final report

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Sensory Testing, Scoring & Analysis of Commercial Lamb & Sheep Meat Cuts

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CONTENTS

1 INTRODUCTION

1.1 SCOPE & REFERENCES

1.1.1 PROTOCOLS

A companion document is available in association with this report. It is titled "Protocols for the Preparation, Assembly, Cooking, Serving, Sensory Testing and Scoring of Commercial Meat Cuts from Lamb, Yearling and Mutton". By Gee, Ross, Pethick, Hopkins, Knight & Slack-Smith.

This work totally defines all the procedures used in this trial.

1.1.2 PAPER

A paper titled "Evaluating Sheep Meat Eating Quality in Australia" by Pethick, Pleasants, Gee, Hopkins and Ross defines the statistical analysis used to evaluate the results of the trial.

These calculations were used to derive the final table set out in results.

1.2 BACKGROUND TO THE TRIAL

1.2.1 PREVIOUS CONSUMER TESTING FOR SMEQ

In general terms, the situation regarding consumer testing of sheep meat for eating quality has remained unchanged for several years.

In essence, the system has been modelled on that used in the testing of Beef meats with consumers.

1.2.2 STANDARD GRILL TESTING FOR SMEQ

In short, for grills this meant that we were preparing a steak to look and cook like a steak section of muscle, grilling it in a clamshell cooker, cutting it in half and serving each half to one consumer.

The dimensions of the material were exactly 15mm thick in the uncooked state by approximately 50mm to 60mm diameter, depending on the physical availability of the subject material.

The methodology was to obtain the testing material by normal killing and boning processes, age, clean and glue together in order to create a “log” of muscle ready to be frozen.

When selected for testing, each log was brought up from minus twenty-five degrees Celsius to approximately minus four degrees Celsius using a microwave oven controlled by the weight of the sample and then sliced in a “Ham Slicer” to precisely 15mm thickness.

See PICK for further detail.

1.2.3 STANDARD ROAST TESTING FOR SMEQ

In the case of roasts, a variety of slice thicknesses were tested in the past, but no serious roast testing has been undertaken in the past two years and when last tested, the system was to section out muscles from a cooked, boneless leg cut, store in Bain Marie steamer pans and serve half of a 10mm slice to each pair of consumers.

The most recent testing involved the use of boneless “Ezicarve” legs which, after cooking, had specified muscles dissected out of the roasted leg to be placed into Steamer Pans with special holders and then served to consumers.

2 NEW APPROACH FOR SMEQ TESTS

2.1 CHANGES TO BASICS

2.1.1 NUMBERS OF CONSUMERS TESTED

We now have all cooking methodologies sharing common numbers of consumers within any minimum trial. Where in the past, Grills were for 180 consumers, all other forms of cooking were for 60 consumers. Now all trials for all cooking methods are based on 60 consumers only.

Late in 2003, Alan Gee and Rod Polkinghorne were in Northern Ireland teaching the Scientists at Queens University how to conduct the MLA style of consumer testing. As part of the planning for this exercise, we deduced that we needed a far more automated and easy to use system than the ones we had been employing for the last six years for the MLA work in Australia.

Part of the solution was to simplify some of the methodologies without weakening them and the other part was to automate a great deal of the more complex aspects of testing using systems operated by Visual Basic programming code.

The major change in thinking on methodologies was to bring Grill testing in line with all the other cooking systems and bring the minimum test back within sixty consumers, rather than the one hundred and eighty consumers used for grill testing in the past.

This has no major effect other than reducing some of the spread of testing, but not any degree of significance.

This is the system that has been used for all recent Beef and SMEQ consumer tests.

2.2 WHAT DRIVES THE MAIN CHANGES

2.2.1 THE NEED TO TEST SALEABLE/COMMERCIAL CUTS

Unlike the Beef testing where, although we were also testing single muscles in beef, they were large enough to also constitute valid commercial cuts.

In the Sheep meat testing, we have long struggled with getting enough material in a single taste test sample to effectively grill each one as individual pieces.
In the past this has only been overcome by gluing various muscles and muscle combinations together with protein glue.

Obviously, there would come a time when we would need to show how Real World cuts behaved in terms of eating quality – hence the need for this trial.

2.2.2 COMMERCIAL CUTS & THE OLD SMEQ SYSTEM

For easy reference, Commercial/Saleable Sheep, Hogget, or Lamb cuts are referred to as CC in the texts from here on and the most recent system used by SMEQ will be referred to as Old SMEQ

3 TRIAL OBJECTIVES

3.1 PRINCIPAL AIMS

3.1.1 CC HAD TO BE COMPARABLE TO OLD SMEQ

To allow the testing of saleable lamb and sheep meat products in a manner so close to that used for SMEQ in the past that results between the two processes may be compared.

This meant that the most salient of the methodologies currently in use should be targeted to remain constant from the old to the new.

3.1.2 REFERENCES AND CONTINUITY

The SMEQ pathways team has always stated that the various trials conducted should always be able to be referenced to each other.

On this basis, we needed to ensure that some of the material used in the past, such as the glued backstrap material, (i.e. the most commonly tested cut), should also be present and part of the new system, so that genuine relativities and comparisons between the systems could be validated.

3.1.3 COSTS AND EXPENDITURE

Knowing that the SMEQ operations, following some time after the Beef work will never be offered the same budgets for testing, one of the major aims in the CC trial was that the cost of setting up the new system should be minimalised as much as possible.

3.2 WHAT STAYED – WHAT WENT

3.2.1 THE "MUST HAVES" FROM OLD SMEQ

That the cooking "state of doneness" remain at "Medium".

That the surface appearance of the cooked product be consistent from sample to sample, irrespective of the samples' provenance.

That we maintained testing ten consumers to each "Taste Test Sample"

That whenever possible, consumers were still served in their "Tandem Pairs".

That no other part of any "Sample" was ever eaten in the same "Group" of consumers.

That each consumer be given a "Sighting" or "Link" sample as his/her first sample.

That each consumer taste test a further six critical samples after that of the link.

That the deconstruction of ordinal precedence be continued by the use of a "Latin Square".

That the mechanics and general physical aspects of the Old SMEQ trials be targeted as much as possible in order to control costs.

That the capital equipment already owned by MLA be used with as little change as possible, again to limit costs.

That the current software known within MLA as the "Blue" system be used with as little modification as possible.

3.2.2 WHAT WE LOST FROM OLD SMEQ GRILLS

The fact that we no longer had our "paired consumers" getting half each of the same piece of meat. (This is not a particularly critical point. See Analysis.)

However, to a very large extent this was mitigated by the fact that pairs will now get the next most adjacent chop or slice from a sample, whenever it is possible to do so.

Serving patterns also changed. In the past, pairs one + two were fed two halves of the same piece of meat just cooked.

As each second slice/chop/steak of material will be cooked some 03:30 apart, pairs will have to be served separately.

We also lose the ripple finish marking on the upper surface of the cooked product and this was unavoidable due to fact that all meat shrinks somewhat under cooking and bone does not.

This meant that the upper plate no longer contributed the significant "Contact Heat" that is so important in caramelisation, but still produces that same degree of coagulation or "doneness" through infra-red in the core of the meat. [See Presentation below]

Another aspect of the old system that changed is the way we assembled a "Pick" or a "Nights Testing" of 60 consumers and then "Posted" it before shipping it to Sydney or wherever for testing.

The "Post" section of the operation was transferred to the actual place of testing and Cosign's oversighting agent or representative actually performed the "Post" stage on site. [See Posting below]

3.2.3 WHAT WE LOST FROM OLD SMEQ ROASTS

Ditto the first item above in Grills such as matched sample pairing.

The biggest change for Roasts though was going to a single slice across multiple muscles for each consumer.

In addition, we were not able to carve such large slices out of the usual Bain Marie 1/9th Steamer Pans and their special cutting boards and cutting guides.

These of course were originally set up for 10mm thick slices of single muscles. [See Roast Storage below]

Slicing was ultimately performed as soon as the material has been rested from the oven.

3.2.4 THE NEW IMPERATIVES FOR CC GRILLS & ROASTS

That full size chops, cutlets and steaks were used as testing elements for grills – one per consumer.

That a realistic 4mm thick slice of roast was used for each consumer from a wide variety of real world roasts.

That this work in both grills and roasts accepted that this will involve multi-muscle sensory testing.

3.2.5 THE WEIGHT/VOLUME ISSUE

The most profound difference between the Old SMEQ and CC was in the sheer volume of material to be acquired, held, prepared and served.

In the case of the grills, the difference in the weight of cuts to be initially prepared was well over double the norm.

To fabricate and store – at least treble – and with the additional penalty of dealing with "bone in" cuts of meat.

To freeze – at least treble. To cook – double. To serve and clean up – at least double.

With .the Roasts, the situation on handling volume/weight is again highly significant with the roasts being typically between two and three times the size of our normal roast block.

In addition, we had to handle rack roasts inferring a completely different process for storing the cooked material and serving it.

This increase in the volume of material has the greatest significance for the cooking of grills.

4 FIXES FOR CHANGES

4.1 MAKING UP FOR WHAT IS LOST

4.1.1 PAIRING

As mentioned above, the issue of pairing where all consumers are paired to their adjacent number – 1+2, 3+4, etc – is very useful in testing how consumers range their answers.

Whilst not a vital section of our regular analysis, it is nevertheless a useful reference in the event that results do not meet expectations or where there appears to be some problem in the resultant scores.

To get over this, we had paired consumers eat either matched samples from the opposite side, (the case in many of the cuts), or from the next most adjacent part of any given sample.

4.1.2 PRESENTATION

Also mentioned above is the issue of no longer having a ripple patterned caramelisation on the upper or presentation surface of the cooked samples.

There was simply no way around this and in view of the nature of a chop, with the material always shrinking below the height of the bone, we had to accept this change and deal with it accordingly.

The simplest solution was to turn all the product upside down on presentation so that at least all the material has a caramelised surface giving off high fraction aromas and of an excellent appearance.

That of course made for an additional issue in the operations side and was resolved by having loading and presentation in a mirror image to that of cooking.

In short, laying out the product for loading the same way we want it served, but flipping it over left to right or right to left for cooking. [See Chop Chop Loader]

4.2 THE VOLUME & SHAPE OF MATERIAL

4.2.1 SIZES AND SHAPES

The volume of material that was to be cooked in the new CC system was between double and treble the amount we were used to dealing with in the Old SMEQ system.

The implications of this were pretty dire – either cook on two Silexes or potentially double the testing time from one hour to two.

One of the major issues was the size and shape of various chops and it proved to be impossible to carry any more than the ten samples we currently cook in any one cycle or "Round".

With twenty various pieces of meat to be cooked in a round of CC material, it was obvious than another approach had to be tried.

We certainly didn't want to double the times of testing as it would add between a third and a half as much again to the costs of each night's testing.

4.2.2 SAVED BY THE BELL?

Luckily, when we operate the Old SMEQ Grills on test, the actual cooking time proves to be less than half of the serving cycle, or "Round Time" of seven minutes.

However, with only three and half minutes to load ten samples, cook them for three minutes, unload them and clean the Silex ready for the next lot of ten, it was obvious that we were going to run out of time.

We tried to speed up the cooking time to cadge some more time, but three minutes at 220 degrees C is about it for the correct amount of caramelisation and state of doneness and we were stuck with it.

When we tried to lengthen out the cycle to handle the double load, it blew the total time for twenty consumers from just under one hour to one and a half hours, basically making the testing of 60 consumers in one night an impossibility.

4.2.3 THE RAPID LOADER CONCEPT

The only solution looked to be some method of loading or unloading the samples to the Silex in less than ten seconds.

Physically, this proved impossible if the samples are placed or lifted one piece at a time and even if the cook managed to throw them down as fast as they could, there was the issue of maintaining correct ID, the most salient and important aspect of any trial.

4.2.4 VARIOUS PROTOTYPES

Over a period of six months during which the testing was performed, many different approaches were tried, but only one was successful.

This was the fourth version of the rapid loader and was called the “Chop Chop Loader”

This unit proved to be extremely successful and was used for all Grill work in the Trial.

4.3 FURTHER TECHNICAL INFORMATION

4.3.1 ALL ADDITIONAL DETAILS ON PROCEDURES

All the details on precise methodology and systems can be found in the Commercial Cuts protocols referenced at the beginning of this report.

4.4 STATISTICAL BASIS FOR RESULTS

4.4.1 BACKGROUNDING FOR THE NEXT SECTION

The statistical basis of the Results section in this report can be found in the paper Evaluating Sheep Meat Eating Quality in Australia, Pethick et al.

5 OPERATIONS

5.1 EXTRACTS FROM PAPER

5.1.1 ANIMALS

Three animal groups were purchased for this experiment with 56 per group (total 168 animals). The lambs were second cross (Merino x Border Leicester dam x Poll Dorset sire) of mixed sex (female or male castrate) and all had no erupted permanent incisor teeth; the yearling animals were male castrate Merinos and had either 2 or 4 permanent incisor teeth; the mutton animals were non pregnant Merino ewes and had either 8 permanent incisor teeth or 'broken mouths'. Each group of animals was purchased from a different commercial property and assembled onto a common paddock (near Murray Bridge, South Australia) of dry cereal stubble with access to a barley/lupin grain mix (70:30) from a self feeder. After 3 weeks of common grazing the sheep mustered on Saturday at 7.30am on 26th February, 2005 and placed in yards with access to water but not feed. On the following day at 10.00am the animals were transported to a commercial abattoir arriving in lairage at 11.45am. Slaughter, as one continuous batch, commenced on Monday 28th February at 10.04am. Slaughter involved electrical head stunning followed by exangusation. Each carcase was to have received electrical stimulation post dressing for 25 seconds at 24 minutes post stunning, *but this proved to unreliable on the day and the animals were aged for nine days in lieu*. pH measurements were taken hourly beginning at 1 hour post stunning for 4 hours with ultimate pH recoded at 72 hours (Pethick *et al.,* 2006).

5.1.2 EXPERIMENTAL DESIGN, COMMERCIAL CUTS AND CONSUMER EVALUATION

Carcases were fabricated into 32 cut x cook combinations for each animal class. The experimental design was to prepare 12 commercial grill cuts (i.e. topside, round, 3 x fore quarter chops, chump chops, eye loin, loin noisettes, shortloin chops, tenderloin, cutlet chops with and with cap), 13 commercial roast cuts (topside, oyster cut, round, easy carve back leg, forequarter with and without fat, forequarter boned and rolled, back leg bone in, rump with and without cap, shortloin, rack with and without cap), 5 commercial stir fry cuts (topside, round, silverside, oyster and eye loin strips) and 2 commercial slow wet cook cuts (fore and hind quarter hocks). Each cut x cook combination had 12 replications. After preparation the cuts were vacuum packed, aged for 9 days at 2˚C and then frozen (Gee *et al.*, 2006).

Cut x cook combinations were tested using untrained consumers which were assembled in Sydney venues such as sporting clubs. The general consumer methodology is described by Thompson *et al.,* 2005 with a more detailed description of this experiment by Gee *et al*, 2006. For any given night of testing 60 consumers were used such that 36 different commercial cut x cook combinations could be assessed. Each consumer tested (blind) 6 experimental samples (slices of a commercial cut) after first eating a starter sample such that each commercial cut x cook replication was eaten 10 times by an untrained consumer. In total 1,920 consumers were used in this study. Each consumer rated the meat from 0-100 (0 bad, 100 excellent) for liking of smell, liking of flavour, tenderness, juiciness and overall liking and then gave the meat sample a single rating being one of awful, unsatisfactory, good every day, better than every day or premium.

5.2 BONING AND SAMPLE ACQUISITION

5.2.1 VENUE

All boning and sample operations were conducted in the Butchery lab at Regency TAFE in Adelaide.

A large team of Local butchers were used for the boning work and Cosign supplied a full team for sample handling and administration.

5.2.2 TIMING

All work was completed well within the ageing period and samples were frozen down on the required day in blast freezers located at Port Adelaide.

5.2.3 TRANSPORT

All samples were shipped to Cosign's freezers at Sawtell and set up into the requisite picks and posts for consumer testing.

5.3 SENSORY TESTING

5.3.1 SENSORY SOLUTIONS PTY LTD

As usual, all sensory testing was carried out in Sydney.

Tim slack-Smith co-ordinated all sensory work including training in the new cooking procedures.

Overall, the trial operated without serious error and all samples allotted into the taste tests were cooked and eaten without exception.

6 RESULTS

6.1 FINAL RESULTS FROM PROJECT

6.1.1 FORMAT OF RELEASE

It was decided by MLA that the final industry release of the results of this project was to be performed by MSA, (Meat Standards Australia).

To this end, officers from MSA were involved in the later stages of the analysis work to ensure a cohesive and smooth transition from finalised data into a format suitable for release to industry.

6.1.2 STATISTICAL BASE FOR INDUSTRY RELEASE

Using the final statistical data from the work described in the paper from Pleasants, Pethick, Gee & Hopkins, a spreadsheet was designed specially suited for dissemination to industry.

This spreadsheet and accompanying data set was supplied to Meat Standards Australia as a basis for final dissemination to industry.

The chart shown overleaf shows all cut and cook methods and their results.

6.1.3 CHART

The chart is laid out very simply with all cuts tested arranged vertically and each cooking method in sets of three columns, one column per category, (red - lamb, brown – hogget/yearling, and green - mutton).

The resulting meat qualities as tested are displayed in four measures of consumer satisfaction and commensurate risk:-

SYMBOL	SMEQ	RISK of being UNSATISFACTORY
• 5 Star	Premium	(nil risk)
• 4 Star	Hi Choice	(low risk)
• 3 Star	Lo Choice	(moderate risk)
• 2 Star	Budget	(high risk)

6.1.4 CHART

CUTS AND COOKING METHODS												
CUT	HAM	GRL			RST			SFR			CAS		
Chump Chops	N/A	4	4	3								
Cutlets Cap / Off (Fr. Tr.)	N/A	5	5	2								
Cutlets Cap / On (Fr. Tr.)	N/A	5	5	4								
Leg 'Easy Carve'	4821				4	3	2					
Eye of Shortloin	5150	4	4	3				4	4	4		
Fqtr Chops Outside Half	N/A	4	3	2								
Fqtr Chops Bone Half	N/A	4	4	2								
Fore / Shank	5031										3	2	2
Forequarter Roast	?				4	3	2					
Fqtr Roast (Den)	?				4	3	3					
Hind / Shank	5031										3	3	2
Leg Chump / On	4800				4	4	2					
Noisettes	N/A	4	4	3								
Oyster	5055				3	4	2	4	4	2		
Rack Cap / Off (Fr.Tr.)	4764				5	5	4					
Rack Cap / On (Fr.Tr.)	4756				5	5	4					
Chump	?				4	4	2					
Rump (Den)	5074				4	4	3					
Knuckle	5072	4	4	2	3	3	2	4	4	2		
Shoulder Roast	?				3	3	2					
Short Loin Chops	?	5	4	3								
Shoulder Chops	?	3	3	2								
Silverside	5075							4	4	3		
Shortloin	4880				5	4	4					
Tenderloin	5080	4	5	4								
Topside	5077	2	2	2	2	2	2	3	3	2		

6.1.5 LEGEND

Eating Quality Grade	Risk of Failures	LAMB	HOGGET	MUTTON
Budget	High	2	2	2
Low Choice	Mod	3	3	3
High Choice	Low	4	4	4
Premium	Nil	5	5	5