SILVER FERN™ FARMS

LAMB EATING QUALITY

The commercial application of findings from Silver Fern Farms' consumer and on-farm research into the Eating Quality of lamb

THURSDAY, APRIL 06, 2017

100% MADE OF NEW ZEALAND

LAMB EATING QUALITY RESEARCH COMMERCIALISATION

LAMB EATING QUALITY COMMERCIALISATION PAPER PURPOSE

This paper outlines the commercialisation process Silver Fern Farms has taken for eating quality with particular reference to the eating quality of lamb and the findings of the 2016 Reserve Lamb Pilot. This paper is not presented as an in-depth science review. It is an overview of the collated research findings and business investigations into commercial viability and operational application of the various drivers that lift the consistency of the eating quality experience for our consumers.

DISCOVERING EATING QUALITY TO DRIVE VALUE

In June 2008 PPCS became 'Silver Fern Farms'; a significant step in the journey towards being a brand-led food company promoting quality New Zealand red meat to consumers around the world. The change in name was part of a strategy to move more of its business away from undifferentiated mainstream products towards creating a value added revenue stream that would be more resilient to downturns in the commodity cycle. This strategy is the Plate to Pasture Strategy – where consumers' needs drive business decisions to create additional value for Silver Fern Farms' red meat.

Discovering the drivers of Eating Quality (EQ) in red meat has been a key part of Silver Fern Farms' Plate to Pasture strategy. Silver Fern Farms has been involved in funding research and development into the eating quality of New Zealand lamb since initial work Silver Fern Farms carried out with the University of Bristol in 2010.

The objective of undertaking the considerable research into this area has been to create new consumer value through product differentiation by selecting and marketing beef and lamb that has consistently superior eating quality. Through these EQ product ranges, Silver Fern Farms can target niches with brand storytelling combined with premium pricing, to grow and capture that value for the business and for the farmer partners who supply EQ product. In our view value is created when a commercial customer (i.e. the retailer or restauranteur) pays the processor a higher price for the product. Creating new additional value typically increases the cost of the product and so in our view it is important to have a strong brand attached to a premium price strategy in order to capture the additional margin. This is a long-game where investment and commitment through the value chain is a pre-requisite before brands are developed, commercialised and become rooted in consumers' habits and buying patterns to ensure sustainable returns.

In 2010 our lead involvement in the Farm^{IQ} Primary Growth Partnership (PGP) aimed to establish an integrated supply chain from market through processor, to farm. Over the 7 years of this partnership programme with the Government and Landcorp it has enabled further market development and investigation into consumer eating quality preferences and decision-making processes, innovation in processing technology in plant, and on-farm influencers of eating quality.

In early 2011, through Farm^{IQ}, Silver Fern Farms commissioned AgResearch to work with Massey University and Lincoln University on a 'Meat Quality Expert Review'. This review looked at quality targets that were possible to measure, to influence or control, and were valued by the consumer/retailer/processor. From that comprehensive beginning, we have progressed a wide range of initiatives in plant and in market as we have developed and commercialised our Plate to Pasture market-led strategy. Silver Fern Farms has now invested more than $55m in Farm^{IQ} since 2010. The Government has invested $59m as a co-investor.

Beef Eating Quality System

In 2012, we established an Eating Quality Grading System for beef to underpin restaurant and retail product ranges and create a genuine market premium. The Silver Fern Farms Beef Eating Quality System involved considerable consumer, plant technology and animal research led by our research partners Texas Tech University, the University of Otago and international meat quality experts. This Beef EQ research was funded through Silver Fern Farms, the Farm^{IQ} PGP and the state of Texas. The Silver Fern Farms Premier Selection Reserve Beef range and EQ Master Grade on Silver Fern Farms beef retail packs are now well recognised brands and marks of quality on these value added ranges. These ranges have experienced sustained growth off the back of this consumer acceptance. Approximately 170,000 animals are assessed by our Master Graders each year. The premiums the ranges achieve in market over and above standard cuts are significant and enable Silver Fern Farms to share these in-market gains with suppliers through our Backbone supply contracts for animals that achieve the Beef EQ Master Grade. Over $3.5m was paid in premiums to farmers over the last 12 months – generated from true market added value.

CONSISTENT RESEARCH STRATEGY

The challenge to identify an Eating Quality system for lamb, which as a product does not have the same natural wide-spread variation in quality (due to the younger age of the animals), has been one of our key areas of focus following the success of Beef EQ.

In 2015 preparation commenced for the Reserve Lamb Pilot, the largest consumer taste panel research carried out to date in New Zealand for lamb. It was undertaken by Texas Tech University and the University of Otago and international meat quality experts and followed the same, robust science-based process used to develop Beef EQ.

To determine genuine consumer-led demand for value added offerings, Silver Fern Farms has used a consistent approach:

i. Starting at **'The Plate'** researching and market-testing consumer needs and wants,
ii. Working with key customers in targeted global markets,
iii. Testing and developing new processing technology and methods,
iv. Working with farmer suppliers testing and measuring new on-farm practices using the Farm^{IQ} farm software,
v. Developing new animal improvement genetic tools (such as SNP chips),
vi. And finally, assessing impacts of **'Pasture'** and animal husbandry methods.

SUMMARY OF EATING QUALITY RESEARCH INTO LAMB

Extensive consumer taste panel research with over 3,200 consumers shows consumers believe the eating quality of New Zealand lamb is of a consistently high quality.

Throughout the 8 years of research and development, we have identified a number of factors that contribute to lamb eating quality. Some of these factors have a significant effect and can be commercialised, others have an inconsistent or insignificant effect and are not economic to commercialise. Most factors tested either had no effect on eating quality or had a small, insignificant effect that would not create a differentiated, supportable, product quality claim.

Consumer taste perceptions have been tested against a wide range of factors including: animal age, gender, farm systems (feed types, effect of dogs in yards, finishing regimes, animal health programmes), breed and genetics, carcase weight, live weight gain variation, GR fat measures, intra-muscular fat, meat-to-bone ratios, carcase conformation and grades, ossification and carcase pH, eating quality DNA markers in sire rams, and has tested potential for regional differences in eating quality.

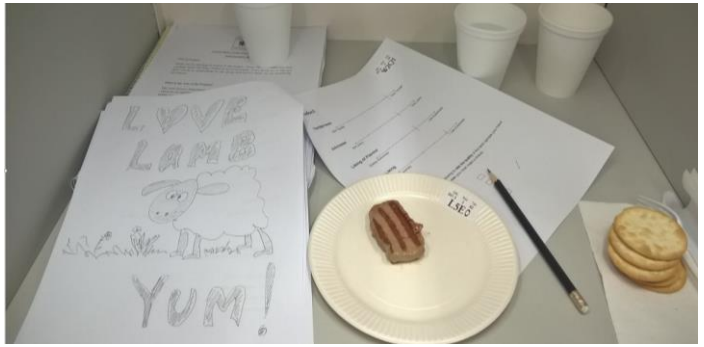
The most recent research project we conducted in the 2016 season involved 4,739 lambs supplied from 16 source properties in the North and South Islands of New Zealand. A wide pool of livestock was sought in order to achieve a significant sample size for the various drivers being investigated.

Base criteria for all stock supplied were: Certified Antibiotic Free, Farm Assured Farms.

This pool contained a representative spread of gender (Ewe, Ram, Wether, Crypt), breed type (27 breeds and crosses grouped into traditional, crossbreed, terminal cross), grading classes (YX, YM, PX, PM, PH, TH, FH), a spread of loin ultimate pH, finishing feed types (ryegrass, plantain, clover, lucerne, chicory, brassica), intramuscular fat GR Fat measurement, conformation information and other farm management information recorded with the Farm^{IQ} software.

Over 23,000 samples of Loin, Rump, Topside, Knuckle were taken from the lambs supplied. These samples were subjected to a spread of chiller ageing prior to being used in controlled consumer taste panels in New Zealand and the USA. 1,800 consumers in Auckland and Dunedin were involved in the research carried out by Otago University. 1,440 consumers in 5 states across the USA were involved in the research carried out by Texas Tech University.

Information recorded included: tenderness, juiciness, flavour liking, overall satisfaction, and consumer willingness to pay.



Over 23,000 samples of lamb were collected for consumer taste panel research carried out in 5 states in the USA and in NZ (Auckland and Dunedin).

KEY FINDINGS INTO CONSUMER PERCEPTIONS OF LAMB EATING QUALITY

Our research confirmed that consumers believe the eating quality of New Zealand lamb is consistently high

Factors that research show have a strong influence on Eating Quality:

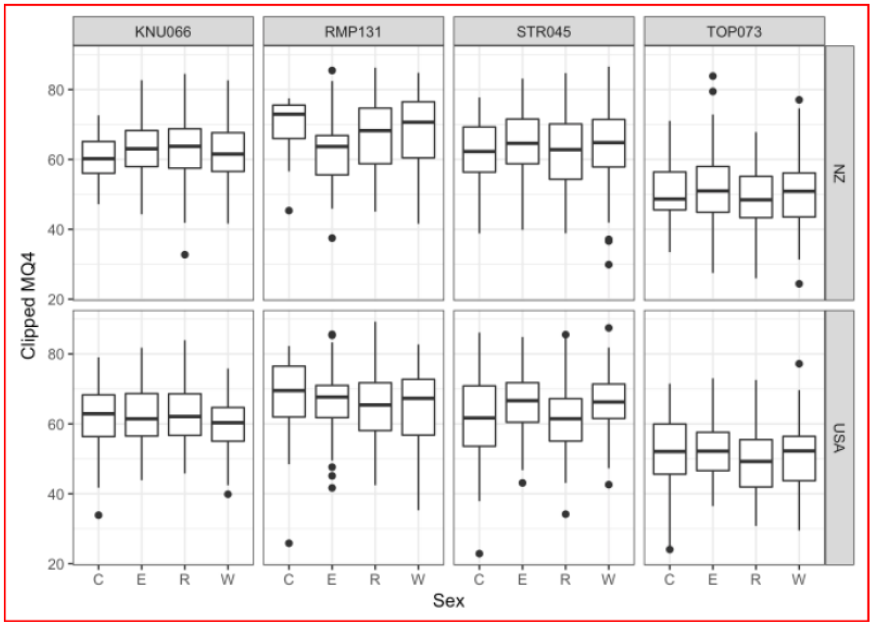
- **Selecting the best cuts.** A clear driver of improved eating quality in lamb is cut type (particular muscles are consistently rated higher than others, regardless of differing on-farm and animal characteristics)
- **Ageing the meat.** The effect of correctly ageing of the meat contributes to consumer perceptions of tenderness and lifts overall satisfaction in the product. For most individual muscles this is a strong positive relationship between higher eating quality ratings and the longer number of days a muscle is aged from 1 day to approximately 28 days
- **Matching the cut to the cooking method.** Correctly matching improved the eating quality outcome
- **pH decline management along with controlled electrical stimulation** assists greatly in creating consistency of product quality
- **Compelling brand story.** Consumer perceptions of eating quality are enhanced through creating an appetite appeal effect via the influence of a compelling consumer brand story. Extensive consumer studies show that consumers' sensory perceptions are amplified by positive story-telling before consuming food (*Reference: Manipulating basic taste perception to explore how product information affects experience, Shiv B Journal of Consumer Psychology Vol. 22, Issue 1, Jan 2012).*

Factors that research show have an inconsistent or insignificant influence on Eating Quality:

- Animal growth rates and good animal nutrition can lift glycogen levels and assist in lowering carcase pH, however this positive impact is very low and insignificant. The same can be said for other on-farm stress factors such as over-use of dogs in yards
- The impact of different pastures and animal health practices showed no significant or consistent impact on eating quality
- While early small-scale tasting studies showed some consumer preference for particular breeds, the 2016 research, which involved 27 breeds and crosses (grouped into traditional, crossbreed, terminal cross), showed breed has little or no effect on perceptions of eating quality
- The research shows that lamb gender is not a driver of consumer preference. All gender types had a range of eating quality scores with considerable overlap in the preference ranges between Rams, Ewes, Wethers and Cryptorchids. The overall impact of male vs female lamb is a very small and insignificant attribute. Furthermore there was no difference between entire ram lambs vs cryptorchids or wethers
- The GR (fat cover) measure, while it provides a good indication of the overall fatness (and yield) of the whole carcase and can assist in controlling pH and temperature decline management, only has a very minor influence on eating quality scores and is not as important an indicator for consumer preference as other factors including the type of cut, or days aged post processing. The current New Zealand standard grading system already allows selection of carcases graded by fat cover
- Intra-muscular fat (IMF or marbling) has a very small impact on the eating quality of loin muscle cuts, and not rump, knuckle or topside. Until technology develops to more accurately assess loin IMF in the production line it is not commercially viable. Even then it would only be of use for loin product, limiting the commercialisation of this small impact indicator.

EXAMPLE DATA ANALYSIS FROM THE 2016 PILOT RESEARCH

Figure 16. Distribution of eating quality (Clipped MQ4) for four lamb cuts by sex as rated by 1,800 New Zealand and 1,440 USA consumers.



Key:

C: Cryptorchid

E: Ewe

R: Ram

W: Wether

Clipped MQ4: Eating Quality score

KNU066: Knuckle cuts

RMP131: Rump cuts

STR045 Striploin cuts

TOP073: Topside cuts

The above table is a summary of analysed consumer Eating Quality scores from the New Zealand and the USA consumer taste panels. It lays out the range of consumer ratings for the four groups of cuts classed by animal sex. As can be seen there is an appreciable range within each cut and considerable score overlap between cuts. While the topside is appreciably lower the loin, rump and knuckle are broadly spread across a similar range. The tails on the box plots represent 25% of the data with the box the central 50% and dots beyond the tails outliers.

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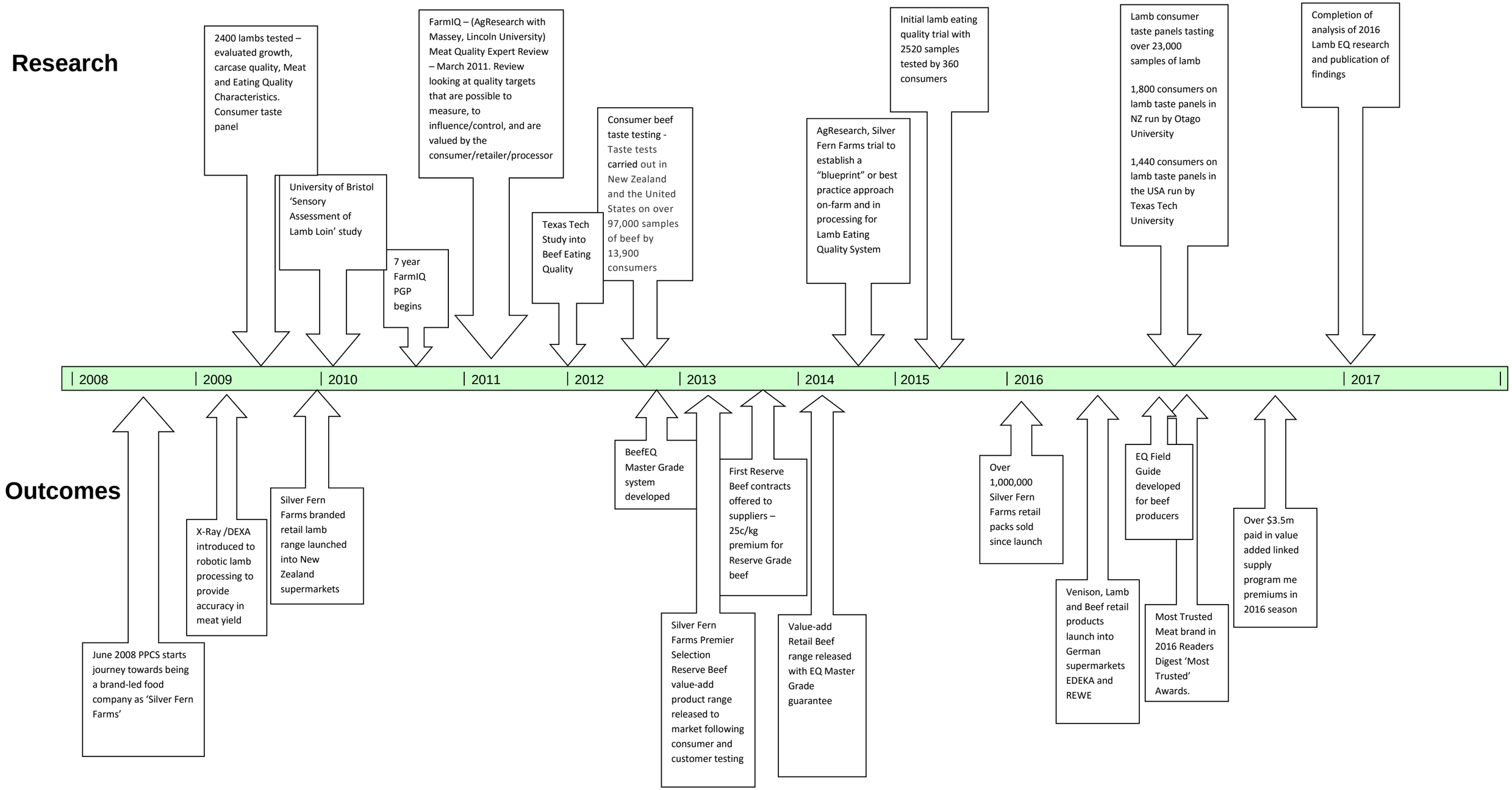
EATING QUALITY AND CONSUMER PREFERENCE RESEARCH AND OUTCOMES OVER TIME



APPENDIX: SUMMARY FINDINGS FROM KEY INDICATORS MEASURED

Indicator researched	Summary
Genetics	SNP chip technology can identify DNA markers in sire rams for eating quality and these have been proven by AgResearch to improve tenderness, increase marbling and lower pH. While the eating quality of New Zealand lamb, as shown by these trials, is excellent, the results also show that continued genetic selection solely for growth and meat yield is unlikely to maintain the current eating quality. A breeding ram can be tested using the new SNP and its progeny then identified using EID tags. Although the ability to accurately track maternal DNA and lamb DNA is not yet commercially at a point where it can currently identify higher eating quality terminal lambs at a processing plant, we are encouraging ram breeders to include meat quality markers in their current selection programmes. This will over time further improve eating quality, growth and yield traits of New Zealand lamb.
Breed	While early small-scale tasting studies showed some consumer preference for particular breeds, our 2016 large-scale research which involved 27 breeds and crosses (grouped into traditional, crossbreed, terminal cross) showed little effect.
Gender – Ram Gender – Ewe Gender – Wether Gender – Cryptorchid	Our 2016 large-scale research indicates lamb gender is not a driver of consumer preference. All gender types had a range of eating quality scores with considerable overlap in the preference ranges between Rams, Ewes, Wethers and Cryptorchids. Given the closeness in Eating Quality preference between Rams, Cryptorchids, Wethers and Ewes it would make little sense to exclude any from a premium value added lamb offering. This indicates a combination of other factors are greater influencers on consumer preference. Through our consumer panel research very few consumers were sensitive to any “Ram lamb effect”.
Age of Animal	Age of the animal can alter the meat flavour through changes in muscle fat content and marbling over time, giving sheep meat a stronger flavour as the animal ages. Typically lambs are harvested between the ages of 4-12 months (before they have any permanent incisors in wear) there is little time for animal age to be a major factor in variations in eating quality.
Weight	Our 2016 study grouped lambs into the following carcase weight ranges: 13-17kg, 17.1 – 21kg and 21.1 to22kg. The heavier carcase weight was found to have a very small negative effect on eating quality.
Conformation (Butt circumference score)	There is not a strong correlation between this conformation score and eating quality.
GR (Fat cover measure)	GR has a very minor impact on eating quality scores with some negative impact from very low fat and very high fat animals. The current NZ grading system can be used to manage this. The GR measure, while it provides a good indication of the overall fatness (and yield) of the whole carcase, is not as important an indicator for consumer preference as other factors including the type of cut, or days aged post processing.
Intramuscular fat (Marbling)	This measure has a very small impact on the Eating Quality of loin cuts only. The development of new technology to accurately measure lamb marbling at commercial chain speed does not currently appear to be feasible for a trait that only contributes a very small impact on lamb eating quality.
Stress (pH)	This measure has a small negative effect on Eating Quality scores – but only at the extreme higher levels (pH over 6.0). This impact is not a significant one, and like marbling, the technology development required to accurately measure pH at a commercial chain speed is not currently feasible.

Nutrition - feed type	Nutrition has the greatest influence on meat flavour and meat colour. Several different pasture types have been tested however none show a significant or consistent difference in EQ scores. Regional influences (e.g. soil and rainfall) also create fluctuating pasture effects across the country. Commercial management of animals coming from a wide variety of regional pasture models also creates significant complexities in managing 52-week premium supply programmes.
Muscle cut type	Particular muscles are consistently rated higher than others. Optimisation of eating quality outcomes can be achieved when muscles are correctly matched to cooking methods (grilling, slow roast, roast, casserole, shabu-shabu, etc.). An important finding however is that the spread of EQ scores across muscle types for lamb are much narrower than for beef. For example, lamb loin (backstrap) EQ scores are very similar to lamb rump and knuckle. This is not the case for beef where these same cut scores are significantly different.
Animal Growth rate	It is true that lambs coming off a high growth rate plane generally have lower incidence of high pH due to optimum glycogen levels. For lambs however, high animal growth rates only have a minimal and insignificant effect on Lamb EQ scores.
Geographic origin	There are no consistent significant links between geographic location and eating quality. Some studies have shown minor differences, but these are not consistent.
Processing technologies	
Electro-stimulation	Electro-stimulation assists the on-set of rigor in carcases and assists in providing consistency in the ageing process.
Chilling rate	Controlled chilling rates assist in providing consistency in the ageing process.
Ageing	Lamb eating quality can be significantly improved by ageing post slaughter. Most of the eating quality gain is made in the first 7 days of ageing with on-going EQ improvements from 7 to around 28 days. Different muscles age better than others, but the overall general positive trend is the same across all cuts.
Consumer Marketing	
Perception of brand New Zealand origin	Consumer perceptions of eating quality are enhanced through creating an appetite appeal effect via the influence of a consumer brand story. Extensive in-house consumer market research and external consumer studies (including those by Prof. Baba Shiv from the Graduate School of Business at Stanford University) show that consumers' sensory perceptions are amplified by positive story-telling before consuming food. Positive story-telling activates endorphins leading to higher levels of enjoyment when food is consumed. For Silver Fern Farms Lamb, we have tested various brand stories with a 100% Made of New Zealand brand promise through both qualitative and quantitative studies with consumers and on-going development in this area is a key part of optimising eating quality perceptions and extracting a premium price.
Packaging Design	The presentation and packaging of lamb is an important component in enhancing Eating Quality. The same endorphin impact is apparent from high-quality, visual packaging as it is from positive story telling. That is, if a food product appears to be of high quality, then consumers will expect a high-quality eating experience. The increase in endorphins that this creates leads to an amplified eating experience.
Consumer cooking instructions	Providing the correct cut matched with recipe inspiration and clear-to-understand cooking instructions is a critical final step in optimising lamb Eating Quality.