final report

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Impact Analysis on one MQST enabling technology

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Executive summary

New technologies may have impacts on demand and supply factors for a range of meat products. The demand factors are typically associated with a change in product attributes. A new technology may cause a product to move to a unique market segment or it may cause the product to switch into another identified product category. The later case is referred to as the substitution effect. Market categories for meat products can be defined by the following variables,

1. visual appearance (muscle to fat proportions, muscle and fat colour, colour stability, shape and wrap type and colour),
2. keeping quality,
3. convenience, and
4. objective qualities including tenderness (WB shear force), cooking loss and cohesiveness under different cooking methods.

When products receive similar scores for the defined attributes then they are classified as close substitutes and therefore an increase in the supply of one close substitute may have a negative impact on the second close substitute. Demand functions can be employed to estimate the impacts from changing attribute levels on various product categories in targeted markets.

The second component of the analysis is to analyse potential changes in supply. These may include a change in costs such as labour, accidents, RSI, drip loss, yield, evaporation, refrigeration, power, packaging, storage, transport and presentation.

Supply and demand are both influenced by the speed of adoption of the technology. The introduction of Cryovac technology will be examined to measure the rate of adoption within Australia and overseas to estimate adoption of the BOA technology. It must be emphasised that the BOA technology may not replace products from all muscle types; hence, a partial adoption rate may be required.

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Background

It has long been recognised that the quality attributes of meat are influenced by the degree of contracture of the muscle. Stretch or contracture is reflected in the sarcomeres, the structure of muscle responsible for generating force. Sarcomere length (SL) is therefore a measure of the degree of shortening or stretching of a muscle.

Contracture of a muscle to produce a shortened sarcomere toughens meat. At contractures of up to 40%, the initial toughness of meat, defined as the toughness at rigor mortis, is increased in proportion to the shortening but, with ageing, will become acceptably tender. At contractures greater than 40%, meat becomes severely and irreversible tough. Conversely, when meat is stretched beyond the normal resting length, the initial toughness is reduced. In effect, stretching replaces, to some degree, the need for ageing to allow tenderisation.

Traditionally, hot boning was associated with the production of manufacturing beef and the process was developed with a process efficiency focus and little regard to end-point meat quality. As a result of this, hot boning was typically associated with poor and highly variable meat quality and it's use was limited to the production of bull and cow meat. However more recently, hot boning has undergone an evolutionary change with many plants now tailoring their process to generate high quality chilled beef destined for overseas markets. Many of these process optimisation procedures have focussed on the more effective control of pH/temperature profiles and the resulting quality has improved dramatically.

BOA technology has been developed in previous MQST Yr2005/06 work, and the benefits and potential markets are proposed to be evaluated in the current Yr 2006/07. The potential benefits and opportunities of pre-rigor stretching to the industry are:

- A clear benefit is the improvement in tenderness. The extent of this benefit depends on the muscle and the extent of the stretch. Muscles with a parallel fibre direction respond most effectively to stretching.
- Portion control: After stretching, meat adopts an even cylindrical shape that is ideally suited to identical portions. Additional shapes can be considered but have not yet been developed.
- Restructuring: Pre-rigor meat held together under compression during the pre-rigor period and during subsequent storage will bind together even without the use of binding agents. These have been shown to hold together even after cooking.
- Meat colour: For reasons that have yet to be defined, both meat colour and colour stability is improved after stretching.
- Process optimisation: Processing muscles individually through a tube-based stretching system offers opportunities for additional process control: these include optimised cooling regimes, individual muscle stimulation, integrated quality measurements systems based on, for example, NIR or NMR.

The current research proposes to evaluate the industry benefit of the Boa pre-rigor stretching technology.

Project Outline

The following are the milestones:

	Milestone and achievement criteria
1	Sign contract. All relevant MLA EQ documents received and project planning complete Milestone 1: Finalise and report on project plan
2	Literature review from historical files, papers, reports and workshops on i) expected labour (ie piecework), processing efficiencies (energy savings contributed by electricity etc) and yield savings contributed by hot boning in beef ii) the expected cost benefits contributed by quality improvements (ie colour, textural, tenderness, etc) and yield (evaporative & cooking losses), technical & processing efficiency benefits obtained from pre-rigor manipulation technologies such as BOA technology and Pi-Vac systems on hot boned beef product. Milestone 2: Collate data and report on initial scoping study to identify potential benefits of Boa technology including literature review on i) hot boning and ii) pre-rigor manipulation of beef product.
3	Case study - Verification of the quality benefits (ie colour, tenderness etc) through preliminary trial(s) at nominated plant and consumer surveys on portion controlled beef product produced from Boa Technology. Milestone 3: Report on case study results and feedback through supply chain on portion controlled product produced from Boa technology
4	Prepare final report including literature review, preliminary trials on sheepmeat, and business case and recommendations for proposed next phase of VFC technology(s) evaluation. Milestone 4: Prepare and report business case including recommendations for next phases of evaluation of VFC, specifically tunnel chilling technology.

Project Objectives

The primary objective was to identify the benefits and potential returns on investment of pre-rigor technology.

The specific objectives were :

1. Prepare a review of the literature on the potential benefits of quality hot boning systems and specifically to pre-rigor stretching technology including Boa and Pi-Vac systems
2. Conduct case study / preliminary Boa plant trial to verify benefits identified in scoping study
3. Collate data and report on benefits and potential impacts of Boa stretching technology to the Australian red meat industry for portion controlled beef products beef.

Experimental work

Meat quality factors on select muscles need to be assessed with and without the use of the technology and this has been planned. This work will be carried out by NSW DPI for lamb and sheep meats, and UNE for beef cuts. At this stage the sheep work has been planned for July at Fletcher's Dubbo. The beef work was to be completed at Murgon in Queensland; however, their management has indicated that they have ceased operations and therefore a new beef partner needs to be identified. John Thompson has said that he has approached a further three beef partners to evaluate the technology. He aims to include a partner from the food service, supermarket and export industry segments.

The implementation of the trial work has been delayed due to issues in constructing and shipping the machine. The NSW DPI and UNE research work is now expected to continue to Dec 2007.

John Thompson has informed me that only objective meat quality data will be collected on trial beef muscles. This may exclude an analysis of flavour profiles associated with different wrapping membranes.

An assessment of the value of muscle shape will need to be completed. Currently consumers use muscle shape to determine muscle type and this indicates muscle quality. If a large number of muscles were to become round and bound then it may be difficult for consumers to identify different muscles. Branding by wrap colour or some other mechanism may become necessary to differentiate product of different quality.

A significant amount of research has been conducted on hot boning and its effect on labour, RSI, meat yield and quality. That research will be reviewed and incorporated into the costs. A preliminary report will be presented in M2.

The adoption of Cryovac packaging may provide a useful comparison for the level of adoption of the BOA technology. The rate of adoption for BOA may be as fast as Cryovac; however, BOA may not totally replace pre-existing technology as Co2 flush and other products may still be beneficial for high value muscles. A report will be presented in M2.

One aspect of this research is to trail the technology for products destined for domestic foodservice and institutional markets. At this stage no food service partner has been identified; however it is prudent to wait until trials have been conducted in abattoirs before approaching this industry sector. The value of the BOA technology in providing portion-controlled product for food service needs to be estimated and much of this can be estimated as a result of the processor trials.

Visual attributes need to be assessed through surveys. My aim is to incorporate an assessment of visual qualities with the assessment of objective qualities. This needs to be confirmed with each research team. An alternate strategy is to survey shoppers on the visual factors separately. A decision will be made on this when preliminary results are received on the number of muscles that may benefit from the BOA technologies. This work is to be completed in conjunction with the two partner research teams.

Supply factors will be assessed through a detailed study of costs associated with the technology including additional costs in some areas and costs savings in other areas. It is expected that this would be completed during testing of the machines during the meat processing work to measure throughput, labour, packaging etc. Previous research on the costs of production has been received and are currently being reviewed. M2 is a review of this literature: however, work is

expected to be completed by August or September 2007 as the quantity of throughput is yet to be determined for Australian conditions.

After the sensory work has been completed an assessment will be made of which muscles will benefit from the use of the technology. This will then provide an indication of throughput quantity per plant and subsequently will provide an indication of the potential costs per unit. This work is expected to be completed by September 2007.

An international trade model is currently being developed for beef and sheep meat by muscle type, or muscle group, where muscle type is not available. Trade data is required for this and this data will be sought from various sources including MLA, USDA and the European Meat Commission. This work is expected to be completed by August of 2007.

Results

Estimate of early impacts on the market from a scheduled introduction of Boa Technologies.

The initial market scheduled is focused on the Biceps Femoris (outside flat). In the Australian domestic market the muscle is preferred in an oval form rather than its natural rectangle shape. The muscle is expected to be thin sliced for food service and institutional markets. It is expected that the oval shape will provide advantages with respect to cooking consistency and reduce variability in eating quality.

The attributes of tenderness, juiciness and flavour can be improved through portion control in commercial kitchens. Improving beef tenderness by one per cent can increase retail values by 20 cents per kilogram and improving juiciness and flavour by one per cent can result in an 8-cent increase per kilogram in the domestic market.

By reducing the eating quality variability by standardising muscle steaks or slices. The eating quality variability of the BF is high and a reduction in the variability due to shaping with Boa Technologies may be 20 per cent. This equates to a value of about 5.6 cents per kilogram.

The cost of Cyrovac bags and processing is approximately 12 cents per unit or 3 cents per kilogram on whole primal packs. The Cyrovac bag would be replaced by a latex wrap and the cost of the Boa technology would need to be less than 3+5.6=8.6 cents per kilogram to break-even. The net benefit above Cyrovac is the 5.6 cents per kilogram. There are additional cold boning benefits that can be added to this figure as the research progresses.

For the export market to Korea the benefit could amount to $4,472,400 in the first year for changes to the BF product destined for the United States, S. Korea,
Chinese Tipai and Eastern Europe.

Assuming a 100 per cent change over in the first year for the BF in the Australian Domestic market the value in the first year is approximately $1,592,237. BASE = 12% of food service market value at the price increase of 5.6 cent per kilogram for BF steaks.

The combination of the export market and domestic market benefits equate to $6,064,637 in the first year.

The export market values are shown below in detail.

Aus $/kg		Export Value Increase	New Value per kg	New Market Value	Difference Value $
	Americas				
4.29	Canada				
3.74	United States	0.01	3.811427	145215360	2847360
	Asia				
4.89	Chinese Tipai	0.01	4.992277	18151920	355920
10.39	Hong Kong				
3.82	Indonesia	0.01	3.894545	4112640	80640
5.54	Japan				
4.65	Korea	0.01	4.743383	60563520	1187520
11.64	Malaysia				
1.97	Philippines				
	Europe				
8.74	Europe Union				
9.20	CIS				
4.00	Eastern Europe	0.01	4.08	48960	960
	Middle East				
5.00	Kuwait				
5.67	Saudi Arabia				
10.54	United Arab Emirates				
	Oceania				
4.40	New Zealand				
2.67	Pacific Islands				
1.95	Papua New Guinea				
4.78	**Total**				4,472,400

Conclusion / Commercial

The combination of the export market and domestic market benefits equate to $6,064,637 in the first year.

Acknowledgements

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