Final report

Teys Australia – Developing capability for external strategic partnerships with experts from Texas Tech University (TTU) Meat Science and Muscle Biology Program

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Executive summary

The overall objective of the project is to build capability in the Australian beef industry through a series of collaborative projects supported by Teys Australia and Texas Tech University.

The project was progressing as planned until domestic and international travel restrictions came into place due to COVID-19. The projects relied very heavily on the sharing of expertise and given the physical nature of most aspects of meat processing video conferencing could only facilitate minor progress. The decision was made to cancel the project. Once those restrictions have been removed the individual projects will be revisited.

The project focused on seven focus areas and had a number of specific deliverables under each:

- Identification of novel value adding opportunities/processes for low value beef primals and sub-primals in the US, Australian, Asian and European markets through new R&D knowledge.
- Develop the capability of Teys Australia staff.
- Develop best-in-class cattle husbandry/handling practices to support the best quality/grading outcome for each carcase.
- Develop and validate pathways to bring cull dairy calves to the beef market.
- Validate grading tools with particular reference to Value Based Marketing
- Support collaborative work in meat safety.
- Support re-establishment of a long-term core meat science/safety capability with an applied global market focus between Australian and US tertiary institutions (and search for potential applications with local Australian universities).

Overall, the Teys Australia & Texas Tech partnership has made significant progress across a number of areas. The leadership course has been very successful and will enable future leaders across the business to have a sound understanding of meat science principles and also build a strong foundation of knowledge and networks across the business. Two participants have been promoted to the position of General Manager - Operations at two plants. The leadership course could be developed into a structured course that could be delivered within Australia to other interested parties.

The marketing and ag-communications internship resulted in the production of various communications which have been very beneficial for the business in terms of marketing and employee engagement.

The success of the internship programs have resulted in development of new research assistant programs to enable these opportunities to be developed with locally based Australian students, which will further build knowledge and capability of future graduates for the Australian red meat industry.

The food safety projects have provided support to underpin Teys continuing strong focus on shelf-life and consumer safety.

The value-add projects have provided strong foundational work, which has allowed Teys to develop new/improved product lines to provide the best outcomes for the Teys Australia Food Solutions (TAFS) and Teys business.

A Fulbright Scholar from the United States of America will be conducting research at Charles Sturt University in Wagga Wagga in 2021 that will benefit rural and regional communities. Professor Courtney Meyers from Texas Tech University, will research two lines of inquiry. The first is on message development about agricultural science topics and message effects on information processing, formation of attitude, and changes of behaviour. The second is on the scholarship of teaching and learning, specifically in the areas of service learning, critical thinking and case study development.

Professor Meyers will explore media representations of agriculture and natural resource issues, create three teaching case studies about the role of communication in agricultural issues, and evaluate the curriculum needs for agricultural communications as an academic discipline.

The strong collaboration work on several projects between various Australian universities and TTU provides a good model to build knowledge and capability within the Australian red meat industry. This collaboration will continue post COVID-19.

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1. Background

Teys remains committed to fostering beneficial strategic partnerships with leading edge science and technology providers to drive their business and innovation strategies. Developing the capability to build and capture value from these partnerships requires innovation capability to identify - contribute – decipher knowledge and learning. Currently, partnerships between solution providers (e.g. research institutes, universities, government agencies, inventor networks, entrepreneurs and philanthropic providers) with solution users in Australian red meat industry has a long history for lack of adaptability and the need to invest in industry experts network is a MLA imperative (AIP 2017/5.1.2.1 and more recently RedMeat 2030).

This MDC project will provide the framework for Teys to partner with Texas Tech University (TTU) over 3 year period in a number of strategic applied research initiatives in meat science to determine new ways (including solutions and science learning with wider industry benefit) of achieving some specific and predetermined objectives across 7 key focus areas summarised in Figure 1.

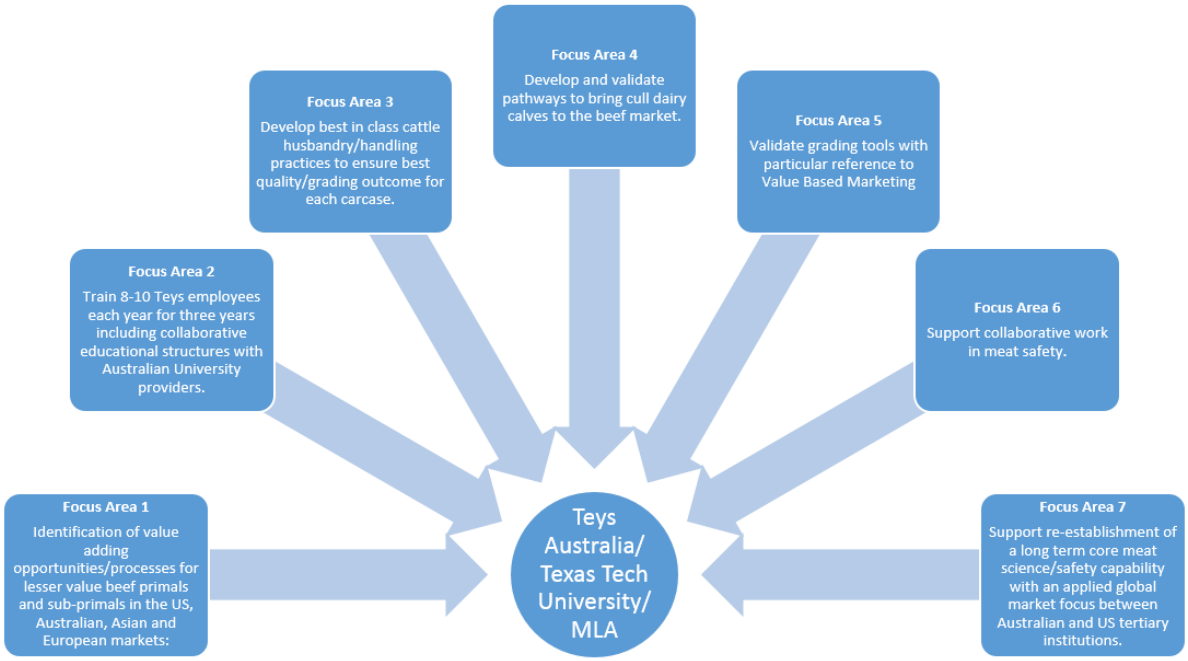


Figure 1: Summary of project objectives.

Teys Australia and TTU have collaborated on two previous MDC projects (A.SCT.0068 and P.PIP 0383) where TTU meat science graduates undertook internships at Teys plants to both build the external relationship between the two organisations and to gain a better understanding of the differences between the two production systems. It was highlighted that there was significant opportunities to collaborate further by undertaking strategically designed and executed projects.

The objectives of these projects were to:

- Evaluate whether participating in an international cadet-ship program with TTU was an effective mechanism to build external linkages with leading education institutions.
- Identify considerations for building an ongoing industry program to link Australian companies with leading educational institutions

- Conduct research projects using TTU undergraduate students.
- Understand the level of knowledge of the TTU students as an indicator of whether Teys should send employees to TTU on a reciprocal exchange program.

2. Objectives

The seven (7) focus areas and deliverables are:

1: Identification of novel adding opportunities/processes for low value beef primals and sub-primals in the US, Australian, Asian and European markets that add new R&D knowledge.

a) Review of previous/current platforms and opportunity identification for investable innovation solutions that optimises overall carcase value and where high value solutions deliver minimum of 3 times multiplier to base commodity value.

b) Management of both prime cuts of unacceptable eating quality and traditional lower value secondary cuts.

c) Acceleration of value added MSA cut/cook platform program.

Deliverables

- 3 x new value added products launched in identified target market(s) based on US insights and include solutions where lower value commodity products are exported from Australia to USA/South America and are value added in market (e.g. beef ribs, brisket and flank derived products where value capture is lost to Australia). Flavor profiles, pack design, and product and process development intelligence is to be presented along with design framework for product-market fit value proposition to identify target market and positioning that best creates and captures value for Australian red meat industry.
- Demonstrated modelling of raw material product quality band and final consumer preferences – input into Teys value add prediction model to underpin Teys Value Added Branding Strategy.
- Contribute to MLA's Insighst2Innovation program if target markets cross over to Asian markets – this could include attractive market identification and sensory profiling of Asian consumers (and comparison against baseline of Australian and/or USA consumers for red meat products)

2: Develop the capability of Teys Australia staff.

Developing the capability across a wider group of team members and the development and alignment of an innovation strategy to business strategy is a key aspiration for Teys.

Working with external partnerships to assist articulating what the problems to solve are and how to brief and communicate with leading edge science providers, and how best to interpret value proposition and opportunities for investable innovation strategies.

Deliverables

- Improved R&D scopes and research questions in a commercial mode
- Broader engagement of staff with leading edge science

- Train 8-10 Teys employees each year for three years including collaborative educational structures with Australian university providers.

3. Develop best-in-class cattle husbandry/handling practices to support best quality/grading outcome for each carcase.

Build on current knowledge and investigate novel solutions and best practices.

Deliverables

- Identify attributes that can be managed and their significance and inter-relationship (i.e. husbandry/handling, trace element deficiencies, breeding, truck journey, refrigeration).
- Examine correlation between pH decline (meat colour) and success of managing identified attributes.
- Examine potential direct animal stress measures and relationship to eating quality.
- Develop best practice guide for cattle handling tailored for each type of livestock presented for slaughter (i.e. extensively farmed Brahman through to grain-fed British breeds).
- Examine and recommend best practice to reduce pathogens and contaminants on cattle presented for slaughter.
- Develop systems to measure non-conformance with grading targets by Teys' cattle suppliers and implement strategies to achieve incremental improvement. - *Target (10%) reduction per year per supplier (review target after 1st year)*

4. Develop and validate pathways to bring cull dairy calves to the beef market.

Demonstrate the value proposition (desirable-viable-feasible) for new business models and emerging technology platforms to create new value in bringing cull dairy calves to the beef market.

Deliverables

- Study dairy calf raising systems internationally and identify best practice.
- Conduct case study within a supply chain using best practice.
- Conduct cost-benefit analysis (scope – yield, quality, public perception (animal welfare).
- Establish parameters to trial supply into Teys' supply chain with identified desirable – feasible – viable criteria.

5. Validate grading tools with particular reference to Value Based Marketing

Investigate leading edge grading tools that build upon current MLA and Teys innovation strategies for Objective Measurement and Value Based Marketing programs

Deliverables

- Evaluate Kuchida camera as a grading tool. Specifically compare to E+V camera output utilised in USDA grading.
- Examine marbling relationships to eating quality, grading and yield composition.
- Evaluate potential for ultrasound marbling measurement of hot carcase.
- Deliver objective grading of current MSA/AUS-MEAT grading attributes.

- Support development and extension work of carcase yield measures.
- Support development and extension work for animal health data.
- Evaluate potential for genomic inputs within eating quality and yield prediction and their practical application on farm through the Teys VBM program and wider MLA supported strategies for objective measurements.

6. Support collaborative work in meat safety.

Investigate leading edge science platforms in meat verification and validation schedules to capture/protect value for Australian red meat exports.

Deliverables

- Review research in risk-based inspection systems being developed internationally to build upon current MLA and AMPC initiatives.
- Identify/develop a model to be followed when determining food safety risk.
- Conduct targeted case studies and risk based models for:
    - Chronic Pleurisy
    - Poly Arthritis
    - Septic Pneumonia

7. Support re-establishment of a long-term core meat science/safety capability with an applied global market focus between Australian and US tertiary institutions (and search for potential applications with local Australian universities).

Develop expanded network of research providers to develop capability for Australian red meat industry to develop and adopt leading edge science.

Deliverables

- Use the deliverables as a means of fostering sharing of knowledge and capability between US and Australian institutions (and demonstrate a more effective mode of engagement between Australian commercial companies and research providers).
- Contribute to several publications to promote collaboration – e.g.:

    - 1 joint scientific publication in area of risk based Post Mortem inspection.

    - 1 Joint scientific publication in the area of objective carcase measurement.

    - 1 joint scientific publication in the area of consumer taste preferences and differing market preferences.
- Develop best practice guide for cattle handling tailored for each type of livestock presented for slaughter (i.e. extensively farmed Brahman through to grain-fed British breeds).
- Establishment of educational and research structures that encourage exchange of research staff, academic staff, graduate and post graduate students between USA and Australian institutions including mutual academic recognition and capability for joint qualifications and course credits.

3. Results

A report is provided below for each of the key focus areas. This details the development and implementation of various activities identified under the key focus areas. There have been a number of success stories which are detailed under their respective focus areas.

The international and domestic travel restrictions in response to COVID-19 have made this particular project virtually impossible to complete. There is no doubt that some of these sub-projects will continue when these movement restrictions are removed but they won't be able to be completed as planned and included in this final report

3.1 Focus Area 1 – Value Add

Develop new value-add products for TAFS business

Clean label alternatives for value-add products

TTU have completed initial work to find an alternative to sodium phosphate in marinated meat products. The aim of this work was to explore options to provide a "clean label" marinated meat product and understand any changes to eating quality. Previous studies have shown that enhanced products can also lack "beef" flavour so work has also been completed to see if beef flavour can be improved and what impact this has on eating quality.

Work to date shows that phosphate can be replaced with clean label ingredients (such as sodium carbonate, sodium bicarbonate and natural potato starch). These trials have also shown use of these alternatives results in an improvement in eating quality consumer scores. In addition, the use of beef flavour on enhanced products has also shown improvement in consumer perception of beef flavour and eating quality within grilled steak products. Roast and stir-fry enhanced products have not yet been consumer sensory tested. Any yield differences between the various treatments also needs to be calculated with further work.

This initial work shows that various 'clean label' ingredients could be used to improve the eating quality experience of enhanced product, and provide a competitive advantage by offering a clean label alternative. However, more work is to be completed on other cook methods as well as understand any yield differences between the treatments.

Barbeque style smoked meats product line development

TTU have performed investigation work into developing a barbecue style smoked meats line for Teys Australia. This preliminary work initially aimed to understand any eating quality differences from various different carcase grades. Initial eating quality work on briskets was completed with US consumers, with Australian consumer trials also conducted to see if any there were any differences between consumers in different countries. The brisket trials to date have shown that briskets from higher quality carcases result in a better consumer eating experience even with slow cooked barbeque style cooking method. Brisket point end (Pectoralis superficialis) had a higher consumer score than Brisket flat end (Pectoralis profundi). Eating quality MQ4 scores decrease slightly by a few points between fresh cooked briskets and reheated retail style brisket but suggest the product would still be suitable for a retail style product offer.

US Consumers sorted Australian briskets similarly to US sourced briskets. However US consumers did prefer briskets from grain fed animal over pasture fed.

The next steps would be to determine if briskets can be batched to cook at similar times and results in similar yields to enable retail production. Further work also needs to be completed to understand differences in eating quality between various types of barbecue cooking systems. Other work that should also be considered is if low quality brisket can be improved with some form of enhancement to produce a higher quality product.

Brisket Navel End New Product Development

TTU have completed preliminary work to determine if new or improved product offerings for TAFS value-add business could be created from Brisket Navel End briskets, which currently are a low value, under-utilized cut. TTU have proposed a product development process to create a beef bacon style product and also look at corned beef product opportunities with this cut. This process would need to be investigated through future trials and consumer evaluation work to ensure any project development has suitable eating quality outcomes for consumers.

Marination Equipment Process Improvements

A preliminary investigation was undertaken to explore potential opportunities to improve the marination process to increase yield, product quality and consumer eating quality. Various different methods were identified for further testing.

Currently mechanical processes such as tumbling are commonly used within value-add to help improve product tenderness and overall eating quality. These studies compared the use of a combination of techniques, including injection and tumbling, tumbling with marinade, or injection with marinade (The studies utilised beef flank steak which is commonly processed via tumbling. The marinade used was a standard salt and phosphate). All techniques were analysed for shear-force and consumer palatability. The results from this trial showed that tumbling alone (mechanical) did not result in any improvement in either shear-force or consumer acceptance scores so was of no additional benefit. All products that were treated with the marinade showed an improvement in consumer palatability scores and lower shear force values compared to tumbling alone.

Using marinade injection in the process resulted in greater consumer scores for juiciness and flavour, however, these was no statistical difference in consumer overall liking scores between the processes which used mechanical tumbling with marinade compared to injection with marinade. Tumbling in combination with the marinade showed the best performance in terms of drip loss and controlling the marinade pump rate percentage.

These initial studies suggest that use of marinades provide an improved consumer eating experience, however, the various techniques also need to be considered in terms of processing cost and product performance in terms of drip loss. Further work needs to be done to investigate any impact on shelf-life of these techniques.

Fajitas & Food Service Steaks value-add opportunities

Teys USA is currently selling sub-primals for fajita-style products. These cuts are then usually further processed before they are then on-sold into the food-service industry. The Teys USA team have identified a possible opportunity to process fajita meat in Australia and then market the value-add product direct into the US market to help expand the TAFS offering. A number of sub-primals have been sourced from Australia and have undergone further processing with TTU. Sub-primals such as inside skirt, thin (outside) skirt and flank steak traditionally used for fajita cooking were soured as well as two novel cuts, flap meat and topside (inside) cap for this cooking style. These were collected from carcases that covered a range of eating quality scores to explore if this would have any impact on consumer scores under the fajita cooking style.

Consumer evaluation studies showed that the consumer tenderness score was impacted by the initial carcase grading score, however, there was no statistical difference in consumer scores for juiciness, flavour and overall liking. The novel cut, flap meat, was ranked the highest for all consumer palatability attributes, with the other novel cut, topside (inside) cap, performing the lowest of all the cuts tested. The other cuts all had a similar performance. This work suggests that depending on price and availability, several different cuts could be utilised from various carcases grades to create value-added product of similar eating experience for consumers. Further analysis needs to be conducted to look at viability of a suitable process to allow commercialisation of this to bring value to the Teys USA offering.

Results from the various project trials were presented to Teys by TTU. A copy of the presentation is available in Appendix 5.1.

Explore MSA principles for novel cuts

Through the TTU/Teys partnership, support was provided for the MSA project to explore MSA principles for novel cuts including ribs and briskets (L.EQT.1814). A brief summary of the work is provided below.

The aim of this research was to improve knowledge of brisket composition and cooking to set a benchmark for future value-added product development. Consumer acceptability was assessed in both American and Australian populations. Samples were served using traditional techniques included chopped, pulled or sliced treatments. The consumer preference for re-heated samples was also assessed which provides insight into the potential for retail-ready style products.

While consumers liked the flavor, the study found that briskets sources from lower-quality carcases (based on MSA standards) had lower overall consumer preference scores. Pulled brisket was least favorable, while chopped and sliced briskets treatments performed similarly. Fresh cooked brisket out performed re-heated (retail style) product. There was also a difference observed between different preparation methods with chopped and sliced brisket performing better as a re-heated product compared to a pulled brisket.

This research work has provided a strong foundation for further work to understand the low'n'slow barbeque cook method for MSA prediction models. This work also shows there is potential for new value-add opportunities for restaurant and retail products.

Review opportunities for high pH meat

A literature review was completed to investigate any opportunities for high pH meat, which causes major losses for industry in terms of eating quality outcomes and product value.

The pH of meat is a widely studied topic due to its impact on composition and quality. Though it is hard to identify the optimal pH of meat, the generally recognized pH range of normal meat is from a pH of 5.5 to 5.7. Meat with a pH above normal conditions is associated with increased water-binding capacity, a darker colour, a coarser texture, and provides conditions more favourable for oxidation and microbial activity that results in bacterial spoilage.

The dark firm and dry characteristics of carcasses are due to low glycogen and reducing sugar reserves at the time of slaughter which results in meat being unable to properly bind enough oxygen to form a bright red colour and develop a high ultimate pH.

Many researchers have determined the relationship between pH and meat tenderness is linear, with tenderness increasing as pH increases. Other studies have suggested a curvilinear relationship

between pH and meat tenderness. The curvilinear relationship is more complex and has been found to be partially dependent on sarcomere length and influenced by enzyme activity. The differences in tenderness and the cause of this curvilinear relationship was due to differences in proteolytic activity. The main protease responsible for tenderization of high pH meat is the calcium-activated factor (CAF). Calpains, or CAF, is a calcium dependent enzyme found within muscle that is responsible for the removal of the Z-line and the degradation of tropomyosin and troponin T and I that occurs during the aging process.

This review is in appendix 5.2

Review current flavor work to define opportunities for future projects

A white paper on flavor has been developed ("Unlocking the Value of Beef Flavor"). A workshop was held with various industry stake-holders to discuss the potential for future work. As part of these discussions, this focus area is now considered a broader industry project no further work was conducted under this project.

3.2 Focus Area 2 & 7 – Capability

Develop meat science & leadership program for Teys staff

An Operational Leadership program has been established through the Teys/TTU partnership. Key staff through the business have been identified for further development as future leaders within the business. Texas Tech University conducted a meat science course via a webinar series to provide participants with an understanding of key meat science factors, eating quality and food safety principles, and how this can be applied practically to the Teys Australia business. The course also aimed to build leadership skills and an understanding of good experimental design process. Participants took part in an industry study tour over two week in the USA, to help provide an insight into a different countries production system and apply new knowledge and broader perspective back to the business.

Two cohorts have successfully completed the Operational Leadership program. Both cohorts completed a group challenge at the conclusion of the course to identify a number of new opportunities for the business based on their new knowledge. Several of the new concepts proposed are now being explored within the business. These included opportunities to improve employee and community engagement, brand development to improve consumer experience, as well as initiatives such as use of female forklift drivers to reduce damage and forklift incident rate, exploration of carcase camera grading to improve data capture and transparency, and development of new products.

Several members of both cohorts have also since been recognised for new positions within the business. The experiences through the operational leadership course has provided them with the knowledge and expertise to build capacity and add value across the business.

The course Agenda is in Appendix 5.3

Develop internship program

A number of internship programs have been completed between Teys and TTU students across both 2018 and 2019. These covered agricultural communications and marketing, meat science and food safety. The success stories from these various program streams are detailed below.

Agricultural Marketing & Communications

Teys Australia and TTU initiated an agricultural communications internship program which has seen several TTU Ag-Communications students spend time working with Teys to complete a series of video-based communications projects for various departments across the business. This has included several marketing videos for our brands, safety awareness videos, and employee engagement and induction communications. This has enabled the business to develop a large number of high quality materials to improve communication to both employees and customers.

Teys Australia also hosted a group of TTU agricultural communications undergraduate students taking part in a study abroad opportunity. The students represented five majors, including agricultural communications, animal and food sciences, plant and soil science, interdisciplinary agriculture and natural resources management. Participants visited various aspects of the red meat industry-topics including visits to a farm and processing plant, as well as presentations on marketing; lectures on regulation and exports; and a university tour. Among the highlights was a presentation and tour of Teys Australia's processing facilities and its value-added packaging program. Also included during the trip were visits to an Australia cattle saleyard, Australia Meat Processor Corporation and Meat & Livestock Australia; a not-for-profit organization that provides research, development and marketing services to Australia's red meat and livestock industry.

There has also been several meetings to explore potential for a reciprocal exchange program between TTU and Australian based institution Charles Sturt University. There is also potential to develop similar relationships with other Australian instructions including the University of New England and Murdoch University.

Relationships developed between various universities as part of the Teys/TTU partnership have led to TTU Professor Courtney Meyers being awarded a Regional Universities Network and Australian-American Fulbright Commission scholarship in 2021, to be based at Charles Sturt University in Wagga Wagga. Her research will create several teaching case studies about the role of communication in agricultural issues within the Australian context and also help with the development of curriculum for an agricultural communications course, which currently is not available in Australia. A copy of the media release is available in Appendix 5.4.

Meat Science Internship Program

Several meat science interns have been hosted through the internship program between Teys and TTU. These students have participated in a number of research projects as well as being involved in the Australian Inter-Collegiate Meat Judging Association events to help build the students' networks with Australian students studying similar courses.

Two interns were hosted at the Teys Wagga Wagga plant. The plant management identified two specific projects for the students to work on during their program. One study involved comparison of longer chilling time on carcase grading scores. Typically carcases are graded and boned the day after slaughter, however with recent chiller expansion work, the plant management wanted to identify what category of carcases would benefit most from extended chilling as some carcases would need to be held over for an extra 24 hours. The students collected both AUSMEAT and MSA grading information at the time of initial chiller assessment which was approximately 17-19 hours

post-slaughter. The students also assessed the carcases under the USDA quality grading system. These carcases were then held over in the sort-chiller and re-graded 24 hours later. The results from this work showed that both AUSMEAT and MSA marble score increased slightly on average, with AUSMEAT meat colour decreasing slightly with extended chilling time. This work allowed management to select categories that would benefit from improved marbling and meat colour to be held for extended chilling.

The second project at Teys Wagga was to conduct a performance analysis of the spray chill system. A recent chiller upgrade at the plant included the installation of new spray chilling systems. Plant management wanted to gain an understanding of any differences in shrink percentage between the new chillers. Carcase side hot weights were recorded at chiller entry. After overnight chilling, carcase side cold weights were recorded at the boning room intake scale to enable a carcase shrink percentage to be calculated. Chiller temperature and spray chill settings were all recorded as part of the analysis. The results from the project showed that all four new chillers had very similar shrink percentages which will enable management to make more informed decisions.

Several interns were also hosted at the Teys Rockhampton plant. This plant is conducting a number of ongoing trials around objective carcase measurement technology including DEXA and other camera-based carcase yield technology. As part of the validation work for these new technologies, several hundred carcases of various grades needed to undergo a full yield bone-out to validate the outputs from the objective yield grading technology. This is a very labor intensive process with each primal, sub-primal, fat and bone individually weighed and recorded. Having the students available to assist with the data collection process, helped assist the project team to get further ahead on trial work. This program has been used as a template to set up similar summer research programs with local Australian university students to assist with trial work research at other Teys Australia sites.

Food Safety Internship Program

Several food safety projects were identified for further research as part of the Teys/TTU partnership. It was identified that some of this work would be suitable for TTU students to complete as part of the Teys/TTU internship program. These trials were conducted at the Teys Beenleigh plant. The specific results from these trials are detailed under the Food Safety focus area section in this report.

Based on the learnings from these internship programs, Teys Australia is considering future development of an internship-style program for students from Australian universities.

3.3 Focus Area 3 – Grading outcomes

Previous milestone reports identified an opportunity to explore potential gene-marker for susceptibility to dark-cutting. Other discussions have been held with various industry partners on a larger genomics project so this particular project has not been pursued further as it may end up being covered under other future work within industry.

3.4 Focus Area 4 – Dairy Beef

The scope of this project has expanded in collaboration with the dairy industry in a jointly funded project (P.PSH.1023 - Creating a dairy beef supply chain to increase the value and volume of beef and veal products). Given the development of this into a broader industry project this was not included specifically under this project. Teys Australia provided in-kind support to the project through feedlot space and access to plants to collect carcase information under the broader project.

3.5 Focus Area 5 – Objective Grading

There was project work around the validation of objective camera grading technology. This initial work was based on testing and validation of the VBG2000 quality grading camera. These preliminary studies showed very promising results so the project was expanded and further work in relation to this has been set up under a different project (P.PIP.5016) for ease of project management.

Various studies are also continuing into the assessment of yield using objective grading technology. These trials included a large amount of validation work which has been supported by the Teys/TTU partnership through the students involved in the internship program (P.PIP.0576 and P.PIP.5015). This is discussed further under the Capability Building focus area section of this report.

3.6 Focus Area 6 – Food Safety

Identify potential areas to improve food safety within Teys business

Teys Australia hosted food safety specialist and TTU Professor Dr Mindy Brashears which included inspection of various Teys facilities. During this visit several projects were identified and several of these were completed by the food safety internship students.

As part of this work, TTU have completed an initial study on bacterial enumeration to investigate the impact of various chilling methods (spray-chill, dry-chill and hot water wash) on product shelf-life and gain a better understanding of microbial population lag times.

Key results from the trial show dry-chilling results in significantly lower micro concentrations longer-term, which may potentially increase shelf-life compared to spray-chilling. Not enough evidence was found to confirm that the hot water wash intervention at 85ºC reduces bacterial concentration on the carcase surface, rather it distributes the bacterial load across the whole carcase so may not be the most effective method at reducing bacterial population. This information will help in selecting the most suitable chilling methods to maintain product shelf-life for extended ageing. Feed type did not appear to have an impact on microbial load across the study.

These are similar results to the Teys annual validations of the spray chill/hot water decontamination processes conducted at our sites. Although the decontamination step doesn't reduce to any significant degree indicator organisms such as E.Coli, Teys believes that it does have an effect on the common spoilage organisms found in vacuum packaged meat such as *Brochothrix thermosphacta* and Gram-negative spoilage bacteria such as *Pseudomonas* and *Shewanella putrefaciens.* Spray chilling with-out carcase decontamination clearly decreased shelf life. However the introduction of hot water carcase decontamination restored shelf life back to what it was when dry chilling was practised.

4. Conclusion

4.1 Key findings

The objective of the overall project is to build capability in the Australian beef industry through series of collaborative projects supported by Teys Australia and Texas Tech University.

Even though the project has had to be cancelled due to reasons beyond any ones control the project has supported the re-establishment of a long-term core meat science/safety capability with an applied global market focus between Australian and US tertiary institutions.

That increase in capability has helped the Teys Australia & Texas Tech partnership make significant progress across a number of areas. The Leadership course has been very successful and will enable future leaders across the business to have a sound understanding of meat science principles and also build a strong foundation of knowledge and networks across the business. Two participants have been promoted to the position of General Manager - Operations at two plants

The marketing and ag-communications internship resulted in the production of various communications which have been very beneficial for the business in terms of marketing and employee engagement. The success of the internship programs have resulted in development of new research assistant programs to enable these opportunities to be developed with locally based Australian students, which will further build knowledge and capability of future graduates for the Australian red meat industry.

The food safety projects have provided support to underpin Teys continuing strong focus on shelf-life and consumer safety.

The value-add projects have provided strong foundational work, which has allowed Teys to develop new/improved product lines to provide the best outcomes for the TAFS and Teys business.

The strong collaboration work on several projects between various Australian universities and TTU provide an excellent model to build knowledge and capability within the Australian red meat industry. This collaboration will continue post COVID-19.

4.2 Benefits to industry

Through the partnership with Texas Tech Teys production and QA staff were exposed to the methodology to develop new products to improve the consumer acceptance of downgraded and ungraded beef. Involvement in the establishment and running of consumer eating quality trials will also serve Teys well into the future.

An Operational Leadership program has been established through the partnership. Texas Tech University conducted a meat science course via a webinar series to provide Teys participants with an understanding of key meat science factors, eating quality and food safety principles, and how this can be applied practically to the Teys Australia business.

Teys Australia and TTU initiated an agricultural communications internship program which has seen several TTU Ag-Communications students spend time working with Teys to complete a series of video-based communications projects for various departments across the business. This has

enabled the business to develop a large number of high quality materials to improve communication to both employees and customers

One of the main benefits to industry is the re-establishment of a long-term core meat science/safety capability with an applied global market focus between Australian and US tertiary institutions. This is evidenced by a Fulbright Scholar from the United States of America will be conducting research at Charles Sturt University in Wagga Wagga in 2021 that will benefit rural and regional communities.

Professor Courtney Meyers from Texas Tech University, will research two lines of inquiry. The first is on message development about agricultural science topics and message effects on information processing, formation of attitude, and changes of behaviour. The second is on the scholarship of teaching and learning, specifically in the areas of service learning, critical thinking, and case study development. Professor Meyers will explore media representations of agriculture and natural resource issues, create three teaching case studies about the role of communication in agricultural issues, and evaluate the curriculum needs for agricultural communications as an academic discipline.

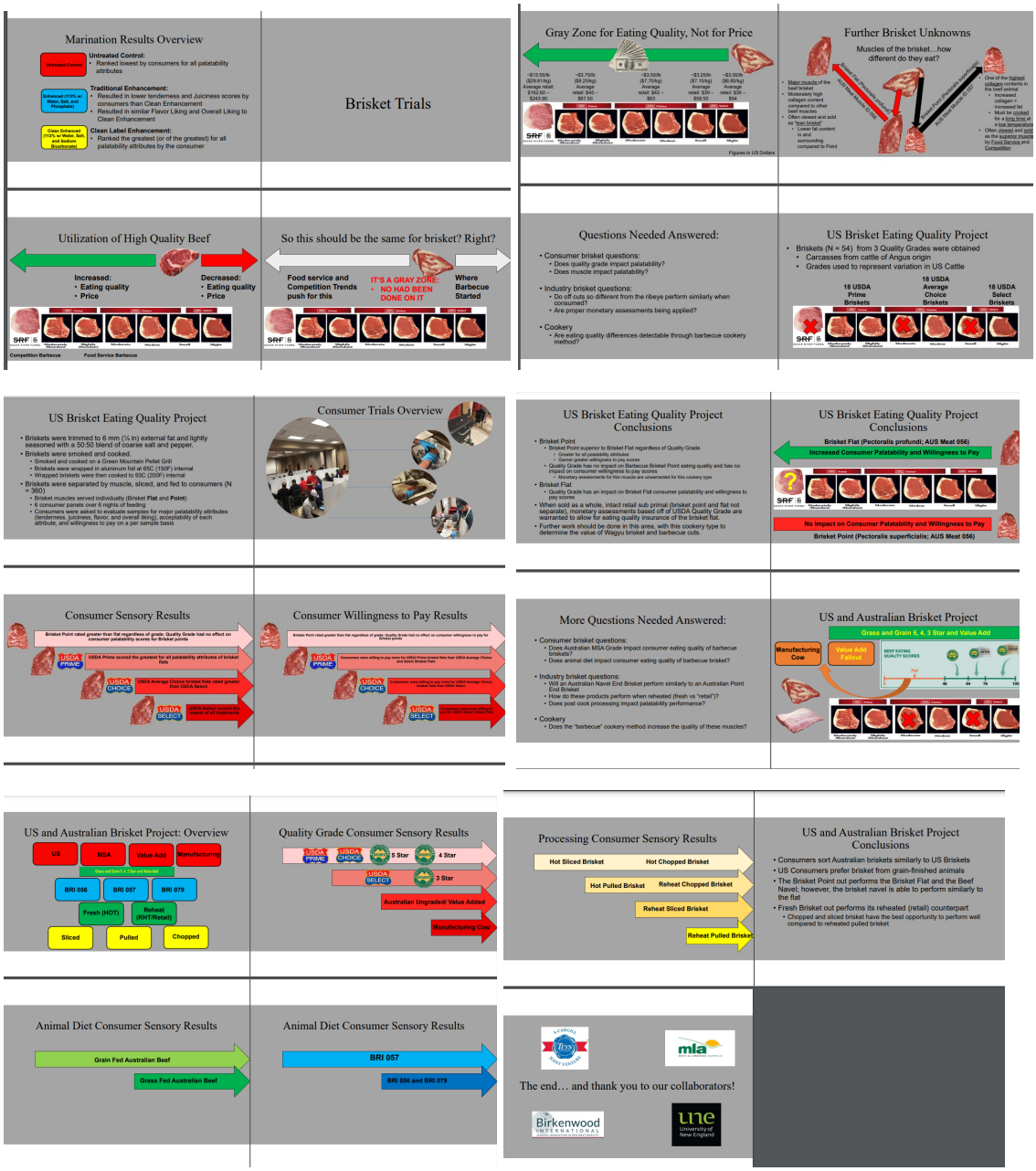
Several meat science interns have been hosted through the internship program between Teys and TTU. These students have participated in a number of research projects as well as being involved in the Australian Inter-Collegiate Meat Judging Association events to help build the students' networks with Australian students studying similar courses.

Two interns were hosted at the Teys Wagga Wagga plant studying the comparison of longer chilling time on carcase grading scores. The results from this work showed that both AUSMEAT and MSA marble score increased slightly on average, with AUSMEAT meat colour decreasing slightly with extended chilling time. This work allowed management to select categories that would benefit from improved marbling and meat colour to be held for extended chilling.

Several interns were also hosted at the Teys Rockhampton plant conducting trials around camera-based carcase yield predictions. As part of the validation work for these new technologies, several hundred carcases of various grades needed to undergo a full yield bone-out to validate the outputs from the objective yield grading technology. This program has been used as a template to set up similar summer research programs with local Australian university students to assist with trial work research at other Teys Australia sites.

5. Appendix

5.1 Appendix 1 – (extract) TTU Value Add presentation


Marination Results Overview
Untreated Control:
Ranked lowest by consumers for all palatability attributes
Traditional Enhancement:
Resulted in lower tenderness and Juiciness scores by consumers than Clean Enhancement
Resulted in similar Flavor Liking and Overall Liking to Clean Enhancement
Clean Label Enhancement:
Ranked the greatest (or of the greatest) for all palatability attributes by the consumer
Brisket Trials
Gray Zone for Eating Quality, Not for Price
Further Brisket Unknowns
Muscles of the brisket...how different do they eat?
Utilization of High Quality Beef
Increased:
Eating quality
Price
Decreased:
Eating quality
Price
So this should be the same for brisket? Right?
Food service and Competition Trends push for this
IT'S A GRAY ZONE:
NO HAD BEEN DONE ON IT
Where Barbecue Started
Questions Needed Answered:
Consumer brisket questions:
Does quality grade impact palatability?
Does muscle impact palatability?
Industry brisket questions:
Do off cuts so different from the ribeye perform similarly when consumed?
Are proper monetary assessments being applied?
Cookery
Are eating quality differences detectable through barbecue cookery method?
US Brisket Eating Quality Project
Briskets (N = 54) from 3 Quality Grades were obtained
Carcasses from cattle of Angus origin
Grades used to represent variation in US Cattle
18 USDA Prime Briskets
18 USDA Average Choice Briskets
18 USDA Select Briskets
US Brisket Eating Quality Project
Briskets were trimmed to 6 mm (¼ in) external fat and lightly seasoned with a 50:50 blend of coarse salt and pepper.
Briskets were smoked and cooked.
Smoked and cooked on a Green Mountain Pellet Grill
Briskets were wrapped in aluminum foil at 65C (150F) internal
Wrapped briskets were then cooked to 93C (200F) internal
Briskets were separated by muscle, sliced, and fed to consumers (N = 360)
Brisket muscles served individually (Brisket Flat and Point)
6 consumer panels over 6 nights of feeding
Consumers were asked to evaluate samples for major palatability attributes (tenderness, juiciness, flavor, and overall liking), acceptability of each attribute, and willingness to pay on a per sample basis
Consumer Trials Overview
US Brisket Eating Quality Project Conclusions
Brisket Point
Brisket Point superior to Brisket Flat regardless of Quality Grade
Greater for all palatability attributes
Garner greater willingness to pay scores
Quality Grade has no impact on Barbecue Brisket Point eating quality and has no impact on consumer willingness to pay scores
Monetary assessments for this muscle are unwarranted for this cookery type
Brisket Flat
Quality Grade has an impact on Brisket Flat consumer palatability and willingness to pay scores
When sold as a whole, intact retail sub primal (brisket point and flat not separate), monetary assessments based off of USDA Quality Grade are warranted to allow for eating quality insurance of the brisket flat.
Further work should be done in this area, with this cookery type to determine the value of Wagyu brisket and barbecue cuts.
US Brisket Eating Quality Project Conclusions
Brisket Flat (Pectoralis profundi; AUS Meat 056)
Increased Consumer Palatability and Willingness to Pay
No Impact on Consumer Palatability and Willingness to Pay
Brisket Point (Pectoralis superficialis; AUS Meat 056)
Consumer Sensory Results
Brisket Point rated greater than flat regardless of grade; Quality Grade had no effect on consumer palatability scores for Brisket points
USDA Prime scored the greatest for all palatability attributes of brisket flats
USDA Average Choice brisket flats rated greater than USDA Select
Consumer Willingness to Pay Results
Consumers were willing to pay more for USDA Prime brisket flats than USDA Average Choice and Select Brisket Flats
More Questions Needed Answered:
Consumer brisket questions:
Does Australian MSA Grade impact consumer eating quality of barbecue briskets?
Does animal diet impact consumer eating quality of barbecue brisket?
Industry brisket questions:
Will an Australian Novel End Brisket perform similarly to an Australian Point End Brisket
How do these products perform when reheated (fresh vs "retail")?
Does post cook processing impact palatability performance?
Cookery
Does the "barbecue" cookery method increase the quality of these muscles?
US and Australian Brisket Project
Grass and Grain 5, 4, 3 Star and Value Add
Manufacturing Cow
Value Add Fallout
US and Australian Brisket Project: Overview
US
MSA
Value Add
Manufacturing
BRI 056
BRI 057
BRI 079
Fresh (HOT)
Reheat (RHT/Retail)
Sliced
Pulled
Chopped
Quality Grade Consumer Sensory Results
5 Star
4 Star
3 Star
Australian Ungraded/ Value Added
Manufacturing Cow
Processing Consumer Sensory Results
Hot Sliced Brisket
Hot Chopped Brisket
Hot Pulled Brisket
Reheat Chopped Brisket
Reheat Sliced Brisket
Reheat Pulled Brisket
US and Australian Brisket Project Conclusions
Consumers sort Australian briskets similarly to US Briskets
US Consumers prefer brisket from grain-finished animals
The Brisket Point out performs the Brisket Flat and the Beef Navel; however, the brisket navel is able to perform similarly to the flat
Fresh Brisket out performs its reheated (retail) counterpart
Chopped and sliced brisket have the best opportunity to perform well compared to reheated pulled brisket
Animal Diet Consumer Sensory Results
Grain Fed Australian Beef
Grass Fed Australian Beef
Animal Diet Consumer Sensory Results
BRI 057
BRI 056 and BRI 079
The end… and thank you to our collaborators!
Birkenwood
University of New England

5.2 Appendix 2 - Literature Review of Meat pH

Potential Hydrogen (pH)

The pH of meat is a widely studied topic due to its impact on composition and quality. Though it is hard to identify the optimal pH of meat, the generally recognized pH range of normal meat is from a pH of 5.5 to 5.7 (Pearson, 1987). Meat with a pH above normal conditions is associated with increased water-binding capacity, a darker colour, a coarser texture, and provides conditions more favourable for oxidation and microbial activity that results in bacterial spoilage (Pearson, 1987; Kauffman and Marsh, 1987; Tarrant et al., 1989). Consequentially low pH meat tends to exhibit the opposite of these traits (Pearson, 1987; Kauffman and Marsh, 1987; Tarrant et al., 1989). Understanding the effects of pH on meat is necessary in order to determine how meat products will perform.

A majority of pH issues that are found in beef are due to a high ultimate pH. Beef with a high ultimate pH are classified as Dark, Firm and Dry (DFD) or as dark cutting (DC) (Pearson, 1987). Though cattle are classified as DC solely upon lean evaluation, it should be noted that these cattle possess a pH that is higher than normal as muscle pH strongly influences meat colour (Holdstock et al., 2014). The United States Standards for Grades of Carcass Beef determine that reductions in economic value for DC beef are due to acceptability and not diminished palatability (USDA, 2016).

The DC grading reduction is applied based on the lean colour of the LD (USDA, 2016). The DFD characteristics of carcasses are due to low glycogen and reducing sugar reserves at the time of slaughter which results in meat being unable to properly bind enough oxygen to form a bright red colour and a high ultimate pH (Tarrant et al., 1981).

Though DC beef can be caused by a low glycogen content at slaughter, beef can possess the glycogen potential to produce normal coloured meat, but produces atypical dark meat instead. Holdstock et al. (2014) conducted a study in order to determine if atypical (AT) dark cutting Canadian beef carcasses were receiving improper monetary deductions due to misclassification. In this study carcasses were classified a normal, DC and AT dark cutters (pH of 5.57, 5.83 and 6.62, respectively). Results showed AT carcasses possessed the greatest shear force values and received the lowest initial and overall tenderness score. The results indicate that palatability issues can exist in beef as a result of

differences in pH. Moreover, DC may lead to palatability issues, which disagrees with the United States Standards for Grades of Carcass Beef (USDA, 2016).

The influence of pH on palatability

Numerous studies have been conducted in order understand the total effect of ultimate pH on meat eating quality. Results from these studies show that the ultimate pH of meat greatly influences tenderness (Bouton et al., 1973; Purchas, 1990; Jeremiah et al., 1991; Purchas & Aungsupakorn, 1993; Wulf et al., 2002; Holdstock et al., 2014) and flavour (Wulf et al., 2002; Holdstock et al., 2014). The alterations in sensory traits can lead to a less desirable meat product (Wulf et al., 2002). Additionally, authors (Wulf et al., 2002; Holdstock et al., 2014) have determined that the negative influence of pH on palatability traits could warrant economic penalties. Lastly, the alterations of palatability attributes caused by pH do not necessarily negatively impact all eating quality traits; some of these alterations may be advantageous for one trait but could diminish another.

Of all the palatability traits, the relationship between pH and meat tenderness has been most widely studied. Controversy in this relationship has been widely published. Additionally, meat's subjective and objective tenderness has shown varied results across the pH scale. Many authors (Bouton et al., 1973; Silva, Patarata & Martins, 1999) determined the relationship between pH and meat tenderness is linear, with tenderness increasing as pH increases.

This linear relationship between pH and tenderness was observed by Bouton et al. (1973). In this study, cattle were stressed to manufacture a range of pH values. In order to initiate tenderness differences, multiple paired LD muscles were collected from beef carcasses that were hung from the Achilles tendon or from the aitchbone in order to stretch the muscles, and aged for 2 days and 21 days. According to consumers, tenderness scores increases as pH increased, indicating a linear relationship between pH and tenderness. When carcasses had a pH near neutral, tender-stretching provided no additional tenderization; however, stretched muscles with a low pH value had a significant improvement in tenderness compared to their Achilles hung counterparts. The inability for panellists to find differences in tenderness for the high pH, tender-stretched carcasses could be due to the panellist's inability to determine minimal differences in tenderness in tender meat. Moreover, Bouton et al. (1973) further supported these subjective findings as

objective WBSF and Instron compression values followed the same linear trend as the panellist's scores.

In a study conducted by Silva, et al. (1999), strip loins were collected from carcasses with a normal pH (5.5 – 5.8), moderate pH (5.8 < pH > 6.2) and a high pH (6.2 – 6.7). Steaks were evaluated by consumers and by WBSF. Both measurements showed normal pH steaks in this study were tougher than high pH steaks. Again, a linear relationship with pH and tenderness was found across treatments as meat tenderness increased with pH.

Conversely, other studies (Yu and Lee, 1986; Purchas, 1990; Jeremiah et al., 1991; Purchas & Aungsupakorn, 1993; Holdstock et al., 2014) have suggested a curvilinear relationship between pH and meat tenderness. In this relationship, meat is toughest between the pH range of 5.8 and 6.2, while increases in tenderness will occur as pH increases or decreases from this range. The relationship is more complex and has been found to be partially dependent on sarcomere length (Purchas 1990; Purchas and Aungsupakorn, 1993) and influenced by enzyme activity (Yu and Lee, 1986).

Yu and Lee (1986) determined that in LD muscles, from both hot and cold fabricated sides of beef, the highest shear values occurred within the pH range of 5.8 – 6.3. In order to understand the biochemical causes for this curvilinear relationship, further investigation was done using electron micrographs and electrophoreses on muscles across the pH range of 5.5 – 7.0. The differences in tenderness and the cause of this curvilinear relationship was due to differences in proteolytic activity.

Images indicated that the tenderization of high pH (above 6.3) meat was due to the removal of the Z-line through the degradation of α-actinin, the main constituent of the Z-line, and the removal of troponin T, troponin I and tropomyosin. The degradation of these proteins would suggest the main protease responsible for tenderization of high pH meat is the calcium-activated factor (CAF) (Yu and Lee, 1986). Calpains, or CAF, is a calcium dependent enzyme found within muscle that is responsible for the removal of the Z-line and the degradation of tropomyosin and troponin T and I (Yu and Lee, 1986; Badman, 1987). In addition to requiring millimolar amounts of calcium, the reactant conditions of CAF are preferentially activated around a neutral or slightly alkaline pH with their optimal environment at a pH of 7.0 – 7.5. The degradation of α-actinin would suggest that activity of another protease at a high pH, since this protein is resistant to the CAF enzyme. Though considered an acidic protease, cathepsin L has an optimal pH near 7.0. This lysosomal

enzyme digests actin, myosin, α-actinin, troponin and tropomyosin; therefore, the activity of cathepsin L might play a role in tenderization of high pH meat as well (Badman, 1987).

Yu and Lee (1986) also determined that both electrophoresis and an electron micrograph of low pH (pH 5.5 – 5.8) meat showed vast degradation of the thick and thin filaments, mainly the myosin heavy chain and the M-line. Degradation of these constitutes would suggest that cathepsins, or acidic proteases, are responsible for tenderization of low pH meat (below 5.8) (Yu and Lee, 1986). Cathepsin A, B and C would fit the constraints of the previous study, as their optimal pH range for activity would suggest they are active in this more acidic environment. Since cathepsin A and C are responsible for breaking down small peptides and are not responsible for degradation of native proteins, cathepsin B would be the acidic protease of primary interest, as its role is to degrade the thick and thin filaments (Badman, 1987).

Lastly in their study, Yu and Lee (1986) found limited degradation of the Z-lines, the thick and thin filaments, troponin T, troponin I and tropomyosin in the intermediate pH (5.8 – 6.3) range of the muscles, which led to this treatment being the toughest. Theoretically, the intermediate pH range was not optimal for CAF or acidic lysosomal enzymes; therefore, this pH range was the least affected during the degradation process.

Although both of these relationships present controversial differences about the optimal pH conditions for meat tenderness, a similarity can be drawn between them. At high ultimate pH values, meat is understood to be tender (Bouton et al., 1973; Yu and Lee, 1986; Purchas, 1990; Jeremiah et al., 1991; Purchas & Aungsupakorn, 1993; Silva, Patarata & Martins, 1999; Holdstock et al., 2014). Improved tenderness can be credited to either an ideal environment for enzymatic activity (Yu and Lee, 1986) or the increased ionic strength that occurs at a more neutral pH. An increase in ionic strength, which predominately occurs above a pH of 6.0 (Bouton et al., 1973), will allow for an increase in water binding which in turn leads to a more tender meat product (Wu and Smith, 1987).

Several researchers have investigated the impact of pH on meat flavor (Dransfield, 1981; Wulf et al., 2002; Holdstock et al., 2014). The flavour differences resulted from alterations in the biochemical composition of meat causing changes in the flavour reaction pathways. Maillard reaction products can be inhibited, reduced or altered in high pH beef due to the limited reducing sugar content. According to Pearson (1987), reduced volatile compounds can result in a less pronounced meat flavour. Moreover, high pH can result in

off flavours in meat and these flavour changes could merit monetary deductions in high pH beef, specifically beef with a pH greater than 6.00 (Wulf et al., 2002; Holdstock et al., 2014).

Flavour differences in DC beef are predominately a result of reduced flavour desirability (Wulf et al., 2002; Holdstock et al., 2014). Additionally, a reduction in beef flavour intensity (Dransfield, 1981; Holdstock et al., 2014) and an increase in off flavour intensity (Holdstock et al., 2014) are associated with DC beef. Interestingly, Wulf et al. (2002) found that although differences in flavour desirability occurred in the LD between normal and DFD carcasses, SM, from the same carcasses, were similar for flavour desirability. These findings indicate that high pH does not influence flavour desirability equally among all muscles.

Of the palatability traits, pH has the least influence over juiciness. Although cooking loss decreased as a result of increased water binding with increased pH (Bouton et al., 1973; Silva, Patarata and Martins, 1999), no relationship has been found between pH and panelist juiciness scores (Bouton et al., 1973; Wulf et al., 2002; Holdstock et al., 2014). This variability from expected results may be due to the panellist inability to detect differences in moisture throughout the chewing process or the ultimate influence that the degree of doneness had on the juiciness of meat (Bouton et al., 1973).

As stated previously, raw meat with a low pH will possess a watery, soft external texture, and meat with a high pH will possess a dry, firm external texture (Pearson, 1987; Kauffman and Marsh, 1987). These alterations in the raw physical texture of meat can alter the texture of cooked meat. Holdstock et al. (2014) determined that meat with a pH above 5.8 resulted in atypical texture when compared to meat with a pH of 5.7 or less according to trained sensory panellists. Segregation of the panellists' responses to the texture of the samples showed that meat at a moderate pH (5.83) resulted in a crumbly, rubbery texture and meat with a high pH (6.62) became crumbly, mushy and spongy when chewed, demonstrating the influence of pH on cooked meat texture.

Variations in classifications based on meat pH

Although beef carcasses are classified as DC based on the LD muscle, variations in pH exist throughout carcasses. This variation is due to differences in composition, such as the percentage of red and white muscle fibre types found in muscles (Baublits et al., 2006c). Wulf et al. (2002) determined that differences exist in the pH and colour of muscles throughout beef carcasses from normal and DFD classifications. In this study, the

longissimus dorsi (LD), *psoas major* (PM), *gluteus medius* (GM), *semimembranosus* (SM), *tensor fasciae latae* (TFL), *rectus femoris* (RF), *biceps femoris* (BF) and *semitendinosus* (ST) muscles were collected from carcasses classified as normal and DC. The LD muscle of DC carcasses had a higher pH than all other muscles tested (pH of 6.00, 5.80, 5.72, 5.66, 5.67, 5.67, 5.57 and 5.83, respectively); moreover, the ultimate pH of TFL, RF, SM and BF muscles would be classified as normal (Pearson, 1987). No trend was found in the pH of the beef from the normal pH carcasses, and all normal pH carcasses resulted in a normal pH for each muscle. When DFD and normal muscles were compared, DFD muscles, excluding the PM, TFL and RF, still possessed a significantly greater pH. The results indicate that some muscles in DC carcasses may be misclassified and are receiving unwarranted monetary deductions.

Although many economic assessments of beef carcasses are based on the observations of the traits of the LD muscle, it may not represent the colour grade of other muscles in a carcass. Wulf et al. (2002) determined that the LD, PM, GM, TFL, RF, SM, BF and ST resulted in a variety of instrumental colour scores even though they were all from the same carcass. Additionally, when all eight muscles from DC and normal carcasses were compared, no differences in instrumental colour scores were found in the PM, RF, and SM. Again, results from this study indicate that some muscles in DC beef carcasses could be improperly classified based on the colour of DFD LD, and these muscles could be receiving unwarranted monetary deductions.

Currently, in the U.S. carcasses are classified as DC based on an appraisal of the LD muscle (USDA, 2016). Monetary deductions due to appearance (USDA, 2016) and palatability issues (Bouton et al., 1973; Purchas, 1990; Jeremiah et al., 1991; Purchas and Aungsupakorn, 1993; Wulf et al., 2002; Holdstock et al., 2014) are necessary for the limited performance of the LD muscle in DFD beef. However, high pH and dark colour of the LD is not indicative of the same issues in all other muscles (Wulf et al., 2002).

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5.3 Appendix 3 – Teys Australia Operational Leadership Course - US study tour

Date	Details
Sunday 7th January	Fly to LBB
Monday 8th January	Live Animal Evaluation with ultrasound (AM)
	Burnett Centre Tour (AM) (http://www.depts.ttu.edu/afs/burnett_center/)
	US Grading demonstration (PM)
	US Fabrication demo (PM)
Tuesday 9th January	Beef Processing Plant tour (Cargill Friona) - all day (https://www.cargill.com/meat-poultry)
Wednesday 10th January	Food Safety Module - Mindy Brashears (AM)
	Texas BBQ Boot camp - Nick Hardcastle, John Reeves, David Hull
Thursday 11th January	Texas BBQ Boot camp - Nick Hardcastle, John Reeves, David Hull
	Processing Module - Packaging, Curing, intro Cookery - Chance Brooks & Jearrad Legako (PM)
Friday 12th January	Feedlot tour - Catcus Feeders, Hale Center (AM) (http://www.cactusfeeders.com/)
	Merrick Pet Care (Hereford) (PM) (https://www.merrickpetcare.com/our-story)
Saturday 13th January	Bayer Museum of Agriculture
	TTU Men's Basketball
Sunday 14th January	National Ranching Heritage Center
	Llano Estacado Winery Tour
Monday 15th January	*Drive to Wichita (7.5 hr)*
	National Cowboy & Western Heritage Museum
	NBA game - Thunder vs Kings; Oklahoma City
Tuesday 16th January	Cargill HQ/R&D (https://www.cargill.com/about/research/wichita-innovation-center)
Wednesday 17th January	*drive to DFW*
	Central Market, other supermarkets for meat retailing
Thursday 18th January	DFW industry tour - value-add focus
	Freedman (Dallas) - specialty steak cutting/grinding
	Standard (Fort Worth) - steak cutting, poultry portioning/marination
	Cargill GB (Fort Worth) - grinding facility
	*Dallas sporting event (TBC)
Friday 19th January	Five Star Custom Foods (Cargill) - meat crumbles/oven-cooked, diced, shredded meat/kettle-cooked products
	Supermarkets (Fort Worth)
Saturday 20th January	Fly DFW to AUS

5.4 Appendix 4 – Fulbright Scholarship Media Release

Fulbright Scholar to conduct research at Charles Sturt in Wagga Wagga

3 JUNE 2020

A RUN Fulbright Scholar Award recipient will conduct research at Charles Sturt in Wagga Wagga in 2021.

- **RUN and Australian-American Fulbright Commission brings American scholar to Charles Sturt in Wagga Wagga**
- **RUN is a network of seven universities, including Charles Sturt, in regional Australia**
- **Professor Courtney Meyers from Texas Tech University will conduct research in Wagga Wagga in 2021**

A Fulbright Scholar from the United States of America will conduct research at Charles Sturt University in Wagga Wagga in 2021 that will benefit rural and regional communities.

The Regional Universities Network (RUN) and the Australian-American Fulbright Commission have partnered to offer scholarships to American academics to conduct research in regional Australia.

Charles Sturt is part of RUN, a network of seven universities in rural Australia with a shared commitment to transforming their regions.

The Fulbright Program was established in 1946 with the purpose of increasing binational research collaboration and cultural understanding. More than 370,000 students, academics and professionals have participated in the program in more than 160 countries.

One of the first recipients of the prestigious RUN Fulbright Scholar Award, Professor Courtney Meyers from Texas Tech University, will be based at Charles Sturt in Wagga Wagga in 2021.

In her application for the award, Professor Meyers said her research has two lines of inquiry.

The first is on message development about agricultural science topics and message effects on information processing, formation of attitude, and changes of behaviour.

The second is on the scholarship of teaching and learning, specifically in the areas of service learning, critical thinking, and case study development.

Professor Meyers will explore media representations of agriculture and natural resource issues, create three teaching case studies about the role of communication in agricultural issues, and evaluate the curriculum needs for agricultural communications as an academic discipline.

Charles Sturt's Deputy Vice-Chancellor (Research and Engagement) Professor Heather Cavanagh said it was a privilege to host Professor Meyers. "It's an honour to add to the pool of talented researchers and interesting projects that are already being conducted on our campuses," Professor Cavanagh said.

"Charles Sturt University benefits from researchers coming to our campuses to further their work.

"Not only is it a chance for staff and students to learn different ways of teaching and techniques, but it is a way of learning about other cultures and sharing our beautiful regions and facilities with international guests.

"We look forward to hosting Professor Meyers when she commences her RUN Fulbright Scholar Award."

Source: https://news.csu.edu.au/latest-news/fulbright-scholar-to-conduct-research-at-charles-sturt-in-wagga-wagga