

## **DEVELOPING A SUCCESSFUL CAREER IN SCIENCE: A POSTGRADUATE'S PERSPECTIVE**

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### **SUMMARY**

This paper provides an insight into the early research experience of 2 postgraduate students. As an invited keynote paper, particular attention has been given to the themes of ASAP 2004, through reflection of the trials and tribulations of an innovative student-initiated research and development program, with a strong industry basis and applied science focus. Science stands on the brink of ensuing swift change away from pursuits of primary academic focus alone, toward research directives that are increasingly reliant upon industry and consumer relevance. However, the irreplaceable need to maintain the philosophical basis of academia rises as a potential conflict of interest. This difficulty is discussed within this paper through first hand, recent experience and, additionally, provides some examples of how ambition, sense of research ownership from idea through to outcome delivery, and clear focus on relevance may prove to be integral components of successful research in the future. This paper is written from personal experience, thus, it is presented purely in an attempt to provoke contemplation and discussion of the future of applied scientific research, and to provide an informative insight into the challenges, pitfalls and triumphs associated with a unique postgraduate research experience.

*Keywords:* ambitions, future, human resources, knowledge, research, development, innovation

### **INTRODUCTION**

If Australia is to have a prosperous future in the new global information economy of this century, scientific research in Australia will need to adapt to ensure it plays a role in providing the new technologies and products that will direct and service the lives of Australians in the future. Part of this realisation will be the need to use more effectively our natural resources in a sustainable manner. To date, this has been a significant problem, particularly in relation to the primary industries. One fledgling industry that has been establishing a place in our economy, and follows the sustainability principles, is the kangaroo meat industry.

We have been instrumental in the establishment of a research program entitled 'Factors Influencing the Quality of Meat from Kangaroos', in which we have initiated various investigations into the eating quality attributes of this alternative meat product supplied by a self-sustaining wildlife industry. This paper tracks the gestation of this project from its evolution as a research idea seen through the eyes of 2 ambitious undergraduate students, through to its proposed form, acceptance, and then its implementation. We describe the research difficulties encountered, followed by an insight into the experimental studies undertaken to deliver project outcomes and ultimately the research achievements. We conclude with the outcomes and personal satisfaction resulting from this project, before moving onto future research prospects. Furthermore, we aim to provoke thought on some of the key elements of successful research for the future, where the opportunity to provide economic, environmental and social benefits, coupled with the transition of traditional science-based research, strengthened by proactive teamwork, provides a focus for the creation of innovative, rewarding (as well as enjoyable) and challenging employment opportunities for the future.

Before working through the evolution of the project, it is important first to mention briefly exactly what the project is about and at what point it currently stands. The project comprises the first systematic investigation of factors influencing the quality of meat from kangaroos. It has investigated the relationship between kangaroo harvesting procedures, carcass and meat handling conditions and storage conditions with various resultant meat quality attributes, both objectively and subjectively. Interactions with basic parameters such as age, sex and genotype of animals have been considered. Further investigation of these factors subjectively through consumer-based sensory evaluation has resulted in the generation of information with direct industry and consumer relevance. A second focus of the project has included detailed investigations into the metabolic processes that occur in kangaroo

muscle post-mortem, such as the relationship between muscle glycogen concentrations and the resulting pH of kangaroo meat, further combined with kangaroo muscle colour and fibre type profile definition. Currently, we are both in the process of writing up our specific research areas, to be submitted as PhD theses.

## **ACCEPTANCE OF A STUDENT-INITIATED PROJECT**

### *How the idea originally evolved*

The idea of conducting research on game meat quality resulted indirectly from a fourth year (B.Sc.Agr.) honours project investigating qualitatively the vegetation intake of sheep and goats in the Western District of New South Wales (Spiegel and Hyde 2000), funded by a small trust fund, West 2000. One student's passion to pursue a research career in applied meat science together with another student's passion for the sustainability and conservation of biodiversity in the semi-arid rangelands and consequences for the human population of the region, culminated in our combined vision for this research project. We were particularly attracted to the development of alternative meat production systems in the semi-arid rangelands of Cobar, the location of the honours research studies. At this early stage, our ideas remained diffuse and unfocused, although there was a general lean toward alternative meat production systems for sustaining the rangelands. Some ideas included the investigation of mixed sheep and goat production; factors influencing the 'gaminess' of rangeland meat products; the eating quality differences of free-ranging and farmed goat and emu; and the variation in meat quality of field-harvested species such as kangaroos and wild pig. The list was rather extensive. An opportunity arose for further consideration of these ideas at an extension meeting, organised for a group of people with diverse backgrounds at Cobar, for the presentation of the results of the honours project. The audience included land owners, game meat harvesters, members of the Department of Agriculture, NPWS, DLWC, West 2000 Woody Weeds and Biodiversity Project, Landcare and (of primary importance) the Kergunyah Rangeland Group. There was a general acceptance of, and enthusiasm for, a number of our proposed research ideas, resulting in much constructive and enlightening feedback which, combined with a shared optimism for future developments, contributed some priorities for the Western District of New South Wales.

### *The tables are turned: a student initiated project is born after a rocky gestation*

Approaches to overworked academics involving potential projects without funding or a 'traditional' scientific basis have a long history of being rapidly assigned to the scrap heap. The project ideas mentioned above looked to be heading in the same direction, having received minimal interest and strong advice from academics that many projects in this area, or at least of this nature, were not possible, and most certainly not the makings of a PhD program. Most of the reasons for this were based on logistical complexity, resource and funding constraints, and lack of acceptance by departments to enable the generation of knowledge in a new area. However, the potential postgraduate students-to-be were not keen on forsaking a vision for their future. Finally, the acceptance of an idea by just 1 person allowed for the critical first steps that were to gain momentum in the transformation of an idea into reality. This person was Peter Wynn (Associate Professor from the then Department of Animal Science, University of Sydney).

### *Crossing the line: contract signed, sealed and delivered*

Perhaps it was luck, fate or just good timing, but regardless of reason, the gestation of this idea coincided with the establishment of a research oriented levy for the kangaroo meat industry by the Rural Industries Research and Development Corporation (RIRDC). Some months later, and after countless drafts and redrafts of the research proposal, the project was submitted and then approved for funding, on a 50:50 basis between RIRDC and the kangaroo industry (Kangaroo Industry Association of Australia). The success of this novel proposal was certainly unexpected and came as a surprise, if not a shock, achieved only after having received tentative support from 1 or 2 key influential members of the major industry body. However, support was certainly not unanimous throughout the industry and, despite the project's focus on the industry's best interests, and thus its potential for providing invaluable information about their product, a feeling of enthusiasm for the expected project was far from overwhelming. Apprehension to the point of opposition towards the proposed project was evident from certain quarters of the industry. As scientists, we felt that our idealistic goal of the creation of an open and interactive research environment with a young, but futuristic, industry seemed to be under threat.

## **RESEARCH DIFFICULTIES ENCOUNTERED**

The major problems encountered revolved around a number of themes.

### *Controversial issues: community constraints*

The project was, and to some degree remains, innately controversial, as the research was based on the commercial utilisation of a unique, Australian, indigenous wildlife icon, the kangaroo or, referred to fondly by many, 'Skippy'. Quite quickly, we found ourselves the targets, both directly and indirectly, of misdirected abuse from many community sectors, including members of outspoken minorities such as the animal rights movement. Often, irrational pressures or uncooperative attitudes were received from people from all walks of life, typically from those who prefer to remain misinformed. This certainly added to the challenge of this project, with many irrational and emotive comments often being directed our way, even in scientific forums. We felt our research was being constrained by extremist views, rather than industry or academic bounds. It quickly became clear that we needed to develop a series of carefully developed replies for what often seemed a constant flow of questions, which varied little in imagination or breadth.

Furthermore, during our transition from a city-based research location to 1 with a predominantly rural-based outlook (discussed below), we were able to reflect on the influence of the urbanisation of the Australian populace and its impact on community perceptions of our research project. Our undergraduate training and limited research experience gave us the capability to at least begin to address the often provocative remarks from these 'special interest groups' aimed at limiting or completely and permanently halting the use of kangaroo meat for human consumption, and even for any other purpose (e.g. pet consumption, skins, pest control). With this newfound self-confidence, we felt more comfortable with the possibility that we were going to play an integral scientific role in this industry. Regardless of this, however, invaluable and effective links with industry were important outcomes from our proactive approach toward developing our research area.

### *Industry v. academic pursuit*

Quite aside from our initial teething problems, the unique logistics associated with the industry posed a number of additional challenges. We discovered just how significant the influence that the industry environment can have upon science, even in this most elementary situation. Product availability proved to be very critical, as unseasonally heavy rainfall in the region in which our co-operating industry partner was operating (Queensland and northern NSW) resulted in a dwindling supply of animals due to transportation difficulties. The exporter was confronted with the unfortunate need to direct the scarce supply of product toward export contracts in preference to supplying carcasses for our research, a choice that we entirely understood and supported. Thus, another exporter and network of field harvesters was sourced in South Australia, and with a fair measure of persistence, the research continued.

The inherent scepticism shown towards our project by many industry personnel working in the field was the first of many challenges that we had to confront prior to the establishment of working relationships. This was based upon the need for self-preservation in the face of the politically sensitive and controversial stigma associated with the commercial utilisation of kangaroos. On many occasions, we felt as if the reticence to co-operate related to the fear that the field operators were not using procedures officially sanctioned by meat industry authorities, thus, we were seen as a potential security threat. Fortunately, we found these fears to be primarily unfounded. On other occasions, we were subject to interrogation, but only for legitimate precautionary reasons as operators attempted to prevent the infiltration into the industry of extremist politically-motivated groups. Usually, we were fortunate in being able to identify personnel who were sympathetic to our scientific cause and, thus, accommodated our research needs with enthusiasm rather than trepidation.

Another phenomenon that was encountered was a belief that the industry was already operating at optimal efficiency, producing even, high quality, meat products, with no room for improvement. There was little doubt that vested interests on the part of some were the source of such unfounded information and our initial investigations found that these assertions were far from reality. This may also reflect the innate conservatism of many of our agricultural industries in which introversion prevents a broader vision of opportunities available for an industry to adjust and expand to meet societal demands and preferences.

The need to identify biological mechanisms responsible for the practical outcomes emanating from the research quickly became an imperative for the sustainability of the research project. This is where the requirements for research training for a PhD program often depart from the fast tracking of research findings to meet industry demands.

Not surprisingly, this often served as an effective source of more conventional laboratory-based research problems, which were the subject of debate in academic circles. Quite unfortunately the strong focus on industry outcomes limited the depth of some scientific investigations under-pinning our findings, which in itself placed a constraint on the utility of these findings for the industry. Therefore, our need to meet industry report milestones often placed limitations on the advancement of our scientific investigations. This then surfaced often as a conflict of interest between commercial expediency on the 1 hand and the need to provide a scientific training for PhD students and a realistic scientific outcome on the other. Certainly, we felt that the track that we followed placed limitations on the long term commercial utility of some of our findings. Rather idealistically, the need for PhD students to pursue science for the sake of gaining knowledge, rather than conducting applied research for the direct and short-term financial gain for the industry, should be explored with all research funding bodies.

#### *Fitting a project into the time frame of a PhD program*

One of the key issues that must be confronted, which is not easily or often appreciated by industry generally, is the need to set realistic deadlines for experimental programs that are consistent with the duration of funding for postgraduate research scholarships. Often industry partners have little concept of the time required to complete experiments. Their demands can often exceed the resources and time available to complete the project, while flexibility with timing to meet altered conditions is all too frequently absent.

In our case, the meat science resources required to undertake the project successfully, and within the allocated time, were simply not available within the bounds of the University of Sydney. The need to seek alternative facilities soon became apparent, resulting in the relocation of the project to another university. Fortuitously, this provided a rural environment where the source of experimental animals was much closer to the laboratory. The acquisition of an additional project supervisor and his meat science laboratory facilities helped greatly with the progression of our project. Fortunately, the Beef CRC had established a state-of-the-art meat science laboratory at the University of New England, Armidale, where the invaluable cooperation and supervision of Professor John Thompson allowed us to undertake our work in the best possible research environment. Australia's scientific infrastructure is often limited, but ours is an excellent example of where co-operation and collaboration between institutes have allowed the best possible outcome for us to meet our research goals. We believe that PhD students should not lose sight of the fact that facilities are often available elsewhere to accelerate their research with little added expense to a project budget.

#### *Working on borrowed time*

The need to refine and further redefine our objectives in close collaboration with industry partners, coupled with the need to relocate the project's base, resulted in delays in our training program. As the scholarship-based funding system does not factor in funding beyond 3.5 years, this did not allow for further extension to account for these problems. The time lost becomes a very important issue when limited or non-existent financial support exists while writing up a PhD thesis. When establishing a project, we now realise the importance of adequately judging the extent of the down time during the initial project development phase. In all cases, this must be minimised and more importantly never underestimated, as the time lost is never recovered later.

While there were numerous difficulties encountered during the course of this research project, ranging from trivial through to crucial issues, the fact remains that these hurdles have been cleared, and we stand on the side of success. The ancillary benefits derived from our research experience are both difficult to quantify and can be quite difficult to convey. Numerous aspects of the project have allowed us to meet many new people, of which many have (at times unknowingly) enlightened us on many issues associated with the industry, and provided us with a more holistic view of how it fits into

the Australian way of life. The associated travel to somewhat isolated locations has also, by necessity, lead to the acquisition of new experimental techniques and the ability to improvise when necessary.

## **ACHIEVEMENTS OF THE RESEARCH**

### *List of publications regarding kangaroo meat quality*

- (i) Harvesting the Australian kangaroo population for meat production: a self-sustaining wildlife industry (Beaton *et al.* 2002a)

This abstract gives a brief background to the commercial utilisation of kangaroo species and discusses some of our earlier investigations. More importantly, it highlights the potential value of developing a quality-based assurance scheme to improve the predictability of the quality of kangaroo products and, hence, consumer confidence. It also emphasises how the emotive issues of consuming a native fauna species of Australia acts as a deterrent for the consumption of this high quality product.

- (ii) Improving the quality of kangaroo meat: effects of carcass suspension by one leg (Beaton *et al.* 2001)

This study involved preliminary investigations into the possibility for utilising tenderstretching procedures to increase the tenderness of meat from field-harvested kangaroos.

- (iii) The effect of pre-rigor temperature on the ageing potential of kangaroo meat (Beaton *et al.* 2002c)

This study examined the effects of delayed or rapid chilling on the ageing potential of various commercially important muscles from the kangaroo carcass.

- (iv) Myofibre types in eight skeletal muscles from the Eastern Grey kangaroo (*Macropus giganteus*) (Spiegel *et al.* 2002a)

The results from this study have proven to be important in furthering the understanding of muscle metabolism in macropods through detailed classification of kangaroo muscle fibre types in an array of economically important kangaroo muscles. This study improved our understanding of factors that impact on post-mortem metabolism, and hence, eating quality of the resultant kangaroo meat.

- (v) The relationship between muscle glycogen stores and ultimate pH in commercially harvested kangaroos (Spiegel *et al.* 2002b)

The study of glycogen metabolism in muscle of a non-domesticated species in their natural habitat presents some novel challenges to the meat scientist. The objective of this study was to establish the relationship between muscle glycogen stores at the time of slaughter with subsequent formation of lactic acid and the ultimate pH of various muscles of commercial importance from the kangaroo carcass, leading to a key understanding of factors influencing important commercial traits such as shelf life and colour stability.

- (vi) Sensory evaluation of kangaroo meat (Beaton *et al.* 2002b)

This research experience represents our benchmark study as discussed below in more detail.

### *Sensory evaluation of kangaroo meat: a benchmark study*

This initial benchmark study marks the first industry-relevant trial for kangaroo meat where consumer-based sensory evaluations of the eating quality attributes of kangaroo meat were undertaken. More importantly in the context of this paper, however, it provides an example of the flexibility that was required to achieve the objectives of our project in an industry structured very differently to the beef industry from which the methodology was taken. This was a necessity to effectively deal with the unforeseen challenges that lay ahead in the dynamic environments of different supply chain levels. Simple tasks, such as the recording of data and documenting observations in the field, tracking carcasses to the processing plant, their breakdown and the collection of individual muscles with definite origin for further objective and subjective analyses, presented unique challenges.

### *Fieldwork investigations for the benchmark study*

We collected muscle samples from 50 animals harvested from the Hallett region of South Australia. Our decision to be present personally at all stages of the trial, from field to final report, allowed us to preserve complete integrity of the data and trial results. During each night's harvest we carried out extensive in-field animal and environmental measurements, such as ambient temperature logging and

vegetation description. We then tracked the carcasses from the field into the field chiller, and eventually to the processing plant. At the plant, we worked in conjunction with personnel and meticulously tracked each of the sample muscles right through the boning out of each carcass to individual vacuum packaged and labelled muscles, before being sent (via frozen, registered road freight) to the meat Science laboratory at Armidale for further analyses.

*Consumer-based taste panel assessments for the benchmark study*

Three muscles were utilised for the sensory evaluations, topside (*M. adductor*), silverside (*M. biceps femoris*) and the loin fillet (*M. longissimus dorsi*). Sample preparation and sensory procedures followed those developed and utilised by Meat Standards Australia for the sensory testing of various beef and lamb cuts (Thompson 1998; Polkinghorne *et al.* 1999). Our choice to utilise untrained consumer-based sensory evaluation procedures was based on the knowledge that they form an effective alternative to trained taste panels, yielding results with less potential for training-based bias, but more importantly, are of direct relevance to industry and consumer.

Many of the muscles proved to be quite small in comparison to those tested in the beef and lamb grilling protocols, which again called upon our improvising skills, for example, adopting protein binding techniques in order to form adequately sized muscle composites, which comprised of both the left and right side muscles from each animal. This allowed for the slicing of evenly sized steaks from each muscle type. The grilling procedures were carefully redefined for kangaroo meat, as were many other integral steps to culminate in the evaluation of tenderness, juiciness, flavour and overall acceptability. Consumers were also requested to rate the eating quality of their steak on a 4 level ranked scale, from unsatisfactory, good everyday, better than everyday, to premium product.

This trial defined many of the factors that influence kangaroo meat quality and, like most research, lead to the posing of many more questions than it originally set out to answer. Briefly summarised, muscle, species and dressed weight of the carcass all influenced various attributes of grilled kangaroo meat eating quality to varying degrees (for further details, refer to Beaton *et al.* 2002b). The results also reflected the inherent differences that kangaroo meat has to other, more conventional, domestic meats. For instance, this benchmark study revealed that tenderness is of less importance to consumers in influencing palatability when compared with beef. One central conclusion of this trial was that, while remaining important, tenderness was not the main driver of consumer acceptance of grilled kangaroo meat in the meat quality sense, with consumers placing a higher importance on flavour. Furthermore, these results formed the basis for the subsequent development of laboratory-based objective analyses (refer to the list of publications above) which were integrated closely with subjective-based sensory evaluations of product.

These studies were important in providing the industry with basal information that developed toward an understanding of the key variables affecting the acceptability of their commercial product. It was important that these results should be understood equally by the field harvest teams, the processors and the marketers of the product. The mere identification of the most important aspects of meat quality influencing consumer acceptability of the product, for example, will be essential information for the development of future advertising campaigns for these products.

At the very least, we were able to provide some direction for the industry towards possible future research endeavours regarding product quality and acceptability. Microbial contamination and food safety are certainly extremely important issues for the industry, but these remained unfortunately beyond the scope of the present studies, although they were always carefully considered, with care taken to not compromise these areas in any way through our methodology. Thus, despite the fact that some aspects of our research was of a strategic or even basic nature, we never lost sight of the need to place it within the context of the entire supply chain context rather than 1 particular aspect of the harvesting, processing, packaging and retailing spectrum.

**PROJECT OUTCOMES AND PERSONAL GAIN**

Upon reflection of the past 4 years, it is important to recognise what one can achieve given the constraints confronted, the negative forces encountered, and the need to diligently battle against the odds. Despite these limitations, the project has provided a solid foundation for research careers in the field of applied meat science and sustainable resource utilisation for 2 PhD students. To measure the

level of success of any postgraduate research program simply through journal publications and conference presentations may be technically proper in the objective sense, however, this approach excludes the value of those irreplaceable experiences that our PhD programs offered. Accordingly, one often has to take risks to achieve the goals created by a vision. In our case, we took a risk because we saw the opportunity to engage our ambition and take on a project that would be enjoyable and ultimately would offer us with real rewards. The way we approached this provided us with a unique sense of project ownership that sharpened our dedication to the task at hand, thus ensuring that all challenges were met successfully. Furthermore, strong devotion to effective and sustained teamwork, coupled with a proactive approach and strong focus on collaborative agreements provided the support infrastructure enabling us to effectively deal with these challenges. We found this very rewarding and if one is allowed to indulge in a little self-contemplation, we feel that the experience was, at the very least, a character building experience.

Retrospective to our limited research experiences thus far is the realisation that the development of a successful career in science may well require the combined ability to remain open-minded, focused, and pro-active at all times. All of these are closely linked to the elementary need to embrace both holistic and strategic approaches to the planning and implementation of science.

### **WHERE TO NOW: FUTURE PROSPECTS**

#### *For the kangaroo industry in Australia*

The more fundamental aspects of the research are yet to be presented completely to the industry, thus, the future prospects for the kangaroo industry will not be discussed here. However, of great interest will be the response received after the final review of research findings are accepted, and which will hopefully be utilised by the industry as it strives to improve product quality for the consumers of tomorrow, ensuring the best possible basis for consumer acceptance of kangaroo meat products in the future.

#### *For scientific research*

As this particular research experience alone forms the basis for the following comments, naivety may well prove to be a significant influence. The new realities that presently face Australian animal production, and the role that science has within society, require careful consideration and development to ensure a prosperous future for young researchers. The continuous cut-backs in government funding, irrespective of level, for research in traditional areas of agriculture have not been helpful in this regard. If Australia is to have a prosperous future in the new global information economy of this century, it will essentially depend on the changing role of scientists in Australia. For science to succeed in the future, it has to be closely integrated with business, and for businesses to remain competitive, they have to adopt the latest innovative technology. For this to occur, a transition in scientific ways of thinking, from analysing and understanding individual natural processes, through to the synthesis and integration of multidisciplinary systems, will be necessary. The management of knowledge and the protection of intellectual property have assumed much greater importance of late, but it is imperative that these processes do not limit the opportunities available for postgraduate students to pursue their research unhindered. The success and progress of scientists in the future will depend on the provision of a research environment in which innovative and holistic approaches predominate to meet the needs of our progressive society. In many ways, scientists are in an excellent position to direct the rate of progression within the complexities of the world economic order. A healthy research environment will facilitate the establishment of networks with industry and consumers, allow for forward, long-term planning, and provide scope for a flow of information from well-funded fundamental investigations and their applications down-stream to realise their commercial potential.

Without this balance, our nation will remain a scientific and economic backwater dependent on over-priced technologies marketed by multi-national companies' intent on recovering the cost of their development. As young scientists entering the workforce for the first time, we look forward to participating in this process.

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