final report

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Accelerated Adoption of New Developments in CPMS Meat Electronics for Beef and Lamb (Commercialisation)

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Executive summary

MLA is aware of numerous medium to low volume processors wanting to install CPMS technologies, however are unable to adopt the technology due to high prohibitive cost based on volume to show a return on investment. The current project proposes to:

i) reduce the overall cost of CPMS installations thereby making it more viable for adoption by medium to low volume cattle and sheep processors;
ii) provide compatibility with future electrical certification requirements.

Pilot trials have demonstrated the CPMS successfully. This project proposes to facilitate adoption and provide mechanical support of new developments in electrical compliance components to achieve a less expensive unit, suitable for sites with limited budgets for installations such as this. In addition, the project will investigate the feasibility of the commercialiser designing and providing a DIY kit with guidelines to assemble electrodes and other mechanical components in house. With both options a reduction in electronics and installation is expected resulting in units with a reduced price tag. This has significant potential to increase the uptake and adoption by the medium to low volume processors, where currently no viable option is available. To ensure the success of this lower cost approach, backup support to ensure compliance and effectiveness of systems after installation in house will be required by Argus Realcold.

The project will facilitate the funding to support one part-time technician (ie approximately 60%) over the next 2 years as further expected developments in meat electronics are delivered as part of the next phase of the adoption strategy.

There will be no requirement for a final report.

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Background

Significant adoption of the CPMS meat electronics technologies by large volume beef and sheep meat processors has been achieved through on-site support by the commercialiser, Realcold Milmech, for individual installations. The commercial uptake of the new electrical stimulation equipment for sheep plants has now reached 75% of total sheep process capacity and 70% of total beef process capacity in the top 56 largest meat processors.

Uptake of CMPS with many medium to low volume processors, interested to adopt the technology, has been limited due to the overall cost of the mechanical and electrical installation For example for a $75,000 commercial sheep installation, the electronic cost is typically $25,000 and the mechanical cost is $50,000. It is important that the benefits of eating quality improvement contributed by the CPMS technologies flows on to medium and low beef and sheep processors

Of the medium to low volume users, a large interest has been exhibited by 30-40 of these processors wanting to go it alone on cheaper alternatives. This will be harmful for the industry in the long run due to lack of managed installations and ongoing support and lack of compatibility with future technical developments.

It is important that this industry need is acknowledge and overall reduced installations costs are investigated. The cost of installation may be reduced by

i) a redesign to make the electronics cheaper,
ii) by producing do-it-yourself kits with guidelines and remote support during and after installation.

A process needs to be put in place to develop cheaper equipment which will be compliant with future electrical certification requirements.

In addition to the costs components of CPMS electronics, a future problem will emerge with lack of the electrical compliance. Current CMPS technologies have not been designed to meet the Australian electrical compliance certification because it is not a mass produced item. In the future, it will be a requirement that all equipment of this type will need to have electrical certification.

There are cheap non-CPMS units available with no mechanical support. The issue is that processors installing these cheap unsafe and less effective units often contact Realcold after installation seeking assistance (for no cost) for modifying the cheaper system.

Project Outline

The following are the milestones:

Milestones and Budget

Milestones
1. Technical officers to: i) facilitate re-design of new CPMS electronics with manufacturer (to be appointed) and develop cost effective mechanical options for installation; and ii) develop documentation for safe operating and maintenance of meat electronics equipment New CPMS costs meets key processors expectations and documentation for safe operating of CPMS new technologies agreed by MLA & manufacturer of CPMS. **GO / NO GO DECISION**
2. Technical Officers to facilitate adoption of new CPMS installations (First Quarter): Technical Officers to: • present the CPMS meat electronics including new developments and their benefits to processing plants; • develop proposal for electrical and mechanical installation; • assist remotely with commissioning by adapting existing equipment or new installation; & • remotely facilitate plant QA staff to conduct initial pH decline validation testing.
3. Technical Officers to facilitate adoption of new CPMS installations (Second Quarter): Technical Officers to: • present the CPMS meat electronics including new developments and their benefits to processing plants; • develop proposal for electrical and mechanical installation; • assist remotely with commissioning by adapting existing equipment or new installation; & • remotely facilitate plant QA staff to conduct initial pH decline validation testing
4. Technical Officers to facilitate adoption of new CPMS installations (Third Quarter): Technical Officers to: • present the CPMS meat electronics including new developments and their benefits to processing plants; • develop proposal for electrical and mechanical installation; • assist remotely with commissioning by adapting existing equipment or new installation; & • remotely facilitate plant QA staff to conduct initial pH decline validation testing
5. Technical Officers to facilitate adoption of new CPMS installations (Fourth Quarter): Technical Officers to: • present the CPMS meat electronics including new developments and their benefits to processing plants; • develop proposal for electrical and mechanical installation; • assist remotely with commissioning by adapting existing equipment or new installation; & • remotely facilitate plant QA staff to conduct initial pH decline validation testing

Project Objectives

The objectives of the project are:

1) Facilitate adoption of new developments for CPMS technologies through on-plant R&D to adapt technologies to the varying plant configurations;
2) Develop documentation to support ongoing adoption for any new CPMS installation including new Generation Two technologies.

Experimental, Results & Discussion

The current project proposes to

i) reduce the overall cost of CPMS installations thereby making it more viable for adoption by medium to low volume cattle and sheep processors
ii) provide compatibility with future electrical certification requirements.

Pilot trials have demonstrated the CPMS successfully. This project proposes to develop a redesign with new electrical compliance components to achieve a less expensive unit, suitable for sites with limited budgets for installations such as this. In addition, the project will investigate the feasibility of the commercialiser designing and providing a DIY kit with guidelines to assemble electrodes and other mechanical components in house. With both options a reduction in electronics and installation is expected resulting in units with a reduced price tag. This has significant potential to increase the uptake and adoption by the medium to low volume processors, where currently no viable option is available. To ensure the success of this lower cost approach, backup support to ensure compliance and effectiveness of systems after installation in house will be required by Realcold Milmech. This aftersales support

The project will facilitate the funding to support one part-time technician (ie approximately 60%) over the next 2 years as further expected developments in meat electronics are delivered as part of the next phase of the adoption strategy.

At the completion of the Project, Realcold will have completed the following to MLA's satisfaction:

- Develop an installation kit and supporting documentation to promote ongoing adoption of new electrically compliant CPMS installations.
- The outcomes of the project for accelerated adoption of new developments in CPMS meat electronics will be measured by the degree of uptake over a 2 year period to achieve 50% adoption of latest developments in electrically compliant CPMS technology in key 50 medium or low beef and sheep meat processors.
- All new installations will be supported by documentation for safe operating and maintenance of meat electronics equipment.
- There will be no requirement for a final report

Outcomes

The outcomes of the project for accelerated adoption of new developments in CPMS meat electronics will be measured by the degree of uptake over a 12 month period to achieve 25% adoption of latest developments in electrically compliant CPMS technology in key 50 high, medium or low beef and sheep meat processors..

New developments in existing meat electronics technology developed on previous industry funded research, including high frequency immobilisation, bleeding, low voltage and mid-voltage

stimulation and generation 2 ALVS will be presented to the key processors contributing to the majority of the processing capacity for beef and sheep meat, and individual supply chain needs will be determined on a one on one basis.

All new installations will be supported by documentation for safe operating and maintenance of meat electronics equipment.

Conclusion

The current project proposes to

iii) reduce the overall cost of CPMS installations thereby making it more viable for adoption by medium to low volume cattle and sheep processors

iv) provide compatibility with future electrical certification requirements.

Pilot trials have demonstrated the CPMS successfully. This project proposes to develop a redesign with new electrical compliance components to achieve a less expensive unit, suitable for sites with limited budgets for installations such as this. In addition, the project will investigate the feasibility of the commercialiser designing and providing a DIY kit with guidelines to assemble electrodes and other mechanical components in house. With both options a reduction in electronics and installation is expected resulting in units with a reduced price tag. This has significant potential to increase the uptake and adoption by the medium to low volume processors, where currently no viable option is available. To ensure the success of this lower cost approach, backup support to ensure compliance and effectiveness of systems after installation in house will be required by Realcold Milmech. This aftersales support

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At the completion of the Project, Realcold will have completed the following:

- Develop an installation kit and supporting documentation to promote ongoing adoption of new electrically compliant CPMS installations.
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- All new installations will be supported by documentation for safe operating and maintenance of meat electronics equipment.

Recommendations / Commercial

Successful commercialisation of this technology will enable process efficiencies and significant expected cost savings for electrical and particularly mechanical installation components of CPMS technology without compromise of effectiveness.

The commercialiser is aware of numerous medium to low volume processors wanting to install CPMS, however are unable to adopt the technology due to high prohibitive cost based on volume to show a return on investment. This project will specifically focus on a significant number of medium to low user, servicing key domestic and export markets which are compromised without ES interventions. Ability to be market competitive without CPMS will become increasingly difficult.

At the completion of the Project, RealCold will have completed the following:

- Develop an installation kit and supporting documentation to promote ongoing adoption of new electrically compliant CPMS installations.
- All new installations will be supported by documentation for safe operating and maintenance of meat electronics equipment.

Appendix A – Commercial facts sheet

CONTROLLED DOSE ELECTRICAL STIMULATION AND IMMOBILISATION OVERVIEW

Realcold Milmech Pty Ltd has the commercialisation rights of controlled dose electrical stimulation and immobilisation, in conjunction with Meat & Livestock Australia and Applied Sorting.

Since the inception of this technology in December 2002, Realcold Milmech has successfully completed installations in both the beef and sheep industries resulting in providing consistent product quality to the end user.

The success of the roll-out of this technology has been enhanced by the endorsement of supermarket chains in that their product quality improvement is measurable.

V&V Walsh are a financial contributor to the original technology trials and have made a decision to install the mid-voltage electrical stimulation technology into their plant situated in Bunbury, Western Australia and commissioning is expected to be completed in February 2005.

PROCESS OVERVIEW

Ageing and tenderness of meat:

Muscles derive their energy from glycogen, which during exercise is broken down into energy and $C0_2$. In living muscles the pH remains just above 7.0, but can vary between 7.0 - 6.4 during exercise.

After death, the breakdown in glycogen leads to lactic acid because of the absence of oxygen. With blood flow having ceased the lactic acid cannot be removed. Thus the lactic acid gradually accumulates, and the muscle becomes more acidic with a lower pH.

Without any intervention either:

An ultimate pH = 5.5 is reached at which point the cell becomes too acidic for cellular enzymes to continue functioning and the residual glycogen remains in the muscles.

Or, all available glycogen in the cell is used up before the pH has fallen to 5.5. Without the fuel the cell ceases to function.

At these situations, the muscles are still and the animal is in rigor.

The MSA tenderness criteria determine that the glycogen decline/lactic acid formation needs to lower the pH to 6.0 with the muscle temperature between 35ºC and 12ºC, followed by standard ageing. This means that the time and temperature needs to be controlled to ensure that a pH = 6.0 is achieved within this "window of opportunity".

Outside of this "window of opportunity" two conditions can apply:

1. Animal's muscles pH reaches 6.0 at temperatures above 35ºC and "heat shortening" occurs.
2. Animals' muscles pH does not reach 6.0 before the muscle temperature has fallen below 12ºC and "cold shortening" occurs.

Hence there is a need to intervene and control the onset of rigor so that:

- Tender meat is produced without having to construct extensive facilities to allow the meat to age rapidly.
- Cold shortening/heat shortening and other problems are avoided.

The standard intervention system has been the application of electrical stimulation, post slaughter, as an electrical current applied to the carcass.

This application of electric current mimics the natural contract – relax signals in living muscles and this accelerates the breakdown of glycogen and accelerates natural ageing enzymes and the onset of rigor.

This intervention is important for:

the chilled meat trade to provide a consistent and correct level of tenderness for local trade. For export trade, the natural ageing rate is very slow at 0º. Hence, during transport it cannot be relied on to produce consistent and correct tenderness particularly if the initial processing time/temperature regime was not correct.

For the frozen meat trade, the natural ageing process is halted when the meat is frozen. Furthermore, if the meat is rapidly chilled and cold shortened this can interfere with the ageing enzymes. Thus the meat will be tough on thawing unless it has been correctly stimulated prior to freezing.

In an overall situation it has been possible to achieve accelerated ageing within normal processing sequence using electrical stimulation. However it has not been possible to guarantee that each individual animal has been correctly stimulated to achieve the optimum tenderness.

This is because the existing systems:

- Do not control the dosage of electricity each carcass receives.
- Do not have the facility for varying and adjusting the waveform.
- Do not measure the individual animal resistance to be able to control the stimulation.

The MLA systems developed have overcome these problems, with controlled dose technology.

The system controls the dosage each animal receives by:

- Segmenting the system so that each carcass is monitored individually.
- The feed back from monitoring allows the dosage and timing to be adjusted for that carcass.

The waveform is adjustable in such a manner as to allow use of narrow pulse widths, which allows use of higher currents that still remain safe. This allows more energy input to the carcass.

The system measures the carcasses resistance and this measure gives the feedback enabling control of the dosage. This is done by applying small test pulses to each carcass.

There are differing forms of electrical energy inputs available which have differing applications such as mid-voltage stimulation, low-voltage stimulation, high frequency immobilisation, low

frequency immobilisation and electronic back stiffening - all having an effect on product quality.

With electrical stimulation the rate of pH fall can now be controlled with the rate being affected by:

- How long after slaughter the stimulation is applied.
- The magnitude of the applied current and duration of application.
- The waveform of the applied current.
- Other electrical inputs to each animal, (eg. "Stimulation" is the total effect of all electrical inputs – not just the stimulation system alone).

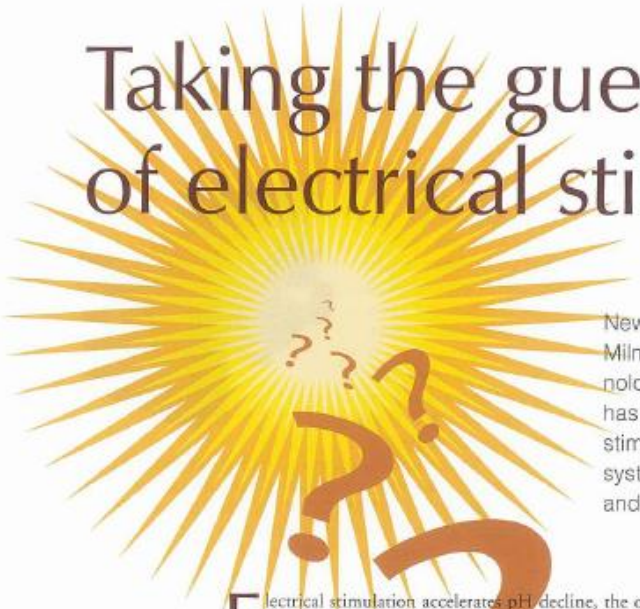
High frequency immobilisation:

This system utilises a high frequency waveform, which activates the nervous system and renders the animal in a relaxed, limp state. The advantage of this system is that there is no effect on ecchymosis or the tearing of the muscle structure, (as caused by the existing immobilisers in use today), with no adverse effect on the rate of pH decline, (major cause effecting meat quality), which has the added advantage when processing grain fed animals.

Appendix B – Commercial publication

processing

Taking the guesswork out of electrical stimulation



New technology jointly developed by Realcold Milmech in conjunction with Applied Sorting Technologies and Meat and Livestock Australia (MLA) has taken the guesswork out of applying electrical stimulation to cattle and sheep carcasses. The system is already operating in a number of sheep and beef plants throughout Australia.

Electrical stimulation accelerates pH decline, the onset of rigor mortis and the natural ageing process. This allows meat to reach an acceptable eating quality in a significantly shorter period of time and can alleviate problems caused by the faster chilling of carcasses. The challenge for processors is to match the level of electrical stimulation (ES) to the rate of chilling and the time the meat is scheduled to reach the consumer.

Muscles derive their energy from glycogen, which during exercise is broken down as a fuel producing lactic acid. In living muscles the pH remains just above 7.0 but can vary between 7 and 6.4 during exercise.

After death, the breakdown in glycogen to lactic acid continues, but with blood flow having ceased the lactic acid cannot be removed. Thus the lactic acid gradually accumulates and the muscles become more acidic with a lower pH.

Without any intervention either:

- An ultimate pH of 5.5 is reached — at which point the cell becomes too acidic for the cellular enzymes to continue functioning and the residual glycogen remains in the muscles; or
- All available glycogen in the cell is used up before the pH has fallen to 5.5. Without the fuel the cell ceases to function.

At these situations, the muscles are still and the animal is in rigor.

The MSA tenderness criteria determine that the glycogen decline/lactic acid formation needs to lower the pH to 6.0 with the muscle temperature between 35°C and 12°C, followed by standard ageing. This means that the time and temperature needs be controlled to ensure that a pH of 6.0 is achieved within this 'window of opportunity'.

For any given chilling rate, too much ES results in too rapid a pH decline. If pH 6 is achieved at a temperature above 350°C 'heat shortening' occurs and the natural ageing enzymes are destroyed. With inadequate ES where the carcass does not reach pH 6 before the temperature falls below 120°C, 'cold shortening' occurs and ageing of the meat is delayed.

The standard intervention system has been the application of electrical stimulation, post slaughter, as an electrical current applied to the carcass. This application of electric current mimics the natural 'contract/relax' signals in living muscles and this accelerates the breakdown of glycogen and serves to hasten the onset of rigor.

This intervention is important for:

- The chilled meat trade to provide a consistent and correct level of tenderness for local trade. For export trade, the natural ageing rate is very slow at 0°. Hence again during transport it cannot be relied on to produce consistent and correct tenderness, particularly if the initial processing time/temperature regime was not correct.
- For the frozen meat trade, the natural ageing process is halted when the meat is frozen. Further, if the meat is rapidly chilled and cold shortened this can interfere with the ageing enzymes. Thus the meat will be tough on thawing unless it has been correctly stimulated prior to freezing.

The effective level of ES is a function of the carcass type and the total electrical load applied to the carcass during the slaughter process. Electrical inputs can come from immobilisers, bleeders, back stiffeners and stimulators with the effect of each depending on the voltage, its duration and the waveform.

The new system accounts for the total electric load (including immobilisation and back stiffeners etc) and can be adjusted on the basis of the ideal electrical inputs for particular carcass types. Its main feature is its use of test pulses to determine the resistance of a carcass and the use of this information to apply the same, precise electrical dose control to all carcasses. The optimal pH decline for any given chilling rate can then be obtained to maximise the benefits of rapid ageing.

Realcold Milmech Pty Ltd
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