Highlights from the CRC Meat Science Program

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- The challenge for the CRC ten years ago was to show the industry how to best meet specifications of high quality domestic and export markets. The CRC's immense progeny test and related experiments enable us to understand how to use genetics, growth paths, nutrition, health and behavioural effects to do this successfully.
- When Meat Standards Australia(MSA) began its ambitious program to guarantee eating quality to consumers, it needed more than a blueprint to meet market specifications. It needed to know a great deal about the factors affecting meat quality – what factors, how big their effect, which cuts of beef they affected. Scientists from the CRC joined with MSA to meet this challenge. Together they have given us a deeper understanding of meat quality, enabling MSA to develop the world's most innovative consumer beef grading system.
- The scientific program has received international recognition, and its outcomes have had unprecedented levels of adoption in the Australian beef industry.

CRC Meat Science Outcomes

There are a number of "critical control points" from "conception to consumption" which determine palatability to the consumer. CRC has quantified the direct effects of factors affecting palatability including:

- Genetics (Bos indicus content, gene markers for marbling and tenderness),
- Nutrition (grass vs grain, growth path effects),
- Pre-slaughter effects (saleyards, growth promotants, mixing, stress)
- Electrical stimulation and chilling of carcase,
- Hanging methods eg Tenderstretch vs Achilles,
- Ageing
- Cooking method

These have been incorporated into the MSA grading model - computer software which for every carcase graded, adjusts for all these factors to predict the eating quality of 36 cuts of beef.

Understanding the relative importance of these factors has direct benefits to:

- MSA suppliers, improving meat quality and improving compliance to MSA specifications
- Market alliances and branded products
- Producers who are proud of their product and interested in what they are producing
- This new knowledge allows us to account for half the variation in eating quality. About a quarter is measurement error, and the remaining quarter may/will be accounted for by new traits not yet quantified.

The CRC Meat Science Program

The CRC Meat Science program was originally set up as a "service program" to measure the meat quality and carcase yield effects resulting from the various experiments covering genetics, growth paths and behaviour. The Meat Standards Australia beef grading program emerged later, and together with the CRC, stimulated enormous development in the understanding of meat quality

Early lessons on meat quality

When the CRC began slaughtering its experimental animals in the mid 1990's, researchers insisted on using the best known procedures for the pre-slaughter handling of cattle, to ensure that factors like stress, poor livestock handling or processing did not affect meat quality and interfere with their other studies.

Their 'best practice' procedures were extremely successful in demonstrating in the first few thousand cattle slaughtered, that there was hardly any incidence of harmful stress, and the meat was consistently more tender than the equivalent commercially produced product. This in itself demonstrated that the industry could lift its meat quality game by getting the basics right.

Well before MSA existed, the CRC protocol included these basic, well-known good management practices. Most of them have been adopted as MSA requirements:

- cattle that are familiar with yarding and handling
- quiet and firm handling - no dogs or electric prodders
- all necessary live cattle handling, measurement and drafting completed a few days before slaughter
- yarding and trucking within 2 hours
- use of professional livestock carriers with a proven record

- a short trip to the abattoir (2-3 hrs max) the day before slaughter
- keeping the mob together and not boxed with other cattle before slaughter
- effective electrical stimulation of the carcase after slaughter
- careful control of carcase chilling conditions.

Connection to Meat Standards Australia (MSA)

As the CRC worked towards its goals in the mid 1990's, the Meat Research Corporation (now MLA) was designing its ambitious "tenderness guarantee" scheme for consumers.

When MSA set out to give consumers a guarantee of eating quality, it needed answers to questions such as:

- What do consumers understand by eating quality?
- What are the factors which affect eating quality?
- How much does each factor affect it?
- Are all cuts equally affected?

MSA consumer testing showed that to guarantee eating quality, we needed to know a lot more about how our production systems affect meat quality. The CRC helped provide the knowledge and develop the basis of today's MSA eating quality prediction system. MSA has become an implementation program for existing technology and for new outcomes from the CRC.

The huge MSA consumer program has been used to evaluate CRC cattle experiments, validate scientific discoveries, pinpoint areas of poor knowledge, identify best practices in production and benchmark progress. Australia now has the knowledge needed to produce the consistent quality beef demanded by today's export and domestic customers.

What determines meat quality?

There are many factors which combine to produce the meat quality eating experience. Some of these come from the animal itself (breed, age, nutrition etc), some from the way it is handled (pre-slaughter stress) and some after slaughter (chilling and ageing, and of course cooking). The combined resources of CRC science and MSA consumer testing have shown:

- Different cuts of beef have different levels of eating quality
- Each cut has an optimum cooking method
- Tenderstretch hanging substantially improves the eating quality of the main grilling cuts, and reduces the need for ageing
- Marbling improves eating quality of grilling and roasting cuts
- Correct management of chilling after slaughter is vital – chilling too fast or too slow can toughen meat and reduce its eating quality
- Rate of chilling must be coordinated with electrical stimulation to avoid cold shortening or heat toughening
- Better fed and fatter carcases need less electrical stimulation
- Bos indicus content produces tougher beef, mainly in the grilling cuts
- Bos indicus carcases are more responsive to electrical stimulation and ageing
- Pre-slaughter stress causes tougher beef, even when its colour and pH is normal
- Hormonal growth promotants cause significant toughening, mainly in the high quality grilling cuts
- Mixing cattle with strangers one week before slaughter results in tougher meat
- Normal saleyard handling results in tougher meat than direct to abattoir consignment
- Other factors being equal, heifers have slightly lower eating quality than steers
- Milk fed vealers have better eating quality than their weaned counterparts
- Ageing after slaughter improves tenderness, particularly grilling and roasting cuts. The improvement is greater for achilles hung carcases and for Bos indicus genotypes
- Younger animals produce more tender meat, but faster growth to any particular age adds only slightly to tenderness

Not only have these factors been identified as significant, but in most cases they have been quantified. Their importance has been recognised by the industry since they have been promoted as requirements for MSA grading, or have become inputs which determine the grade of cuts in the MSA grading prediction model.

Dark cutting beef

Dark cutting beef (also called dark, firm and dry, or DFD) is a serious cause of downgrading of table beef in the industry. It occurs in beef when the energy store in muscle (glycogen) is depleted at slaughter and there is insufficient left to convert to lactic acid and produce normal pH (acidity) in meat of around 5.5.

MSA Consumer Testing

Cooking method	*Consumers*	*Samples*
Grilling	20,980	146,860
Roasting	7,500	52,500
Slow cook	4,140	28,980
Corning	540	3,780
Stir Fry	10,620	74,340
Thin Slice	1,620	11,340
Yakaniku	360	2,520
Marinade	180	1,260
Mince Patties	720	5,040
Mince Bolognaise	360	2,520
Total	**47,020**	**329,140**

Figure 1. MSA consumer testing results

1. Pre-slaughter stress and poor nutrition are the main causes of "dark cutting" beef.
2. Pre-slaughter stress can be physical (exhaustion), environmental (extreme heat or cold) or psychological (confinement with strange cattle, humans).
   - Effects of these are cumulative in depleting glycogen
3. Better fed cattle (eg grain-fed) have higher reserves of glycogen, and are less susceptible to dark cutting
4. Electrolyte supplements in lairage are unlikely to make up for poor nutrition and stress
   - They require several days to produce results
   - Animals take several days to settle in a new environment anyway
   - Feeding in lairage is not usually practical
5. The industry is adopting better pre-slaughter management to reduce dark cutting beef, e.g.
   - MSA requirements for direct consignment to slaughter with no mixing etc.
   - Direct farm to abattoir purchase by processors
   - Focus on transport and yard design
   - New saleyard pathways for MSA
   - Protocols for branded products and marketing alliances
   - Minimising use of electric prodders at abattoirs

Further information

- The CRC's web site www.beef.crc.org.au is being upgraded to provide a large range of reports and information.
- The CRC has published a 240-page book "Producing Quality Beef from Australian Cattle Herds" for the practical people of the beef industry. It is available for $25 posted from the Beef CRC.
- The CRC is represented at seminars and field days all over Australia. The most comprehensive is the Armidale Feeder Steer School, held by the CRC in conjunction with NSW Agriculture and the Angus Society over three days every February. It is an excellent mix of practical live assessment sessions (feeder, slaughter and breeding cattle) along with talks from leading scientist, extension officers and industry speakers.
- For information on BREEDPLAN contact http://breedplan.une.edu.au your breed society or ring ABRI on (02) 6773 3555.
- For information on MSA contact www.msagrading.com or phone (07) 3620 5200.
- Contact the Beef CRC at University of New England, Armidale NSW 2351, phone (02) 6773 3501, fax (02) 6773 3500, e-mail beefcrc@metz.une.edu.au

The Armidale Feeder Steer School - held in February each year.