VARNZ research programmes.
3. Having made certain assumptions, the authors have used appropriate methods for calculating the NPV of the research programmes and the sensitivity of the NPV to reasonable changes in underlying assumptions.



3. THE REPORT

The Report consists of three parts:

1. A classification of research activities into three broad categories¹:
 - a. “pure science” programmes funded through FRST
 - b. “industry good” programmes funded from NZGIB and involving research likely to benefit the whole industry rather than individual companies or organisations.
 - c. “revenue potential” programmes which potentially produce intellectual property capable of being captured by individual companies or organisations.
2. The estimation of the financial benefits assumed to have arisen from each of 13 separate research programmes. In most cases financial benefits are expressed as a percentage of total export earnings in any given year. There were two exceptions to this:
 - a. Returns from “extract” research are measured as known licence fees of \$50,000 per annum for five years
 - b. Research programmes that had not yet been commercialised are recorded as having produced no financial benefits.
3. The calculation of net present value (NPV) of each research project. NPVs are expressed in year 2000 dollars and a 7% discount rate is used. The @risk computer simulation program was used to conduct a sensitivity analysis. @risk uses Monte Carlo simulation techniques to model the probability of outcomes occurring given certain assumptions. In the case of the VARNZ review, simulations were run in which possible benefits ranged from 0.25 to 2.0 times the assumed benefit. For example, if a research programme was assumed to contribute 1% of export earnings in a given year, a simulation was run where returns could vary between 0.25% and 2.0% of export earnings in that year.

The key outcome of the Report was that “the \$10.1 million investment ... has resulted in a mean nominal benefit of \$17.5 million and Net Present Value of \$21.2 million” and that even if the benefits were only a quarter of those estimated, the benefits of the programme in Net Present Value terms are still positive.

¹ Dr Suttie has indicated that, while this classification was viewed as appropriate at the time when much of the research was initiated, it is no longer regarded as a framework which VARNZ or the wider scientific community use for classifying research activities.



4. OUR REVIEW OF THE REPORT

Having reviewed the Report and held discussions with Dr Suttie, we make the following observations:

1. Firstly, validity of the analysis rests on the quality of the original assumptions made by the authors. Based on available information, we are not in a position to judge the validity of the assumptions, and our discussions with Dr Suttie have indicated that no models have been developed estimating the impact of specific research outputs on export price or volumes. Such models would be difficult to develop as returns to New Zealand exporters are confounded by external forces such as fluctuating demand in the Korean market and supply by key competitors (Russia and China). In the absence of such models, the assignment of assumed financial benefits has relied principally upon the judgement of the Reports' authors.
2. Although it is not possible to objectively assess the validity of some key assumptions, the authors generally appear to have adopted a conservative position when making those assumptions. For example, although the authors regard animal welfare research as fundamental to ensuring that the removal of velvet continued to be permitted in New Zealand, they have assumed that it added only 5% to export earnings in the five years from 1996 to 2000, compared to the export earning that would have arisen without that research.
3. The authors have also been conservative in not projecting financial benefits for research projects which are incomplete or have not yet been commercialised, but have recognised the costs of these in the NPV calculations. Dr Suttie believes that several of these projects have strong potential to produce positive financial returns.
4. Having made assumptions about the financial benefits arising from the research in terms of increased export sales, the treatment of the assumptions appears to be appropriate. Specifically:
 - a. values have been discounted to year 2000 dollars using a 7% discount rate.
 - b. Monte Carlo simulation techniques have been used to undertake sensitivity analyses of the key assumptions. As a result, the ranges given about the mean NPVs provide robust indicators of the extent to which financial benefits are likely to vary about estimated means.
5. A small number of research activities appear to have made major contributions to the NPV figure. In particular, the Animal Welfare research, which is regarded as securing and/or retaining market access, is a major contributor, as are the Comparative Composition and Assay and Cell Culture research projects.



6. Only one completed research programme (Nutrition and Selection) has a negative mean NPV. This appears to be a very high success rate for research programmes, something which Dr Suttie attributes to the collaborative industry/researcher model used by VARNZ to identify research programmes.
7. Although the classification scheme is no longer used for categorising research programmes (see Footnote 1 above), most of the financial benefits belong to Category B type research - industry good research which does not generate intellectual property capable of being captured by individual companies or organisations.



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THE VARNZ RESEARCH PROGRAMME: PAST, PRESENT AND FUTURE

James M Suttie, MJ Loza, Mark O'Connor And Stephen Haines

1 Introduction

Velvet Antler Research New Zealand (VARNZ) is a GIB and AgResearch joint venture that formally began in 1994. It arose out of science co-operation, between MAFTechnology (one of the fore-runners of AgResearch) and the GIB on deer velvet related matters. It began in 1989. The purpose of VARNZ, then and now, is to:

- Undertake research into deer velvet and deer co-products and
- Control and manage the outputs of such work for the benefit of the New Zealand deer industry.

The joint venture has a research budget which is more-or-less equally contributed to by AgResearch, from its Government Science contracts, and by the GIB from levy income. IP is deemed to be owned 50:50 by each partner irrespective of the funding source. GIB owns its share in VARNZ through a holding company, Group Research Holdings Ltd. From the start, the aim of the research programme has been to support the velvet industry strategy through a balanced portfolio of discovery and product development science with the ability to respond rapidly to market led issues. This requires agreement of research priorities between the joint venture partners.

The aims of this paper are firstly to describe the current situation in VARNZ and to set out its strategic directions. Secondly it provides a framework of competitor analysis, international velvet research and market segmentation within which to view VARNZ's performance and strategic directions.

2 The Current Situation for VARNZ

This section of the paper includes a description of the general research strategy, our current state of knowledge and progress in deer velvet research and concludes with a summary of the key benefits and outcomes of the research programme.

2.1 General Research Strategy

Since 1994 the overall strategy of VARNZ has been to provide support for the strategic direction of the New Zealand deer velvet industry. This has taken place in two key areas:

- Product support and
- New product development

Product support was initially for Asian markets but progressively, and particularly since 1998, has addressed the needs of the emerging dietary supplement market in the USA. The Product Support area has been market responsive and has delivered benefit in areas such as removal technique, product safety, ash regulations and product colour.

New Product Development began with extracts, which have now been licensed and has progressed to the gene discovery programme. Thus the strategy has been to balance science push and market pull to deliver benefits over the short and long term. It is hoped benefits emerge progressively in following years due to investments made in the late 1990s. These are explained in more detail below.

In the past, research was conducted in antler growth physiology and selection and feeding for velvet production. This research ceased some years ago and now all the research investment in the combined programme is for product support and new product development.

It is worth pointing out that the strategy has been to contract research to the most appropriate supplier of research. Major sub-contracts have been let to University of Otago and Massey University. Currently AgResearch actually receives less than one third of the levy payers' investment in research, the majority of the investment being subcontracted to specific clinical providers who have the required expertise.

2.2 State of Knowledge

It is useful to list some of the issues that New Zealand velvet has faced and how the VARNZ research programme has solved specific problems and contributed to the development of the New Zealand deer velvet industry.

A Comparative Composition

Issue: The Korean market did not consider New Zealand velvet as efficacious as traditional suppliers of velvet (Russia and China). They considered New Zealand velvet more in the category of reindeer horn (low quality, not real velvet).

Solution: Identification and comparison of composition of New Zealand, Russian and Chinese velvet. Early research on comparative antler composition was instrumental in showing that New Zealand deer velvet had similar or better chemical composition than Russian or Chinese velvet, thereby raising its status in the Korean market place. Reindeer velvet is now banned in the Korean market.

This knowledge of composition gave marketers the information to cause the controversial Korean ash regulations to be relaxed. Knowledge of composition has assisted the development of the Industry Agreed Minimum Standards. The knowledge of composition now extends to the search for marker substances and active ingredients which may be the quality markers of the future – and if successful, will allow New Zealand velvet to be identified and give New Zealand velvet a competitive edge.

B Safety

Issue: Although velvet has a 2,000 year history of use, non-Asian manufacturers and consumers of dietary supplements require clinical evidence of the safety of velvet.

Solution: In conjunction with colleagues at the School of Pharmacy, University of Otago, VARNZ has carried out an extensive range of oral toxicity research with New Zealand deer velvet powder. These include acute and sub-chronic toxicity on freeze dried and heat processed velvet, and reproductive and developmental toxicity. These trials have all shown no oral toxicity. The latest work has sought to ensure that deer velvet does not in some way promote or exacerbate solid tumour growth. This research has shown that deer velvet is safe to take, even at very high doses. These results have been invaluable in the US dietary supplement business to have velvet considered as a safe, credible natural health product.

C Removal

Issue: Markets and the general public demand that removal techniques do not cause pain to the animal while using the least amount of chemicals possible.

Solution: VARNZ has studied local analgesic requirements with colleagues at Massey University, which show that electric analgesia is not effective for effecting pain relief. VARNZ has developed the compression analgesic system approved for use with spikers and is researching a new system for use in mature animals. VARNZ trials have studied the impact of the use of chemicals on final products and ways to minimise these impacts.

To date, the New Zealand velvet industry has managed welfare issues through a proactive approach to ensuring animal welfare.

D Extract Development

Issue: Markets demand further processed velvet products with the highest efficacy possible.

Solution: VARNZ has developed deer velvet extracts and tested their efficacy in cell culture. VARNZ has used these extracts to study the effect of grade, processing technique and time of removal on the efficacy of deer velvet in cell culture.

E Oriental Medicine Research

Issue: The Korean market claimed that there was no efficacy research on New Zealand velvet available specifically for Oriental Medicine Doctors.

Solution: VARNZ co-ordinated three sub-contracts in Korea and one in China on a broad range of health benefits. The Korean work is published and the Chinese research will be finalised this year. This research shows clear effectiveness of New Zealand deer velvet for a number of uses including osteoporosis, stress relief, promoting immune function and improving stamina. The research was tailored for traditional oriental medicine doctors to support sales of New Zealand deer velvet in Korea. The Chinese research compares New Zealand deer velvet with Chinese wapiti-type velvet. Results to date indicate that velvet of New Zealand and Chinese origin compare very favourably.

F Western Clinical Research

Issue: The need for clinical data supporting health claims is fundamental in the marketing of health products in Western markets.

Solution: VARNZ has conducted a range of clinical research with collaborators. VARNZ has conducted research on growth, osteoporosis and dog joint health. VARNZ has worked with human clinical subjects on athletic performance (two trials in New Zealand and one in the USA) and injury recovery (one trial in New Zealand). These trials have revealed statistically significant, positive results showing that New Zealand deer velvet benefits strength training and recovery after exercise. Significant further trials are planned.

G Novel Attributes

Issue: Velvet has special attributes (speed of growth, complete regeneration), that make it is likely that there are factors in velvet that are unique and offer novel product opportunities.

Solution: The development of a genomic discovery programme. Deer antler is unique in that it grows rapidly each year and regenerates. It is then sensible to deduce that there are unique restoration, healing and regeneration factors in deer velvet. It is in these areas that new product research focuses. VARNZ has discovered unique factors in deer velvet which are responsible for blood vessel growth and cartilage growth. These discoveries are being patent protected at this time, but both are being evaluated as wound healing aids. This necessarily has a wider timescale and higher risk than the product support work described above. It is also more expensive research to conduct.

2.3 Progress

Over the last eight years the VARNZ research group and its collaborators have become a well respected international group among those studying deer velvet as a product. This group has built a platform which allows VARNZ to predict what are likely to be maximally effective benefits of deer velvet and it is actively working in some of the most promising areas. The Genomic Discovery Platform is unique for deer velvet product discovery. VARNZ's dossier of safety data is unique. The programme is integrated with the market and the research targets are attainable.

A key feature of the clinical research is that it has been conducted at doses which are appropriate for market lead outcomes. Most people who take deer velvet take no more than four 300mg capsules daily and many people take less. VARNZ has consistently sought applications for deer velvet which are effective at that dose level. Many scientific studies which are widely published on the effectiveness of natural products use doses which are many fold higher than is commercially viable. People read these studies, begin supplementation at lower than effective doses and become disillusioned. VARNZ's goal has been to preserve the credibility of New Zealand deer velvet by seeking unique, effective applications at commercially viable doses. This has proved an enormous challenge, but has been done with the greater long term good of the New Zealand deer industry at heart. This goal is exacerbated by the fact that deer velvet is expensive and many of its effective applications are targeted by much cheaper competing products. This is briefly analysed in a following section.

2.4 Key Benefits and Outcomes of the VARNZ Research Programme

New Zealand deer velvet is now recognised in Asia for its quality. Key entry requirements for New Zealand velvet into western dietary supplement markets are being addressed. The short and long term needs of the deer industry as a whole are being addressed. Ongoing, close dialogue with the New Zealand deer industry is essential for further commercial development.

3 Where Is VARNZ Headed?

This section sketches the overall research direction, outlines the 2001-2002 programme, discusses VARNZ's commercialisation strategy and gives an account of expected future benefits and outcomes.

3.1 Overall Future Directions

Feedback from the USA dietary supplement marketplace indicates that VARNZ's approach of developing a dossier of information on product safety and efficacy and developing a quality assurance system is sound. Consequently VARNZ will continue to build on these key areas. Removal techniques and welfare issues continue to be raised by prospective buyers of deer velvet, across the value chain. The programme will be expanded in these areas to ensure that removal techniques required by the marketplace are available and to further demonstrate the industry's commitment to welfare. Finally, research into new product areas will continue. This is an exciting area as the first patents will be applied for this year. A transparent commercialisation strategy to which all sectors of the velvet industry will have access, will be developed over the course of the year.

3.2 2001-2002 Research Outline

A Product Safety

VARNZ has initiated a research programme, following on from the 2000-2001 themes, to ensure that consumption of deer velvet does not present a risk of blood cancer initiation or the worsening of existing blood cancer disease. In addition, a second programme has been initiated, in response to concerns that some natural health products may have harmful effects due to interactions with pharmaceuticals that are being taken at the same time. This can occur because of effects of the natural products on enzymes in the liver and the gut that are responsible for the removal of the drugs from the body. In the case of deer velvet there is evidence that it can protect against liver toxicity, which suggests it enhances activity of some of these enzymes. So, as well as investigating the possibility of interactions with standard pharmaceuticals, VARNZ seeks to find if deer velvet can induce protection mechanisms in the liver. This will not only to increase industry knowledge of deer velvet's safety but potentially suggest a further benefit of taking deer velvet.

B Efficacy

There is a growing use of deer velvet in the USA by the anti-aging market. The so-called anti-aging market is a growing market in the US which is fuelled by aging baby-boomers' (market size in US of 80 million people) desire to slow or reduce the effects of aging. Deer velvet is well-placed to provide a suite of benefits to older consumers. The goal is to establish whether there are overall health benefits in terms of protection against disease, increased energy, improved well-being, improved memory, less pain and better joint function in senior citizens taking deer velvet. The contract for this work will be let to a clinical provider. VARNZ is currently searching for a suitable institution to carry out the work.

This represents a change from the athletic performance work VARNZ has focused on over the last few years.

C Quality Assurance

Further work will be carried out to increase the robustness and scope of the Industry Agreed Minimum Standards. For example, a simple, easily understood measure of quality will assist standardisation and comparison of different velvet products. This index, called the "Yield of Extractable Total Index" or "YETI", will allow comparison between extracts and powders with different levels of bioactivity.

D Removal

An expansive programme on the use of compression analgesia for deer velvet removal will continue in 2002. This will include work required by the National Animal Welfare Advisory Committee for consideration of the technique for approval and will also attend to other details of the welfare of stags at and after velvet removal time.

E New Product Development

The first provisional patents from the programme will be filed in 2002 and work will continue to allow conversion of the provisional patents to full patents. In addition, work will commence on the next range of novel products from deer velvet. It is expected that these will be ready for commercialisation in 2-3 years time.

3.3 Commercialisation Strategy

The novel factors which VARNZ has discovered in deer velvet have a potential use for wound healing and surgical repair.

The first move is to provisionally patent the findings and then convert the provisional patent to a full patent. The conversion must take place in less than one year. At that point, VARNZ will seek external investment to pay for the full product development. VARNZ, which owns the IP, is working at this time with both its parent bodies to develop the most appropriate commercial model to exploit the discovery. VARNZ is committed both to obtaining the best collective result for investors and to giving deer velvet producers and processors the opportunity to invest.

3.4 Expected Benefits and Outcomes of the Research

New products from deer velvet and a new product development pipeline are the objectives of this year's work.

The second key benefit is the incremental increase in the dossier of information on product safety and efficacy. A very important point, and one which it is worth continually emphasising, is that one single 'discovery' will not make a product attractive to the market if this is in isolation. What is needed is quality research built on a solid foundation of safety and general product knowledge. This foundation is what the VARNZ programme is set up to deliver. VARNZ's commercialisation strategy seeks to build on this platform.

3.5 Competitor Analysis

Deer velvet from New Zealand competes in both the Asian and North American marketplaces both with product from Asia and North America and with the supplements which have similar efficacy. Inevitably, VARNZ's research programme must be set up to position New Zealand deer velvet where we have a competitive edge. Consequently it is interesting to briefly state what the strengths and weaknesses of New Zealand deer velvet are. As the VARNZ research programme primarily deals with access to North America markets, it makes sense to concentrate on competitor analysis for this market.

A Velvet from Canada

The deer industry in Canada faces considerable challenges as a result of chronic wasting disease (CWD). This is a prion-based disease similar to bovine spongiform encephalopathy (BSE). Although CWD has never been proven to be transmitted to people, the Canadians are still restricted in how they can sell velvet until this disease problem is solved. Coupled with lower production than New Zealand and a somewhat fragmented industry structure, Canada is in a difficult position in the short term. Their strengths are that they produce large velvet, preferred at least by traditional Asian consumers, they are investing in deer velvet research and they are skilled, efficient producers. Arthritis research has been conducted in Alberta since 2000, currently new work in Saskatchewan on liver toxicity and immune function.

B Velvet from USA

Essentially, the US industry is similar to the Canadian situation, but US research activity is growing faster. They are investing in research which is very similar to the VARNZ programme as well as pharmaceutical product discovery. A new research programme in Texas is very similar to the VARNZ programme. There have been three patents in the last five months from US companies which use deer velvet wholly or in part.

C Velvet from Australia

Australian production is lower than New Zealand, and much of the Australian red deer velvet production is processed in New Zealand. They have a research programme on deer velvet efficacy but this is currently unconnected to the core industry. Research has been conducted on arthritis since the mid 1990s.

D Asian Velvet

Very little Asian velvet is exported outside the region, and it is mostly used in Chinese medicinal products.

E Other Health Products

While velvet from other countries competes with New Zealand deer velvet, many botanicals compete with deer velvet for beneficial effects which they share with deer velvet. New Zealand velvet has unique attributes that cannot be replicated by botanicals. It has had many traditional benefits ascribed to it during its 2,000 year history of consistent use. It is a renewable animal based supplement that does not involve harm to the animal. However, botanicals are in the main more cheaply priced and are at present more readily accepted than animal products due to consumer preference for plant based products and large marketing budgets of companies selling them. Echinacea boosts the immune system, as does deer velvet, but at a lower price. MSM and chondroitin sulphate improve joint health like velvet, but more cheaply. Calcium supplementation is taken to assist with osteoporosis, even though it may not be effective in the most critical target group of post-menopausal women. Ginseng is a strengthening tonic, which is supported by a vast published literature.

Consequently the biggest competition for deer velvet is not other countries' velvet products but rather well-researched, predominantly botanical, alternatives. The VARNZ programme has consistently attempted to carry out research on New Zealand deer velvet powder which will position it cost effectively in the dietary supplement market where it can compete successfully with non-velvet products. Dietary supplements in the USA are arranged in health food stores and supermarket shelves by health benefit rather than product identity, for example Echinacea is found with other immune-enhancers and Ginkgo biloba is found with memory-supporters. Assuming one is positioning a product as a dietary supplement, it is important that either a well-recognised efficacy category is chosen or the product meets a very specific need in the market. Given that deer velvet is expensive and is not well known or understood, it would be ineffective to choose a category, and then conduct research, where velvet would not be able to compete. This was the logic that underpinned the athletic performance research:

- There is an efficacy known from previous Russian work
- There is a defined market segment in the US and this market is not as cost-sensitive as others
- Velvet has male connotations (eg strength and power of the stag) and males comprise the bulk of the market
- The athletic performance market is less likely to be affected by welfare issues and the "bambi syndrome"
- Any brand awareness is likely to relate to sexual function and it's a relatively short step from vitality to virility
- There are fewer competing products (creatine, ribose).

Thus the programme researched a market segment where New Zealand could compete if the science was strong. The anti-aging market for seniors has emerged since the athletic performance work started and it is prudent now to address research to this opportunity.

The above analysis pre-supposes that deer velvet will be sold as a dietary supplement. If deer velvet is to be sold as an over-the-counter (OTC) drug or pharmaceutical, the regulations change. This change in regulations enormously increases the research costs.

These and other points are brought together in the summary of this paper.

3.6 International Velvet Research

New Zealand will host the 2nd Antler Science and Product Technology Symposium in Queenstown in February 2004. At that time we expect to bring the world's deer velvet researchers together to discuss results and progress.

3.7 Market Segments

When velvet sales started from New Zealand 30 years or so ago the market was relatively simple; there was a single market in Asia which purchased dried whole stick velvet. Since that time the market has become more complex and is on track to become even more complex. This complexity presents velvet research some challenges as it is not possible to spread research investment to all segments and market led decisions need to be made. The existing market segments are as follows:

		PRODUCT FORMS		
		Traditional	Non-traditional	
MARKETS	Traditional	TRADITIONAL ASIA <i>Traditional markets in Asia (Korea, China, Taiwan)</i> <ul style="list-style-type: none"> • <i>Whole Stick/Sliced</i> • <i>Older generation – female, housewife</i> 	NEW ASIA <i>Younger market segments in Asian markets (Japan, Korea, China, Taiwan)</i> <ul style="list-style-type: none"> • <i>Further processed product forms</i> 	
	New	ASIAN IMMIGRANTS <i>Asian immigrant populations in Canada and USA</i> <ul style="list-style-type: none"> • <i>Whole Stick/Sliced</i> • <i>Older generation</i> 	WESTERN NATURAL HEALTH MARKETS <ul style="list-style-type: none"> • <i>Velvet as a natural health product/dietary supplement</i> • <i>Velvet as a cosmeceutical product</i> • <i>Novel Products, eg angiogenesis, wound healing applications (could spill over to pharmaceutical applications)</i> 	
		ANIMAL PRODUCTS <i>Pet Supplements or performance animal supplements</i>		PHARMACEUTICAL APPLICATIONS <i>Drugs from or based on active ingredients from deer velvet</i>

The VARNZ programme has actively carried out research to support market development in the Traditional and New Asia segments, and deer velvet powder and extract for the dietary supplement segment. The current novel product research originally set out to develop natural health products (supplements) but it may produce spill-over pharmaceutical benefits. In determining priorities VARNZ has focused on deer velvet alone, rather than combinations, and whole stick deer velvet and powder. The work on extracts has been deemed a lower priority as it was felt that extracts were sold as proprietary products by companies, who should be responsible for their own research. In contrast work on whole stick velvet and powder benefited the industry at large. There was also an implicit fear that were VARNZ to find a pharmaceutical in velvet which was potent, then it could be synthesised chemically and the research would not benefit the producer. Hence the VARNZ programme has tended to focus on whole stick velvet and powder.

It may be that specific product forms and efficacy need to be researched for new market segments. This is a logical extension of the VARNZ programme which has already begun in the Novel Product Discovery part of the programme. It must be acknowledged that this research is likely to be of higher cost and higher risk than much of what has gone on before, but of potentially higher economic benefit. It must also be acknowledged that this research builds on the foundation of safety and efficacy research which has already been carried out.

4 Summary

The VARNZ programme has been underway for eight years and both internal and external reviews are positive. This means there have been tangible cost effective benefits and the research has been peer-reviewed as to its thoroughness and appropriateness. The programme has built a sound platform of safety and efficacy knowledge which is constantly being added to. This is the fundamental key which will allow more innovative efficacy research to take place, either from within VARNZ or outside it.

There is a clear strategy for both the direction of research itself and for its commercialisation. This strategy is market led and seeks to produce overall benefits to the deer velvet industry. Momentum is gathering and research is diversifying as the complexity of the industry increases.

It is important to understand the reasons for the VARNZ programme strategy, as have been documented in this paper. The programme principally has sought safe, cost effective, applications for deer velvet in established market segments where it can reasonably compete with existing products. In the USA dietary supplement market this research has primarily been in support of deer velvet powder. This research has been balanced by higher risk research, leveraged from our knowledge of antler growth, which is at this time delivering new products. These products may not be in the typical segments and consequently this compounds the risk.

The VARNZ programme is and will continue to be a balanced portfolio of product support and innovation which has the goal of keeping New Zealand deer velvet to the fore. As competition gathers, it is important to concentrate on our strengths and leverage from them.

Notes for the VARNZ Research Map

*Jimmy Suttie
Invermay, March 2002*

1. Background

The VARNZ Board has requested and used a map to plot the progress of VARNZ research programmes for many years. This map shows the linkages between programmes and gives a chronological sequence of research effort. When read with the costs (Appendix 1 in Internal Review document) it gives a breakdown of investment across time, and how the investment has been integrated.

2. Map Layout

The left hand side of the map is labelled with simplified names for the major research programmes. These represent major areas of research rather than outcome areas. (The outcome areas were analysed in the Internal Review). The upper edge of the map gives time in years, either as blocks 1976-1981 and 1981-1989 or in separate years when the scope and complexity of the programme increased in 1990-91. Research areas along a single line are continuation of projects. Research areas linked by lines show where knowledge from one area has played a major role in assisting with another part of the programme.

3. Description of Research Activity

The benefits of the research have been covered separately in the Internal Review but brief descriptions are provided here to make this a stand alone document.

- **Composition.** Comparative composition of Chinese and Russian velvet with New Zealand velvet.
- **Extract Production and Evaluation.** Making extracts of deer velvet for testing efficacy in cell culture.
- **Velvet Colour.** The effects of removal techniques and post harvest handling on deer velvet colour and efficacy.
- **Diagnostics, Active ingredients and Quality Mark Standards.** Attempts to find a unique quality indicator for deer velvet. This includes assays for velvet removal drugs in deer velvet and research to develop the Quality Mark Standards.
- **Clinical Trials and Product Safety.** Clinical trials in Korea, China, New Zealand and USA to show velvet's efficacy for a range of health benefits.
- **Velvet Removal.** Welfare of stags, removal technique development, local analgesia recommendations.
- **Feeding & Breeding.** Breeding and nutrition studies conducted at Invermay Deer Farm which were relevant to velvet performance.
- **Mechanism of Antler Growth.** A fundamental programme begun in 1981 which evolved into the novel products research taking place now.

- Gene Mapping. A small project which aligned developments in bovine and ovine mapping with deer specific genes. This is ongoing, but has not specifically addressed velvet genes for two years.
- Miscellaneous. Small projects requested by GIB in 1992-1993 and 1997-1998. For example a DNA test to enable identification of illegal reindeer horn in Korea.

4. Publication of Results

The vast majority of the results are available from the GIB as reports from AgResearch. Publications in peer reviewed journals of the Growth Mechanism research are available from Invermay. The dossier of published information was the material presented to Professor Molan for the External Review. Some results are confidential to VARNZ, but can be accessed by signing appropriate confidentiality documents. VARNZ Board and Executive are available to give more detail to any New Zealand industry member who requests this.

VARNZ Research Map: 1976-2001

