final report

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Meat and well-being: Investigate sensory red meat cues (by cut) and their effect on consumer choice and wellness (nutritional and emotional map: stage 2)

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Executive summary

The first consumer-led and product-specific emotion lexicon consisting of 20 emotion terms was generated to evaluate consumer emotional responses to red meat (beef and lamb) consumption. Subsequently, a quantitative consumer (n=126) hedonic and emotional assessment of 16 different meat experiences was conducted to validate the emotion lexicon. The 16 consumer experiences were generated in New Zealand by combining 2 species (beef, lamb), 2 muscles [*Longissimus lumborum* (LL): short loin, *Semimembranosus* (SM): topside], 2 degrees of doneness [medium-rare (MR), well-done (WD)] and 2 contexts (BBQ outdoors, Dinner at home) to provide a broad range of sensory experiences. Meat composition was mapped along with consumer overall liking and emotional response profiles for the evaluated samples. Consumer overall liking was higher for lamb, LL and MR than for beef, SM and WD, respectively.

The samples evoked distinct and significant consumer emotions, providing similar product differentiation to consumer liking. However, ***meat samples with similar liking scores tended to be separated by certain emotions (happy, satisfied) and overall liking was less influenced by the context than consumer emotions.*** Beef and lamb, and LL and SM muscles within each species differed in their chemical composition (collagen, heme, non-heme and total iron). This difference significantly influenced the hedonic and emotional responses of consumers towards the meats. ***In general, higher meat juiciness and tenderness elicited positive, whereas higher meat microelements and collagen content provoked negative emotions in consumers.***

Compositional, hedonic and emotional profiling undertaken here supports supplementing hedonic consumer evaluation of meat with emotional measures to provide a deeper level of understanding concerning consumer product experiences, especially in relation to diverse situational contexts. Meat composition along with consumer liking and emotion data should be collected over time to find functional and emotional patterns of response to different red meat Cuts x Cooking methods x Contexts combinations for targeted marketing of differentiated value propositions based on improved consumer experience (e.g. best cut for a given occasion) and/or health and well-being (e.g. higher iron).

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1 Background

Meat Standards Australia (MSA) provides a well stablished pathway for predicting eating quality of various cuts x cooking methods that considers key processing and animal conditions to inform cutting lines, packaging and aging conditions for the various meat cuts and their intended use. However, emerging food trends now see consumers making food choices that are beyond just tenderness, flavour and juiciness and traditional butchery/chef plate profiling of red meat. Consumer's growing focus on physical, functional and mental well-being is leading behavioural changes including dietary habits and more active lifestyles. That is, meat is selected based on not just the cut name, or even the way it's to be used (e.g., grilling steak) but its functionality and delivery of micro/macro nutrients. This consumer behaviour represents an innovative opportunity for new bundles of red meat-based products and services that drive higher valued usage and occasions.

Preliminary results presented in the stage 1 report (P.PSH.1164) showed that developed techniques that measure emotional responses to other foods can be implemented in the meat consumption context to gain additional product insights beyond consumer liking, and support consumer-driven new product development and marketing. It was also confirmed in this stage that consumers were willing to pay premiums for meat cuts labelled with the nutrients/functionalities and/or fabricated to suit their lifestyles and demographic requirements. This research in stage 2 aims to transcend beyond eating quality, looking at consumer emotional responses to red meat driving purchase/consumption decisions. In addition, new insights on the functionality (and nutritive values) between muscles from carcass mapping could lead to alternative cutting lines that can unlock a different value proposition based on nutritive values and functionalities.

This final report presents a summary of the methodology, key findings, next steps, conclusions, recommendations, and key messages. Milestone 2, 3a and 3b reports present full details about methodology, results, and discussion. The reader is also directed to outcomes listed in MLA project V.RMH.0106 which included assumptions related to customer personas, prototypes and cost benefit analysis for harvesting and merchandising meat cuts based on the outcomes from this project.

2 Project objectives

Milestone 1 – kick off workshop, following by Milestone 2: Implement/adapt methodologies for consumer emotional evaluation: select and implement methodologies/techniques to measure consumer emotions/feelings/mood associated with red meat consumption.

Milestone 3a: Nutritional, functional, and emotional mapping of selected red meat cuts: the quality and nutritional properties of a selected range of red meat cuts will be presented along with the sensory and emotional profile of the cuts.

Milestone 3b: Complete series of key stakeholder interviews with industry to test value proposition and technical feasibility for the concept and rigor behind the carcass mapping pathway/cues.

Milestone 4a: Presenting key findings in a workshop with MLA.

Milestone 4b: Completion of final report and peer reviewed publication(s) for submission.

3 Methodology

3.1 Evaluation of consumer emotional responses to red meat

3.1.1 Emotion lexicon development – Consumer focus groups

A consumer-led and product-specific emotion lexicon was generated to evaluate consumer emotional responses to red meat consumption. Three consumer discussion group sessions (8 consumers per session) were carried out to collect emotion responses to different meat samples (Species: beef, lamb; Muscles: loin, topside) cooked using two different methods (Sous Vide, Pan-fry) in two evoked contexts (Barbeque outdoors, Dinner at home). The three consumer discussion group sessions generated a total of 81 expressed emotion terms, as well as 152 statements that were subject to review for potential transcription into an emotion term. After combining terms using a thesaurus, as well as further reviewing and discussing all emotion terms and statements, a list of 20 terms was generated as the final lexicon.

3.1.2 Hedonic and emotional mapping – Quantitative consumer study

A quantitative consumer (n=126) hedonic and emotional assessment of 16 different meat experiences was conducted in New Zealand to validate the first generated consumer-led and product specific emotion lexicon for red meat (beef and lamb). The 16 consumer experiences were generated by combining 2 species (beef, lamb), 2 muscles [*Longissimus lumborum* (LL): short loin, *Semimembranosus* (SM): topside], 2 degrees of doneness [medium-rare (MR), well-done (WD)] and 2 evoked contexts (BBQ outdoors, Dinner at home) to provide a broad range of sensory experiences. A total of 24 consumer sessions were conducted over 2 weeks at the Food Experience and Sensory Testing Lab, Massey University, Palmerston North, New Zealand, with 12 sessions per week distributed over 3 days with 4 sessions per day and approximately 10 consumers per session. Each session was assigned to one of the two contexts. In the first week, half of the consumers evaluated the 8 different types of meat samples in one context and the other half in the second context, switching the context in the second week. The evaluation of the meat samples was performed in portable individual sensory booths 2 metres apart due to COVID-19 restrictions in a room with controlled environmental conditions under regular light (Picture 1). Consumer responses were collected using iPads (6th Generation Apple Inc. Cupertino, CA, USA) and Compusense Cloud Software (Compusense Inc., Ontario, Canada). To help consumers engage with the context, a description and a couple of pictures per context were presented in front of them in each booth as well as in the iPads (Picture 2). First, each consumer rated the 10 positive and 10 negative emotions in a random order maintained for each participant, for each of the eight meat samples using a 5-point scale (1, Not at all; 2, Slightly: 3, Moderately; 4, Very; 5, Extremely). Then, after a 10 min break, with another set of the 8 meat samples, consumers rated the degree of tenderness and juiciness and liking of flavour and overall liking using a 100 mm non-structured line scale anchored at each end (0: not tender, not juicy, dislike extremely to 100: very tender, very juicy, like extremely).

Picture 1. Set-up of consumer booth under COVID-19 restrictions.

Picture 2. Evoked contexts using images. Top: Barbeque outdoors and Bottom: Dinner at home.

3.2 Nutritional, functional, and emotional mapping of selected red meat cuts

There are up to at least 18 muscles of reasonable commercial sizes in beef and lamb carcasses that could be deeply mapped for their nutrients and functionalities. Only two of these muscles [loin (LL) and insides (SM)] within beef and lamb were analysed for their chemical composition in this study.

The raw muscle pH, moisture, collagen, total iron (heme plus non-heme), and intramuscular fat (IMF) and fatty acid composition were evaluated for LL and SM muscles from the beef that were cooked to a medium-rare degree of doneness and evaluated in the BBQ context. In addition, beef samples were also used to evaluate magnesium, zinc, and fat-soluble vitamins concentration. The details of the various methods used are found in Milestone 3 - Emotional mapping and compositional/nutritional functionality assessment of New Zealand red meat cuts report.

The meat composition was also mapped along with consumer overall liking and emotional response profiles for the evaluated samples.

4 Results

4.1 Evaluation of consumer emotional responses to red meat

4.1.1 Emotion lexicon development – Consumer focus groups

Self-reported emotion responses of consumers to beef and lamb samples cooked in two different ways and assessed in two evoked contexts were captured and processed qualitatively into a lexicon consisting of 20 emotion terms presented in Table 1.

Table 1. Consumer-led emotion lexicon for red meat. Terms are sorted by positive and negative use, listed in descending order of frequency of use.

Positive Emotion terms	Negative Emotion terms
Happy	Disappointed
Satisfied	Unhappy/dissatisfied
Relaxed	Bored
Relieved	Annoyed
Impressed	Anger
Nostalgic	Disgust
Thankful	Rushed
Excited	Sad
Loved	Embarrassed
Engaged	Confused

4.1.2 Hedonic and emotional mapping – Quantitative consumer study

Consumer liking of food is traditionally measured by food companies in new food product development but liking rarely predicts food choice in real life environments (Dalenberg et al., 2014). To gain additional product insights beyond consumer liking and better understand the factors affecting consumer perception of food and consequent food choice behaviour, multivariate approaches have been proposed involving other consumer responses such as sensory perceptions (Lawless and Heymann, 2010), emotional associations (Jaeger et al., 2019), attitudes (Ng et al., 2013a) or situational appropriateness (Giacalone et al., 2015). Dalenberg et al. (2014) showed that food-evoked emotion scores significantly improved food choice prediction over merely liking scores. Measuring emotional responses to food can be more discriminating than liking because it considers wanting. While liking is related to palatability, wanting drives consumers towards behaviours, and liking and wanting are processed differently in the brain (Berridge et al., 2018), both being important to study consumer responses to food.

This study was conducted to assess the hedonic and emotional consumer responses in a quantitative study (n=126 consumers) of 16 different experiences using the first generated consumer-led and product specific emotion lexicon for red meat (beef and lamb), and mapping of meat composition along with consumer liking and emotional response profiles for the selected meat cuts in two evoked contexts. Figure 1 shows consumer overall liking scores for the 8 different meat samples in both contexts showing that meat sample selection was successful in generating differential overall consumer liking scores with 40 points of difference in 100 lineal scale (range from 34 to 74 liking scores corresponding to beef-SM-WD and lamb-LL-MR, respectively). There were a few significant interactions among the main effects but overall, consumer liking scores were higher ($P<0.05$) for lamb than beef, for LL than SM and for MR than WD (except degree of doneness for lamb-LL and beef-SM, $P>0.05$). The eating quality of LL and MR is expected to be higher than SM and WD. However, when comparing species, it should be highlighted that lamb resulted in higher consumer liking scores than beef in this particular study conducted in New Zealand, and the relative consumer liking of beef and lamb will vary depending on the type of animals used (age, breed, diet, carcass weight and fatness among other factors).

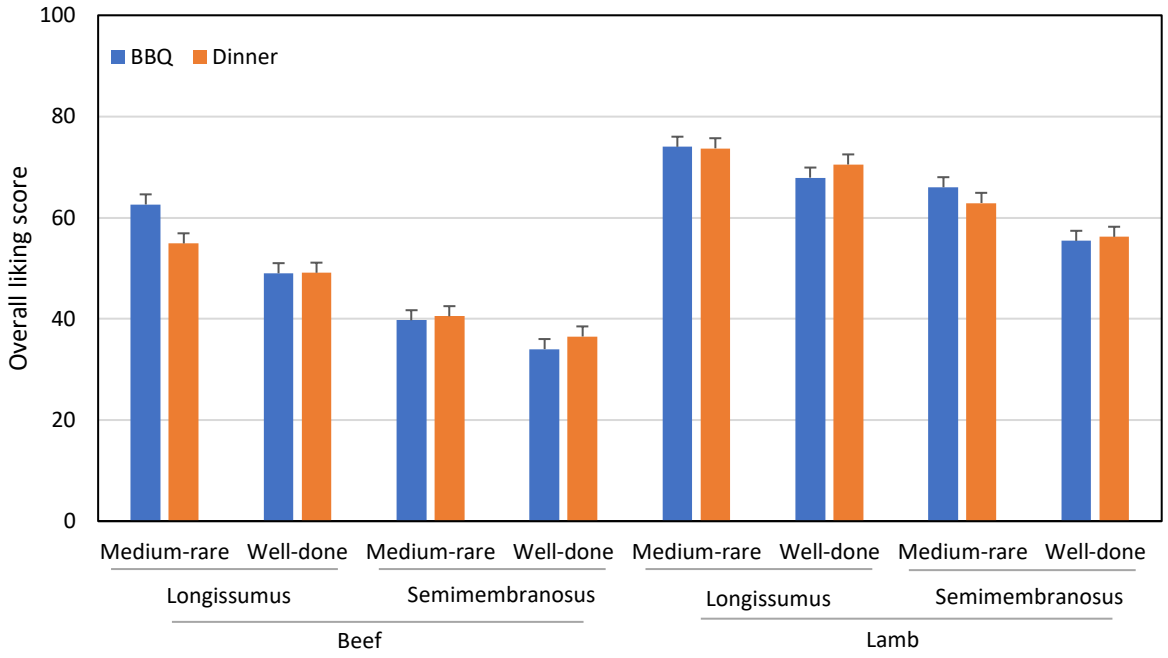

Figure 1. Effects of species, muscle, degree of doneness and context on consumer overall liking scores (0: not tender, not juicy, dislike extremely to 100: very tender, very juicy, like extremely). Species (S), $P < 0.001$; Muscle (M), $P < 0.001$; S x M, $P = 0.004$; Degree of doneness (DD), $P < 0.001$; S x M x DD, $P = 0.011$; S x M x Context (C), $P = 0.023$; DD x C, $P = 0.017$.

Figure 2 summarises consumer emotion scores for the 8 meat products by occasion. Not surprisingly, consumer emotion scores agree with liking scores showing higher positive emotions for lamb than beef, for LL than SM and for MR than WD. However, the differences in the emotional response between MR and WD were more evident in the dinner context mainly for beef. Beef had higher intensity of negative emotions for WD than for MR in SM that rated lowest in consumer liking scores, showing that emotions rather than liking were mainly affected by the context. It should be highlighted that the evoked context in this study was achieved by using pictures presented to consumers in the individual booths and the iPads. While not possible in the current study due to restrictive testing conditions associated with COVID-19 (e.g. portable booths in a hall test), other ways of evoking

context such as mixed reality (e.g. Microsoft HoloLens) or an immersive room, could be more effective than pictures in immersing consumers in each situational context (Low et al., 2021).

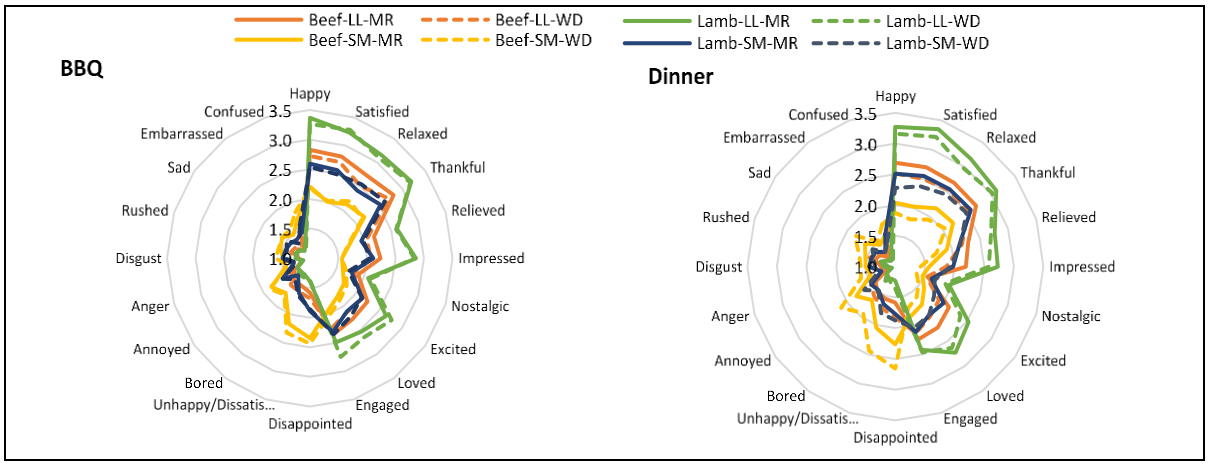

Figure 2. Consumer emotion scores (1, Not at all; 2, Slightly: 3, Moderately; 4, Very; 5, Extremely) for the eight meat products by context.

The PCA biplot (Figure 3) show the relationships between consumer hedonic and emotional responses to the 8 meat products in the 2 contexts. The PCA biplot explains 95% of the variation in the data set and the first principal component explains most of the variation (91%). The first component is typically related to pleasantness of emotion (from negative, e.g. unhappy and disappointed, to positive emotions, e.g. happy and satisfied) and the second component to level of activation (from passive, e.g. relieved and bored, to active emotions, e.g. excited and disgust). Lamb-LL with the highest consumer overall liking scores (e.g. high MSA graded product) is located on the right side of the horizontal axis of the plot where liking scores (flavour and overall), degree of juiciness and tenderness and the positive emotions are located. At the opposite end, beef-SM samples with the lowest overall liking scores are positioned next to most negative emotions, while beef-LL and lamb-SM are located close to the centre of the biplot. The second principal component explains an additional small percentage of the variation (4%) showing a context separation, where a high eating quality product (Lamb-LL) in a BBQ context is associated with active-positive emotions like 'Nostalgic' and 'Excited', while the same product in a Dinner context is associated with passive-positive emotions like 'Relieved'. On the other hand, a low eating quality product (Beef-SM-WD) is associated with active-negative emotions like 'Disgust', while the same product consumed in the Dinner context is associated with passive-negative emotions like 'Bored'.

Results show that mainly emotions and not liking were influenced by context. It has been reported that food-evoked emotional response is context-dependent (Spinelli et al., 2014). These results indicate that measuring emotions can provide a better understanding of consumer engagement with products in context than liking, and as consumers generally consume meat in a context this is valuable to the meat industry for promoting products and highlights the importance of understanding the relationship between meat cuts, context and the consumer. Emotions provide a more holistic view and a better understanding of the consumer response to a product than liking which is correlated differently with each emotion. Gathering emotion data beyond liking will help to understand better the impact of the demand space, which becomes increasingly more important when getting closer to market. In this study similar differentiation between samples was observed with liking and emotions, while in other studies and product categories higher differentiation between samples have been reported with emotions than liking (Ng et al., 2013b). Dalenberg et al. (2014) highlighted that the focus in recent studies has shifted towards using emotion-profiling methods that can successfully

discriminate between products that are equally liked. The present study was designed to obtain a broad range of consumer liking scores, however, samples with similar overall liking scores (Figure 1) such as Lamb-SM-WD and Beef-LL-MR (different species, muscles and degrees of doneness) were separated in Figure 2 and the PCA plot (Figure 3) by the emotional response profile (mainly happy and satisfied being higher for Beef-LL-MR). Further studies are needed with different cuts from the carcass, cooking methods and situational contexts to gain additional insights into supplementing hedonic consumer evaluation of meat with emotional measures. Further insights would be particularly valuable for products that are equally liked and to identify emotional patterns associated with different meat categories and occasions for marketing purposes.

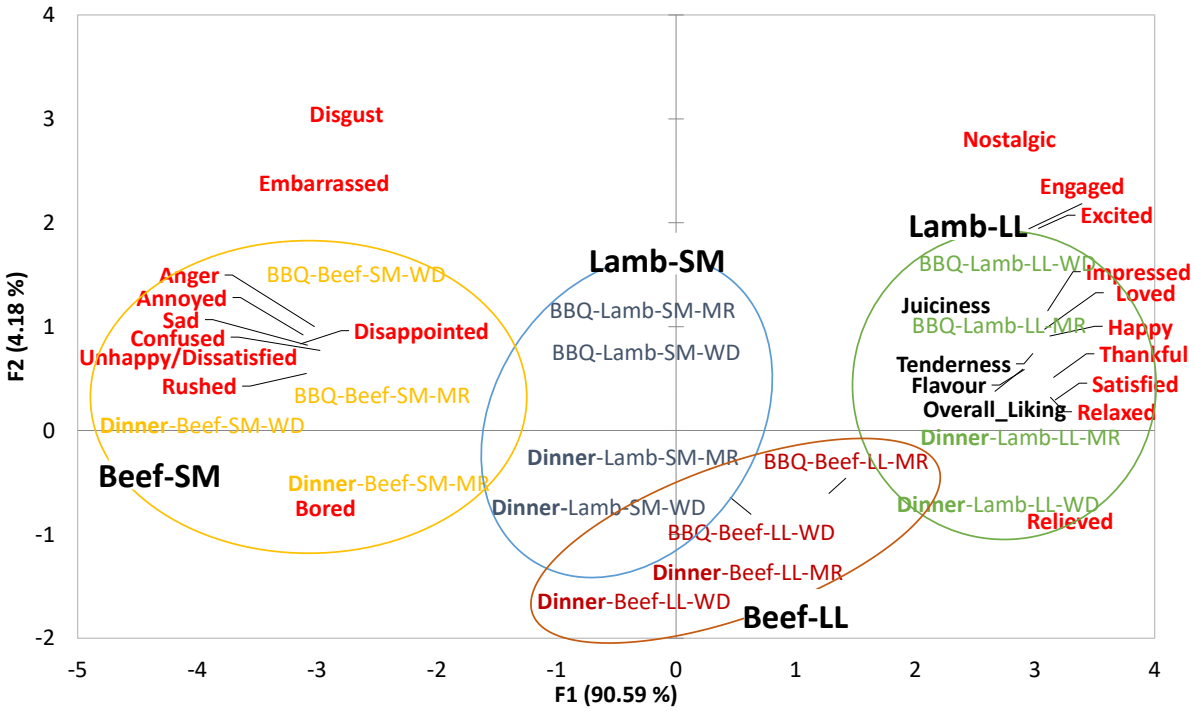

Figure 3. Biplot of consumer liking (consumer liking scores: tenderness, juiciness, flavour and overall liking) and emotion scores for the 8 meat products (Species: Beef, Lamb; Muscles: *Longissimus Lumborum*, *Semimembranosus*; Degree of Doneness: Medium Rare, Well Done) and the 2 contexts (BBQ outdoors, Dinner at home). Active variables in red. Active observations: Lamb-LL in green; Lamb-SM in blue; Beef-LL in red; Beef-SM in yellow. Supplementary variables in black.

- The first generated consumer-led and red meat-specific emotion lexicon improved product differentiation beyond liking. Samples rated with different consumer liking scores evoked distinct and significant consumer emotions providing similar red meat differentiation to consumer liking. However, samples rated with similar consumer liking scores were discriminated by consumer emotional profiling.
- Consumer emotions rather than liking were influenced by the simulated context (BBQ outdoors vs Dinner at home), which indicates that measuring consumer emotional responses to red meat can provide a better understanding than liking of consumer engagement with the product in context.
- Flavour, tenderness and overall liking were mainly related to the pleasantness level of emotion (pleasant/unpleasant), while juiciness was also related to the activation level of emotion (active/passive).
- A high eating quality product (e.g. high MSA and liking score) consumed in the simulated 'BBQ outdoors' context evoked pleasant and active emotions such as nostalgic, excited, engaged and

impressed. The same product consumed in the simulated 'Dinner at home' context evoked pleasant and passive emotions such as relaxed, relieved, happy, satisfied, thankful and loved.

- A low eating quality product (e.g. low MSA and liking score) consumed in the simulated 'BBQ outdoors' context evoked unpleasant and active emotions such as disgusted, embarrassed, angry and sad. The same product consumed in the simulated 'Dinner at home' context evoked unpleasant and passive emotions such as bored.

4.2 Nutritional, functional, and emotional mapping of selected red meat cuts

The summary of the results of the chemical analyses of the beef and lamb loins and topsides are shown in Tables 1 and 2, and the relationships between the meat components with consumer emotions are shown in Figures 4 and 5.

There are significant differences in some of the chemical attributes measured between beef and lamb and within species between LL and SM (Tables 1 and 2). The collagen, heme, non-heme, and total iron content of beef was higher than lamb ($P < 0.01$) and that of SM was higher than that of LL in both species ($P < 0.03$). Beef SM had more magnesium than beef LL ($P < 0.001$), but the two muscles did not differ ($P > 0.05$) in zinc or in fat soluble vitamins (A, E, Lutein and Carotene). Beef had higher intramuscular fat and monounsaturated fatty acids compared to lamb ($P < 0.01$), but the difference did not extend to the two muscles within the species ($P > 0.05$). Lamb on the other hand had higher branched chain, polyunsaturated, and many of the other individual fatty acids than beef ($P < 0.05$ - 01) (Table 1). Within each species, the two muscles did not differ in most of the fatty acids (Table 1).

Table 1. Effect of species (Lamb and Beef) and muscle (*Longissimus lumborum*: LL and *Semimembranosus*: SM) on consumer overall liking scores and chemical composition of meat cooked to a medium-rare degree of doneness (n=32).

	Lamb		**Beef**				
	LL	**SM**	**LL**	**SM**	**Species**	**Muscle**	**SpxMsc**
pH	5.96	5.84	5.67	5.54	<0.01	<0.01	**<0.01**
Sensory panel scores							
Tenderness	78.798	68.547	58.722	24.054	<0.01	<0.01	**<0.01**
Juiciness	68.201	69.799	52.320	30.526	<0.01	<0.01	**<0.01**
Flavour	66.229	64.036	63.512	48.205	<0.01	<0.01	**0.02**
O.Liking	71.439	67.136	62.261	37.203	<0.01	<0.01	**<0.01**
Fatty acids, % in total fatty acid							
C18-0	19.363	17.477	16.032	15.373	**<0.01**	**0.04**	0.30
C18-1t	0.146	0.153	0.115	0.136	**0.03**	0.18	0.50
C18-1t11	2.289	2.247	1.901	1.872	**0.03**	0.83	0.97
C18-1c9	33.695	33.666	38.179	37.948	**<0.01**	0.84	0.88
C18-1c11	1.137	1.179	1.430	1.528	**<0.01**	0.35	0.70
C18-2n6	4.571	5.453	2.360	2.917	**<0.01**	**0.04**	0.64
C18-3n3	2.398	2.727	1.541	1.720	**<0.01**	0.11	0.63
C22-5	1.252	1.462	0.944	1.074	**0.01**	0.20	0.76
C22-6n3	0.343	0.440	0.103	0.126	**<0.01**	**0.01**	0.12
Group of fatty acids (% in total fatty acid**)**							
SFA	48.171	45.649	46.865	45.656	0.59	0.13	0.59
BCFA	1.493	1.490	1.393	1.352	**0.05**	0.72	0.75

MUFA	39.099	39.479	45.662	45.503	**<0.01**	0.87	0.70
PUFA	12.730	14.871	7.473	8.841	**<0.01**	0.06	0.67
Intramuscular fat (% in meat)	2.135	2.047	3.003	2.944	**<0.01**	0.75	0.95
Muscle composition							
Moisture (%)	74.822	75.136	72.611	72.135	**<0.01**	0.77	0.17
Total collagen (%)	0.504	0.581	0.687	0.730	**<0.01**	**0.03**	0.52
Total iron (mg/kg meat)	23.866	28.514	28.561	37.918	**<0.01**	**<0.01**	**0.05**
Heme iron (mg/kg meat)	17.482	21.490	20.581	26.558	**<0.01**	**<0.01**	0.31
Non-heme iron (mg/kg meat)	6.385	7.025	7.979	11.360	**<0.01**	**<0.01**	**<0.01**

Table 2. Beef muscle (*Longissimus lumborum*: LL and *Semimembranosus*: SM) effect on iron, magnesium, zinc, A and E vitamins, lutein, and carotene.

	LL	**SM**	***P*-value**
Microelements (mg/kg meat)			
Iron	18.34 b	22.15 a	**0.009**
Magnesium	241.00 b	259.25 a	**0.001**
Zinc	39.54	38.21	0.326
Vitamins (µg/100 g meat)			
A vitamin	12.30	14.24	0.377
Lutein	0.54	0.454	0.257
E vitamin	101.19	100.13	0.928
Carotene	2.40	1.17	0.202

The relationship between the meat components determined in the present study with consumer emotions are shown in Figures 4 and 5. The difference in the chemical composition significantly influenced the hedonic and emotional responses of consumers towards the meats. Moisture content of beef and lamb and the total amounts of saturated, polyunsaturated, branched chained, and many of the individual fatty acids in the meats were associated with positive consumer emotions; whereas, the meat's collagen, iron, total unsaturated, and monounsaturated fatty acids were associated with negative consumer emotions. The fat-soluble vitamins in beef including carotene, vitamin A and E were associated with positive consumer emotions, whereas lutein appeared to be neutral in terms of the emotions it elicits from consumers. In general, higher meat juiciness and tenderness elicited positive, whereas higher meat microelements and collagen content provoked negative emotions in consumers.

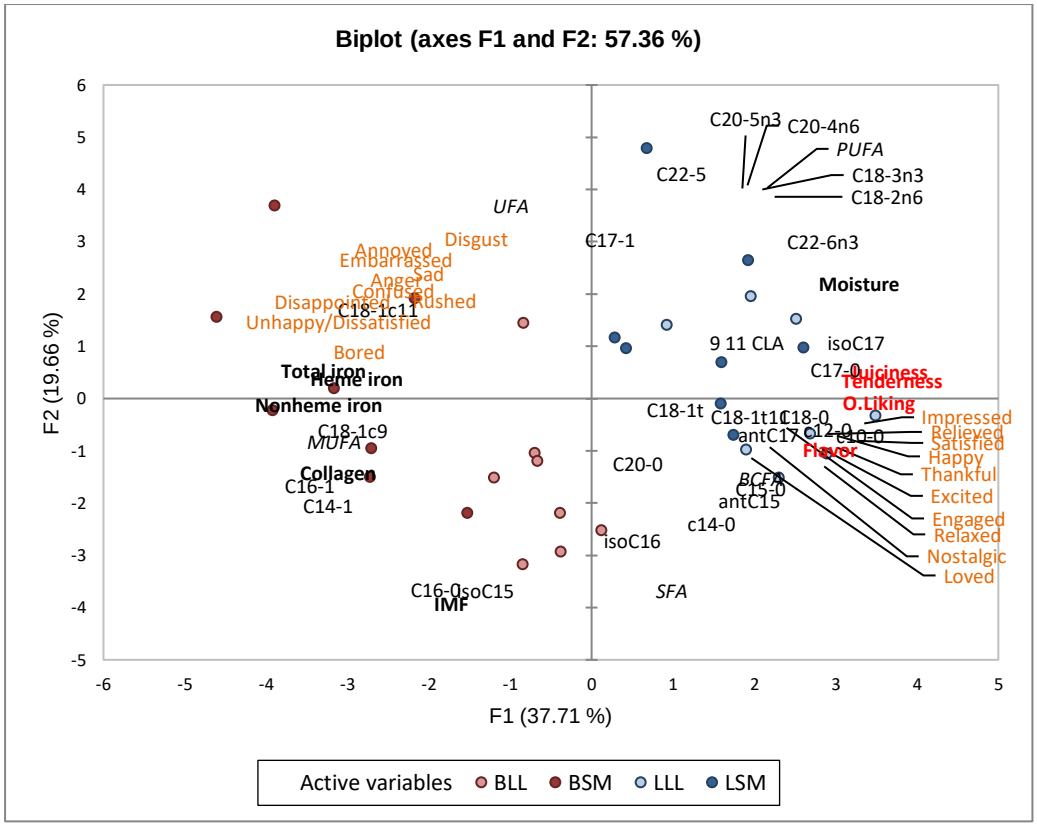

Figure 4. Biplot of hedonic and chemical variables for Beef Longissimus Lumborum (BLL), Beef Semimembranosus (BSM), Lamb Longissimus Lumborum (LLL) and Lamb Semimembranosus (LSM).

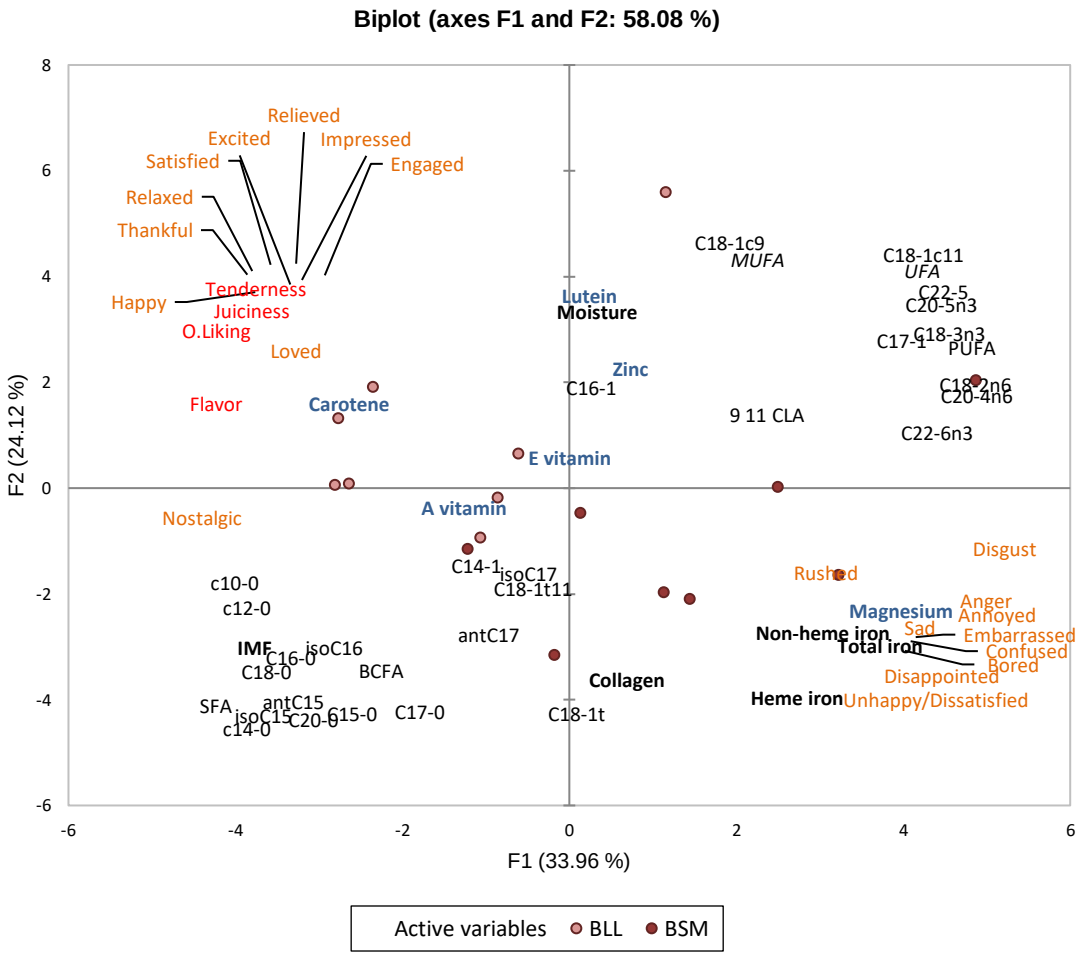

Figure 5. Biplot of hedonic and chemical variables for beef *Longissimus lumborum* (BLL) and beef *Semimembranosus* (BSM).

4.3 Key stakeholder interviews with industry to test value proposition and technical feasibility for the concept and rigor behind the carcass mapping pathway / cues

- Only New Zealand key stakeholders were surveyed due to covid-19 restrictions. The proposition should be further tested in interviews with more stakeholders in Australia and New Zealand with the involvement of MLA/MDC personnel.
- The major meat processors in New Zealand saw value in the carcass mapping and nutrient and functionality front of the pack labelling value proposition.
- Potential barriers to providing front of pack nutritional labelling have been identified.

5 Next steps

The following next steps are suggested:

- Present the results of this study to the Australian Meat Industry.
- Extend current carcass fabrication based on eating quality to include health and wellness criteria. All the major muscles in beef and lamb would need to be fully characterised and the health and wellness considerations of all the major markets and consumer demographic groups should be analysed.
- Validate the current lexicons using different cooking methods and contexts to determine if they can change predominantly negative to positive emotional profile for lower value cuts.
- Validate lexicons with different meat matrices, including organ meats, to determine if emotions can be improved by grinding meat with the same chemical composition compared to whole tissue.
- Develop more lexicons specific to cuts with high essential nutrients which elicit negative consumer emotions.
- Validate if the value of cuts with lower eating quality can be lifted if these cuts are confirmed to be richer in some of the nutrients that consumers consider relevant such as collagen.
- Validate formulating for health and wellness through restructuring various meat matrices from fine emulsion to coarse ground and whole tissue cuts and determine the relationship between meat formats and eating occasions to enable formulating for health and wellness.
- The willingness of consumers to pay for health and wellness above eating quality should be further validated.
- Qualitative interviews to be conducted with stakeholders in Australia and New Zealand to provide the opportunity to explore the value proposition and technical feasibility for the concept and rigor behind carcass mapping pathway in more depth; ask a wider range of questions; and explore potential solutions to the identified barriers.
- Use improved context methods: immersive, mixed-reality, real context.
- A manuscript 'Emotion lexicon development and validation for consumer assessment of red meat' is in advanced stage of writing for publication in a peer reviewed journal (Food Research International, Meat Science or Foods).

6 Conclusions/recommendations

- The first generated consumer-led and red meat-specific emotion lexicon improved product differentiation beyond liking. Measuring consumer emotions can provide a more holistic view of the consumer response to red meat than liking alone and a better understanding of the demand space, which becomes increasingly more important when getting closer to market.
- Beef and lamb, and the loin and topside muscles within each species differed in their chemical composition. The difference in the composition between the species and muscles significantly affected the liking and emotional states of consumers towards the meats. In general, the juiciness and tenderness of meats elicited positive, whereas meat microelements and collagen content provoked negative emotions in consumers.
- It is recommended that the study be extended to include most of the major muscles on a carcass for beef and lamb and to validate other factors and lexicons that might be more appropriate for describing the emotions of consumers towards cuts rich in nutrients but lower in palatability for marketing and adding value purposes.

7 Key messages

- Nutritional and functional mapping of all the major cuts in a carcass is necessary to enable cuts to be differentiated and to add value from health and wellness perspectives rather than eating quality alone.
- Understanding the major health and wellness drivers for consumers in major Australian beef and lamb markets is necessary to fully exploit the opportunities associated with deeper carcass mapping for nutrients and functionalities relevant to consumers.
- Carcass mapping based on emotions beyond liking can facilitate insightful and nuanced product differentiation aligned with product performance as experienced by consumers in a given context for marketing purposes.
- The generated consumer emotion lexicon can be refined to cover other muscles across the carcass and potentially expand or develop an organ meat-specific lexicon. Meat composition along with consumer liking and emotion data should be collected over time to find functional and emotional patterns of response to different red meat Cuts x Cooking methods x Contexts combinations for targeted marketing of differential value propositions based on improved consumer experience (e.g. best cut for a given occasion) and/or health and well-being (e.g. higher iron).
- If certain emotions are confirmed with further studies as predictors of potential market success, the meat industry could reduce the risk of introducing a cut in the marketplace that is prone to fail in adding value and reduce the lengthy testing time.
- Key industry stakeholders in New Zealand saw potential benefits for their business in providing additional information on labels relevant for their customer/consumer health and wellness.
- There are potential but not insurmountable barriers identified for front of the pack labelling of beef and lamb for health and wellness purposes.

Consumers are considering health and wellness more than just eating quality indicators in their choice of beef and lamb as meal ingredients. Meat processors and purveyors must respond to this signal from consumers by providing evidence-based front of the pack messages/information about beef and lamb nutrients and functionalities to (1) enable consumers to make informed decisions at the point of meat purchase about which cuts better support their wellbeing requirements, (2) attract premiums for farmers and processors alike, and (3) ensure a sustainable meat industry long-term. This value proposition is found through survey to be attractive to some major industry stakeholders in New Zealand.

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