

Final report

Mincing words: Valorisation of mince beef through nutrient/functional formulation

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Abstract

This project aims to deliver a prototype of nutrient-enhanced mince to early adopters in the Australian Meat Industry, based on insights from mapping beef muscles and offal for nutrients and functionalities valued by Australian consumers. The project includes four main tasks: (1) opportunity discovery, (2) concept scoping, (3) value proposition development, and (4) business model development and commercial solution provision.

Literature review, lab studies, focus groups, and consumer surveys identified iron as a key nutrient sought by consumers. A blend of 85% beef mince and 15% beef liver meets FSANZ's RDIs for iron, allowing it to be marketed as a "source of," "good source," or "complete source" of iron. To assess desirability, the prototype was tested in real-world usage, with 73% of respondents expressing positive feedback and interest in future adoption.

Recommendations include positioning the beef-liver mince as a bold new product rather than hiding its liver content. Adoption of this nutrient-enhanced mince by the Beef Industry is expected to boost revenue, promote sustainability, and highlight the nutritional benefits of beef. This differentiation can attract health-conscious consumers, particularly those in the 'Mixed Feelings - Health' and 'Part of my Culture' segments and eventually the 'Young, Sheltered Lives' segment, ensuring the industry's long-term sustainability and profitability.

Executive summary

Background

This project aimed to explore whether nutrient enhanced beef mince can appeal to Australian consumers and command a premium price, reflecting a shift in consumer trends towards seeking foods with positive health benefits. The research sought to assess and understand the following points: feasible nutrient enhancements for mince meeting regulatory requirements, consumers' reactions to conceptual prototypes, nutritional properties of a range of beef muscles and organ meats, determination of nutrient composition of enhanced mince using rapid and non-invasive methods, consumer preference between specific nutrient claims vs holistic wellness concepts, barriers to consumer in home usage, and feasibility and viability of the value proposition using Business Model Canvas. The main target audience includes meat processors, retailers, and health-conscious consumers, as they will use the findings to guide product development, marketing strategies, and purchase decisions.

Objectives

The project achieved the following objectives: 1. Literature review of nutritionally enhanced food offerings in the market, 2. Lab feasibility assessment of prototypes, 3. Consumer validation, 4. Carcass mapping of beef muscle and organ functionality, 5. Rapid analysis of target nutrients, 6. Value proposition, 7. Consumer usage testing, 8. Business Model Canvas, 9. Technology transfer to the Australian meat industry, and 10. Launch strategy.

Methodology

The project design considered the appeal of nutritionally enhanced beef mince by determining the optimal degree of enhancement and identifying the ideal combination of beef muscles and organ meats. It focused on whether health and wellness benefits should be expressed at the nutrient or overall wellbeing level, evaluated real-world perceptions and trade-offs of the product, assessed economic feasibility of production, and explored requirements for market acceptance and integration into existing mince production lines. The project involved four key milestones: (1) scoping phase – literature review, (2) scoping phase – proof of concept, (3) value proposition development, and (4) Business Model Canvas and commercial solution development. Detailed method descriptions of each milestone and task were provided in the corresponding milestone reports: 1, 2a, 2b, 3a, 3b, 4a, and 4b.

Results/key findings

Scoping phase – literature review

The literature review and analysis highlighted:

- Significant variability in nutrient content across beef cuts and organ meats enabling nutrient enhancement of beef mince.
- High consumer preference for beef mince due to its versatility.
- The potential for a premium for nutrient-enhanced beef based on the premiums achieved by other products in the market.
- Limited commercial examples of mince incorporating offal meats for nutrient enhancement.
- Main challenge involves consumer aversion (“yuk factor”) to organ meats.

Scoping phase – proof of concept

The regulatory review, laboratory formulation of nutrient enhanced mince and consumer testing indicated:

- Regulatory guidelines support nutrient claims for enhanced mince.
- Acceptable formulations with 10, 20 and 30% kidney, liver and heart, respectively, enhance nutrients like iron, vitamins A and B12, and omega-3 fatty acids.
- Liver was most effective due to higher nutrient density.
- Qualitative and quantitative consumer trials showed significant potential for nutrient enhanced mince, particularly when flavoured dishes masked organ meat taste.
- Mince was seen as an ideal vehicle for nutrient enhancement, with consumers expecting a meaningful 50% nutrient increase.
- Enhanced mince versions can potentially trade up existing 4 and 5-star mince users and increase overall mince consumption, possibly reducing reliance on supplements.
- Offal inclusion may require adaptations in cooking and address concerns about smell and taste, with 15% of consumers finding the idea off-putting.
- Alternative packaging format is needed to address colour and shelf-life issues of mince with added offal.

Value proposition development

Nutrient mapping of beef cuts and organ meats, and prediction of nutrient profiles using hyperspectral imaging (HSI) and UV-Vis-NIR spectroscopy (NIRS) demonstrated:

- High variability in composition and nutrient profiles of different cuts and offal meats.
- Potential for rapid and non-invasive nutrient analysis: high R^2 values suggest the feasibility of using HSI and/or NIR for rapid nutrient analysis in commercial production, though more robust calibration with larger sample sizes is needed.
- An 85:15 beef-liver mince formulation was preferred by consumers, offering a balanced nutrient boost using 8.4mg/100g iron content of liver.

The consumer trial using a prototype 85% beef and 15% liver blend ("Super Mince") assessed real-world usage and perceptions providing the following insights:

- Enhanced nutrient content was highly appealing, particularly for health-conscious consumers, but they are worried about the strong taste of liver.
- Optimism about the product increases once it is browned and combined with other ingredients, making it more like regular mince.
- Taste and texture perceptions varied, with sauces and strong flavours masking organ meat differences, making the product suitable for strongly flavoured dishes rather than meals requiring a pure beef taste, like burgers.
- Younger consumers valued sustainability, using more of the animal and minimal packaging.
- 73% of participants expressed future purchasing intent, although enthusiasm decreased with a 20% price premium, indicating consumer price sensitivity and awareness of liver's low cost.

Business Model Canvas and commercial solution development

Two primary production paths were identified for integrating beef-liver mince into existing production systems with minimal adaptations affecting feasibility and commercial viability:

- *Chilled supply chain*: advanced packaging solutions are needed to extend shelf life. This approach may cause significant disruptions and costs to current beef mince production but maintains the normal downstream chilled supply chain operations.
- *Frozen supply chain*: this validated approach, used successfully by premium butchers, significantly extends shelf life through freezing. It causes fewer production disruptions but incurs Capex costs if frozen beef mince is sold alongside chilled mince in supermarkets.

The launch strategy defined the customer journey map and identified critical opportunities for engagement:

- Key stages involve understanding the target customer's mindset, mapping their decision journey, and identifying touchpoints for effective engagement.
- By addressing preconceptions, meal preparation experiences, and advocating ongoing usage, the strategy aims to ensure a positive consumer experience and long-term adoption.

Benefits to industry

Focusing on the beef mince segment, a widely consumed product, this project filled a significant knowledge gap and provided actionable insights that can drive innovation and competitiveness in the Australian meat industry:

- Adoption of nutrient enhanced mince is expected to boost revenue and promote sustainability within the beef industry.
- The product can create a distinct market position, attracting early adopters and driving positive perceptions of red meat.
- Differentiation from regular mince can attract health-conscious consumers, particularly those in the 'Mixed Feelings - Health' and 'Part of my Culture' segments.

Future research and recommendations

- *Shelf-life assessment*: Test different types of chilled packaging for an 85% beef mince and 15% liver blend undertaken by a proper testing lab following strict protocols and conditions.
- *Operational test runs*: Conduct commercial-scale test runs to evaluate the impact on production costs and disruptions to existing operations.
- *Test market deployment*: Test frozen beef-liver mince to assess consumer adoption and switching behaviour.
- *Test toned-down versions of the enhanced blend*: Develop a "half-strength" version with 7 to 10% liver content to appeal to consumers who are hesitant about the strong flavour.

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1. Background

Recent consumer trends have shifted from merely avoiding perceived negative dietary components—such as sugar, salt, and artificial ingredients—to actively seeking foods that offer positive health and wellness benefits. This shift presents a unique opportunity for the red meat industry to evolve from promoting a "non-negative" health message (emphasizing leanness and moderation) to highlighting the positive health benefits of nutrient-enhanced meat products. Enhancing the nutrient composition of red meat, rather than simply adding nutrients to meat matrices, is believed to be a more compelling approach to motivate consumers.

Outcomes of two previous surveys of New Zealand consumers indicate they would be willing to pay a premium for front of the pack labelling of meat with nutrients and functionalities relevant to their wellbeing (Farouk et al., 2019; Realini et al., 2019). The surveyed consumers also indicated mince/ground meat is one of the matrices they most frequently consumed beef, due to the versatile nature as an ingredient for various food formulations (Farouk et al., 2019). In Australia, beef mince represents approximately 30% of all the beef dishes prepared in households (Fayet-Moore et al., 2014).

For a claim to be made, 20% incremental improvement of a nutrient/functionality over a standard version is needed to be achieved to justify making the claim (Flynn and Green, 2021). This is far more readily achievable if offal meats are utilised as a component of the formulation of the mince. For example, data from Beef & Lamb NZ indicates liver has 338% more iron than most lean muscle meats, whereas the muscle meat with the highest level of iron, only has 20% more. Thus, suggesting a blend of mince lean meat with a small percentage of liver can enhance the iron content beyond what is required to make a claim for incremental improvement of a nutrient of interest (Beef & Lamb NZ, 2022). However, it is clearly understood that beef is first and foremost consumed for its flavour enjoyment and suitability for a range of favourite meals, and that compromising on this would significantly affect the acceptability of any nutrient enhanced mince product.

Product differentiation and premiumisation via functionality claims are well-established in many food categories. Farouk et al. (2019) highlighted examples where nutrient enhancement claims led to significant premiums: (1) Waitrose Omega 3 chicken attracted 33% premium compared to equivalent chicken with no functional claim; (2) a premium of up to 103% was charged for the combination of functional labelling and further processing, as demonstrated by the price difference between Waitrose's functionally labelled chicken breast and unlabelled counterpart.

This project hypothesized that nutrient enhanced mince would appeal to Australian consumers and command a premium, like other product categories that currently enjoy strong consumer patronage and premium prices for their processors. To test this hypothesis, there are several primary questions that should be addressed, including:

1. What are the feasible nutrient enhancements for mince that meet regulatory requirements for nutritional claims?
2. How do consumers react to conceptual prototypes of nutrient enhanced mince?
3. What are the nutritional properties of various beef muscles and offal meats, and how can they be formulated to deliver a valuable nutrient enhanced product prototype?
4. How can the nutrient composition be assessed through rapid, non-invasive testing methods?
5. What is the consumer preference between specific nutrient claims (e.g., High in Iron) versus holistic wellness concepts (e.g., Vitality Boosting with Fe, B12, K)?
6. What are the barriers to ongoing consumer usage of nutrient enhanced mince, and how can

these barriers be addressed through in-home usage testing?

7. What is the feasibility and viability (through Business Model Canvas tool) of the value proposition?
8. Ultimately, whether Australian consumers will value nutrient enhanced mince enough to pay a premium.

These questions are critical for meat processors and retailers to determine the viability and profitability of such products. The target audience for this research includes meat processors, retailers, and health-conscious consumers, who will use the insights gained from this project to guide product development, marketing strategies, and purchase decisions. Focusing on the beef mince segment, this project aimed to fill a significant knowledge gap and provide actionable insights that can drive innovation and competitiveness in the Australian meat industry.

2. Objectives

The original objectives of the project and their achievements are listed below:

1. Complete a literature review

The review of literature was comprehensive and covered industry reports, refereed journal articles, retail outlets, webpages and commercial product databases (e.g., Mintel). The information was summarised, discussed and key insights highlighted in Milestone 1 (marketing assessment of successful offerings) and Milestone 2a (regulatory requirements for nutritional claims) reports.

2. Assess lab feasibility of prototypes

Laboratory trials successfully developed mince prototypes incorporating liver, heart, and kidney, demonstrating the feasibility of these formulations in a small-scale lab setting. These prototypes were then sensorially evaluated by consumers in a focus group, confirming the potential acceptability of some of the prototypes. Results were presented and discussed in Milestone 2a report.

3. Consumer validation

A qualitative research group survey was conducted to understand consumers' reactions to the conceptual prototype offering, followed by a quantitative survey that validated the appeal of nutrient enhanced beef mince by consumers. Results were presented and discussed in Milestone 2b report.

4. Carcass mapping of beef muscle functionality

The nutritional properties of a series of muscles and organ meats were assessed, and a recommended formulation developed for the value proposition. Results were presented and discussed, and recommendations provided in Milestone 3a report. Manufacturing guidelines of the recommended liver enriched mince were developed for small butcher operations to be used in objective 7.

5. Rapid analysis of target nutrients

The analysis and prediction of nutrient profiles showed potential for using hyperspectral imaging (HSI) and UV-Vis-NIR spectroscopy as rapid and non-invasive tools. Results were presented and discussed in Milestone 3a report.

6. Value proposition

A quantitative study evaluated the appeal and trial likelihood of nutrient-enhanced beef mince with 15% liver, focusing on consumers' dietary preferences, perceptions of offal, and the credibility of various health benefit claims. Results were presented and discussed, and recommendations provided in Milestone 3b report.

7. Consumer usage testing

A consumer usage testing in a real-world context evaluated the likelihood of repeat purchases of nutrient-enhanced beef mince by assessing consumer satisfaction, barriers to adoption, and the potential for a 20% price premium, while identifying early adopters and examining the impact on perceptions of red meat's healthiness and sustainability. Results were presented and discussed, and recommendations provided in Milestone 3b report.

8. Business Model Canvas

The Business Model Canvas was completed by integrating feasibility and viability considerations for producing the beef-liver mince blend, working with a Commercial Partner to assess the necessary operational changes and evaluate incremental costs and revenues. The Business Model Canvas was presented and discussed, and recommendations provided in Milestone 4a report.

9. Technology transfer to the Australian meat industry

The technology transfer process has been documented, starting with lab scale blending, testing, and progressing to the actual production of consumer test samples by a selected butcher (an example of the preparation guidelines of concept samples for consumer in-home usage testing, can be found in Appendix 1). If a future commercial partner expresses interest in proceeding, the technology transfer associated with this project will continue.

10. Launch strategy

A launch strategy was proposed for the beef-liver mince blend to achieve best chance of market establishment, including defining a consumer journey map and highlighting key areas for maximum influence on target consumers. The launch strategy was presented, and recommendations provided in Milestone 4b report.

3. Methodology

The project design considered the appeal of nutritionally enhanced beef mince, determining the optimal degree of enhancement, and identifying the best combination of muscle and organ meats. It focused on whether health and wellness benefits should be expressed at the nutrient or overall wellbeing level, evaluated the real-world perception and trade-offs of the product, assessed economic production feasibility, and explored the requirements for market acceptance and integration into existing mince production lines. The methods used are outlined below. For additional details, please refer to the corresponding milestone reports: 1, 2a, 2b, 3a, 3b, 4a, and 4b.

3.1 Scoping phase – Literature review

3.1.1 Market review

The review included published industry reports, journal articles, retail outlet webpages, commercial product databases (e.g., Mintel), and internet grey literature. The approach focused on exploring mainstream offerings through grocery channels and commercial databases, assessing successful and recent products, and considering previous attempts like omega-3 rich chicken. Success criteria included the ability to command a price premium, display prominence, and evaluation of nutritional attributes, perceived health benefits, nutritional focus, and enhancement methods. The review classified offerings into primary categories (e.g., dairy, juices, eggs, meats), minimally processed categories (e.g., pasta, bread, plant-based milks), and excluded complex processed categories (e.g., snack products).

3.2 Scoping phase – Proof of concept

Two lab trials were conducted to determine acceptable levels of offal (liver, heart, and kidney) in beef mince for a focus group of testers. The second trial refined these formulations to meet consumer acceptability within the limits allowed by FSANZ. Final prototypes were then used to develop a questionnaire to test Australian consumer acceptance of the nutrient enhancement concept and lab-formulated prototypes.

3.2.1 Regulatory requirements for nutritional claims

The sale of all foods, including beef mince, in Australia and New Zealand is regulated by the joint Food Standard (FSANZ). Our review of regulatory requirements for nutritional claims focused on the standards established under the Food Standards Australia New Zealand Act 1991 and its amendments. Additionally, we reviewed other health and nutrition-related guides to understand professional recommendations to consumers and how they differ from FSANZ regulations.

3.2.2 Lab development and testing (what is feasible in the lab)

3.2.2.1. *Preliminary lab trial and testing of formulated mince products*

Three whole chucks and three types of organ meats (liver, heart, and kidney) from three animals were used for the preliminary lab trial. All cuts and organs were received frozen, stored at -20°C, and defrosted at 3-4°C for 72 hours before testing. The heart, liver, and kidney were sliced, analysed for pH and colour, then ground for chemical analyses. Composite samples of the chucks and offal meats were formulated and minced through a 3 mm plate to test various enhanced nutrient beef mince blends, with percentages of liver, heart, and kidney ranging from 0% to 30% (0, 2.5, 5, 10, 15, 20 and 30%). The blends were mixed, reground, and sampled for chemical analyses before being formed into patties for further analysis. These patties were evaluated for colour stability under simulated retail conditions, then grilled and served to a tasting panel to determine the acceptable levels of offal meat incorporation.

3.2.2.2. *Main lab trial and focus group testing of formulated mince products*

The main lab trial evaluated mince shelf-life in two formats: traditional meat product and as patties in trays. Mince and patties were placed on polystyrene foam trays overwrapped with traditional polyvinyl chloride (PVC) permeable film and kept in refrigeration (2–4°C) and darkness. Ten products (including 2 controls plus liver and mixed organ additions at 4 levels: 5, 10, 20 and 30%) assessed over a week in simulated retail conditions. Instrumental colour measurements and photos were taken daily.

An AgResearch in-house tasting panel with 12 diverse participants evaluated nine patty formulations, cooked and cut into portions [C: Control (just mince from chuck), L5: Liver 5%, L10: Liver 10%, L20: Liver 20%, L30: Liver 30%, L20S: Liver 20% + Spices, L30S: Liver 30% + Spices, M20S: Organ Mix (2 liver:1 kidney:1 heart) 20% + Spices, M30S: Organ Mix 30% + Spices]. Participants ranked the patties in order of preference and provided feedback on each, testing formulations with varying levels of liver, spices, and mixed organs.

3.2.3 Testing and validation of prototypes by Australian consumers

3.2.2.3. Qualitative consumer research

The first phase of research involved Qualitative Research Groups to gain deeper insights into consumer motivations and perceptions, making the subsequent Quantitative Research phase more effective. Key areas investigated included the importance of nutrients for health and wellness, the role of beef mince in consumers' lives, familiarity with offal and its nutritional benefits, differing opinions on nutrient-enhanced formulations, and the appeal of offal-based nutrient enhancements. Qualitative groups, conducted both online and face-to-face, consisted of regular beef mince eaters who valued good nutrition and were stratified by household structure:

- DINKS (under 45, living with partner, no kids)
- Young Families (kids predominantly 11 or under)
- Older Families (kids predominantly 12 and over)
- Empty Nesters (45 and over, no dependent kids)

3.2.2.4. Quantitative consumer survey

This project stage aimed to validate the appeal of nutrient-enhanced beef mince, achieved by incorporating offal. Insights from qualitative research shaped the questionnaire and respondent sample, which included 800 'core users' of beef mince, ensuring statistical robustness and adequate representation of key consumer segments. The strategy focused on trading existing users up to a higher value offering rather than attracting new users or increasing consumption frequency. Therefore, respondents had to be main grocery buyers who had bought beef mince in the last month. Excluded groups were single-person households and retirees aged 70 plus. The research ensured a minimum of 160 respondents from defined household structures (DINKS, Young Families, Older Families, and Empty Nesters) and a spread of household incomes, particularly over \$140K. A total of 1339 respondents started the survey, with 823 completing it. Key investigation areas included existing mince behaviour, consumers' motivation for nutrient-rich diets, familiarity with offal, reactions to nutrient-enhanced beef mince, future purchase intent, willingness to trade up from existing choices, and the potential impact on increased consumption.

3.3 Value proposition development

3.3.1 Carcass functional mapping

3.3.1.1 Animals, preparations, and sampling

Preliminary trial

Two cuts, the crosscut (*M. infraspinatus*) and the eye of the round (*M. semitendinosus*), were obtained from five beef carcasses. These cuts were held at 12°C overnight to set in rigor before processing. The left and right sides of each muscle from each carcass were combined, ground, and divided into three portions. Each portion was then ground using different plate sizes (3.0-mm and 4.5-mm) to create

patties for analysis. This resulted in 25 mince combinations. The study aimed to evaluate the effects of plate size and muscle type on the physical and chemical properties of ground beef and to assess the feasibility of using hyperspectral imaging (HSI) to predict these properties.

Main trial

Beef cuts and offal meats from three animals were sourced from a NZ meat processing plant. Six beef cuts (chuck, clod, brisket, inside, outside, and knuckles) and three offal meats (liver, heart, and kidney) were ground and mixed individually. The ground beef cuts were formed into patties and also used to formulate nutrient-enhanced meats with varying levels of liver and a mix of liver, kidney, and heart. This resulted in 33 patty combinations, including both enhanced and non-enhanced mince. The patties were analysed using HSI and UV-Vis-NIR spectrophotometry and sampled for nutrient profile analyses.

3.3.1.2 Physical and chemical measurements

Preliminary trial

pH: The pH of beef cuts from 5 animals was measured using a calibrated pH probe, with duplicate measurements taken and averaged.

Proximate Analysis: Moisture content was measured by oven drying, crude fat by Soxhlet extraction, and protein content by the Kjeldahl method.

Collagen: Approximately 0.3 g of freeze-dried meat was hydrolysed in HCl, reacted with chloramine propanol buffer and dimethylaminobenzaldehyde, and the absorbance measured at 570 nm to determine hydroxyproline content, which was then used to calculate collagen content.

Iron

Haem Iron: Haem iron concentration was determined by homogenizing meat with an extraction buffer, centrifuging, and measuring optical density at 640 nm against a hematin standard curve.

Non-Haem Iron: Non-haem iron was extracted with citrate buffer, ascorbic acid, and trichloroacetic acid, then reacted with ferrozine reagent, and the absorbance measured at 562 nm against an iron standard curve.

Total Iron: Total iron content was calculated by adding the haem and non-haem iron percentages.

Instrumental Colour: Beef patties were bloomed at 6-8 °C for 30 min, and colour was measured using a Minolta Chroma Meter to record L* (lightness), a* (redness), and b* (yellowness). Chroma and hue angle were calculated to provide a more detailed description of the colour properties.

Main trial

Elemental Analysis: Samples from patties were analysed for elemental composition at an accredited food composition laboratory (Eurofins, New Zealand). Following AOAC 990.08 guidelines, patties were digested with nitric and hydrochloric acids and analysed using inductively coupled plasma mass spectrometry (ICP-MS). Results are reported as mg per kg of meat.

Fat-Soluble Vitamins: To extract fat-soluble vitamins, approximately 5 g of sample were homogenized with 8 mL of 2% Pyrogallol (in ethanol). After overnight incubation, the mixture was extracted using 0.01% butylated hydroxytoluene (in hexane), centrifuged, and the supernatant evaporated under nitrogen. Extracted vitamins were quantified via HPLC on an Accucore™ C30 column, with detection wavelengths set for each vitamin. Standard curves of five standard vitamin solutions determined vitamin concentrations in meat samples, presented as µg per 100 g meat.

Fatty Acid Profile: An approx. 50 g sub-sample of minced meat underwent freeze-drying and grinding into a fine powder. Fatty acid analysis was conducted using a direct trans-methylation method as described by Agnew et al. (2019). Total fatty acid content was presented as a weight percentage of raw meat (g of fat per 100 g of meat or percentage fat, IMF), while individual fatty acid concentrations were reported as mg of fatty acid per g of wet basis.

3.3.2 Rapid non-invasive testing of nutrients

Preliminary trial (HSI)

In the preliminary trial, patty samples underwent analysis using a hyperspectral imaging (HSI) system comprising a translation stage, illumination system, and a hyperspectral camera. The camera, with a spectral range of 550 nm to 1700 nm and a spectral resolution of 5 nm, was adjusted to prevent detector saturation and ensure square pixels in the image. Each hyperspectral image was calibrated for reflectance values to mitigate spatial distribution effects on the sample surface. HSI was conducted on both sides of each patty to ensure comprehensive analysis.

Main trial (HSI and UV-Vis-NIR spectrophotometer)

In the main trial, HSI measurements followed the same protocol as in the preliminary trial. Additionally, UV-Vis-NIR spectrophotometry was performed using a LabSpec5000 spectrophotometer with a spectral range of 350–2500 nm. Spectra were collected using a custom contact probe, calibrated with dark current and white reference measurements, with three measurements taken on each side of the sample surface, totalling 6 measurements per patty.

3.3.3 Large scale quantitative testing of specific vs. holistic wellness concepts

This study sought to understand the appeal of the concept across a broad and statistically robust sample of consumers. The research was undertaken online, where visual concepts can be shared with respondents and a large sample of consumers can be accessed:

- 2235 respondents commenced the research, with 1202 qualifying, as ‘beef mince users’.
- Respondents were filtered out if they didn’t regularly eat beef mince (fortnightly), weren’t the main/shared decision maker for household food choices or were over 70 years of age.
- The sample reflected the Australian population, in terms of household income and by state within Australia.

3.3.4 Consumer in home usage testing of prototype offering

This study employed a mixed-methods approach to explore consumer usage experiences of a prototype offering, combining video ethnography, detailed written responses, and quantitative measures. A total of 48 ethnography respondents across three states (VIC, QLD, & NSW) and 54 written-response respondents primarily from VIC participated. The delivery process ensured convenience, with respondents selecting the quantity and delivery day of the beef-liver mince samples, and contingency plans were in place for unforeseen circumstances. Respondents received a guidance 1-pager to structure their feedback naturally. Data collection involved video ethnography capturing real-time experiences and written responses with accompanying photos, while quantitative assessment provided statistical robustness, exploring attribute assessment and future intentions. The comprehensive analysis aimed to inform product development, marketing strategies, and commercial decisions.

The prototype offering, Super Mince, consisted of 85% beef mince and 15% beef liver, vacuum-sealed for freshness and extended shelf life. Produced by Cannings butchers, it maintained quality and safety, labelled simply as "Super Mince - 85% beef mince & 15% beef liver" (Figures 1 and 2). Instructions emphasized consuming the product within 24 hours of defrosting. Attributes of the beef-liver mince blend were objectively assessed, noting its darker colour, minimal visible fat, paste-like consistency, and mild odour as crucial considerations for consumer acceptability. Acknowledging the subjective nature of attribute interpretation, the study aimed to capture varied preferences to assess overall acceptability effectively.



Figure 1: Super Mince prototype offering produced by Cannings butchers for consumer in home usage testing.



Figure 2: Opened pack of “Super Mince” prototype offering produced by Cannings butchers for consumer in home usage testing.

3.4 Completion of Business Model Canvas

The Business Model Canvas was completed by integrating feasibility and viability considerations for producing the beef-liver mince blend, working with a Commercial Partner to assess the necessary operational changes and evaluate incremental costs and revenues. To ensure easy adoption by the red meat industry, it was considered preferable to produce the blend within existing beef mince production setups, minimizing business model adaptations and avoiding the significant capital expenditure and risks associated with establishing a new production plant. Preliminary feasibility work with the leading beef mince producer identified potential challenges. Despite plans to produce a 120kg batch for consumer testing and challenge validation, operational demands prevented a test run, leaving these challenges as assumptions until business validation. A launch strategy was proposed for the beef-liver mince blend to achieve best chance of market establishment, including defining a consumer journey map and highlighting key areas for maximum influence on target consumers.

4. Results

4.1 Scoping phase – Market review

4.1.1 Implications from the review of Industry reports & commercial product databases

4.1.1.1 *Mince matrix*

Outcomes of our literature review found that the mince matrix is highly desirable to consumers due to its versatility and convenience as an ingredient. The versatility of mince is evidenced by the many dishes that can be prepared using mince as the meat ingredient (refer to Farouk et al., 2022a for details). A mince matrix, unlike whole tissue muscles/steaks, also has the following advantages:

1. Enable the formulation of meat ingredients with enhanced nutrients by combining ground meat from different muscles in a carcass or from a range of carcass classes or offcuts.
2. Enable the incorporation of offal/organ meats for their specific nutrients and functionalities.
3. Enable specific improvements to be made in nutrients for the purpose of meeting RDI (Recommended Daily Intake) and/or regulatory targets for making claims.

4.1.1.2 *Muscle and offal nutritional composition*

Data on the nutrient composition of muscle and offal meats will be required for the nutrient enhancement of mince to be achieved and optimised. Our review found strong evidence to suggest that the nutrient contents of beef cuts and offal meats vary enough to make it possible to formulate mince with enhanced nutrient content.

4.1.1.3 *Ability of nutrient enhanced offerings to command a price premium*

Outcomes of our review suggest product differentiation and premiumization via functionality claims can be found in many food categories such as, (1) Waitrose Omega 3 chicken attracting 33% premium compared to equivalent chicken with no functional claim; (2) a premium of up to 103% was being charged for the interaction between functional labelling and further processing as exemplified by the difference in the prices of Waitrose functionally labelled chicken breast and the one that was not; (3) the whole chicken example compared to the boneless chicken breast shows that the functionality premium was almost three-fold higher in the further processed product form, illustrating that when developing a processing strategy to maximise value, there may be important interactions at play between functionality claims and product packaging/presentation; (4) Weet-Bix cholesterol lowering variety attracted a 55% premium over the baseline product in a similar size; and (5) Manuka honey with the higher methylglyoxal (MGO) content attracted a significant premium (150%) over lower strength versions of Manuka honey. In the same report Farouk et al. (2019) found that just by indicating the content of soluble collagen and iron on a packaged meat label could attract premiums up to 67% compared to no functional labelling at all (control) highlighting the importance of health message framing for consumers. The report also provided other examples where nutrient enhancements are being capitalised on or touted by the food industry underscoring the different food categories charging premiums for claims related to the enhancement of nutrients of interest to the health and wellbeing of consumers. Outcomes of the review also indicated that premiums can be achieved beyond a standard branded offering, with the broadly appealing health benefit attracting premiums in order of 30% to 40%, and the more focused offerings with targeted appeal achieving 70% to 80% (detailed references are found in Farouk et al. 2022a).

4.1.1.4 Learnings from other markets where nutrient enhancement of red meat has been undertaken

Outcome of our review revealed hardly any examples of products in commerce indicating nutrient enhancement, was achieved using offal/organ meats in a mince. The most consistent and successful strategy by the food industry sectors currently enjoying premiums for their nutrient enhanced offerings, is by boosting the nutrients that are inherently present, delivering a health and wellness (H&W) benefit, such as boosting the live cultures in yoghurt for gut health. A small incremental improvement in a key attribute can be sufficient, particularly if it delivers on recommended dietary intake (RDI), such as YoPro’s 15% increase in protein, but delivers a daily ‘serve of protein’ or the Kiwi Gold’s 18% increase in Vitamin C, but delivers a daily serve of Vitamin C. There is no single definitive approach to adding value in enhanced H&W, some products have a key nutrient that resonates at the attribute level (e.g., consumers want more Protein, Omega 3, Fibre), other products’ key nutrients are better expressed as delivering a H&W benefit (e.g., Vitamin B12 to assist with Immunity function), yet, other products offer a bundle of nutrients for holistic H&W (e.g., Special K cereal for women).

4.1.2 Marketing assessment of successful offerings from other categories

In our review (Farouk et al., 2022a), sectors with enhanced offerings like milk, juices, eggs, kiwi fruit, tinned tuna, and chicken; and those with fortified offerings like pasta, yoghurts, bread, cereal and milk alternatives were examined. Outcomes of the review suggest that there are many examples from the food industries of products attracting premiums from enhanced nutrient claims.

4.1.2.1 Identification of alternate angles & most successful approach / what works

There are several ways H&W enhancement have been approached by the food industry as shown in Figure 3.

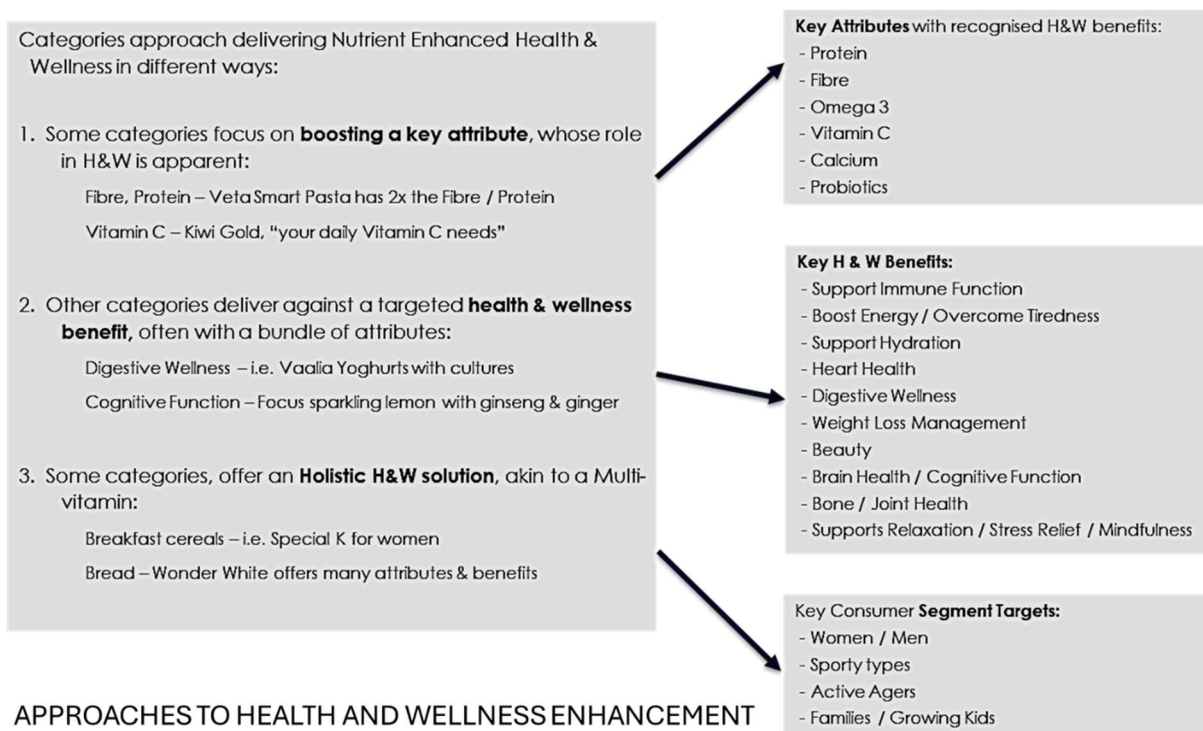


Figure 3: Approaches to health and wellness by the food industry.

4.1.2.2 *Achieving nutrient enhancement without compromising other dimensions of quality*

The biggest challenge in the nutrient enhancement of meat using offal/organ meats is the possible yuk factor associated with the use of organ meats for certain categories of consumers. Thus, any new offerings need to achieve nutrient enhancement without compromising other food product dimensions such as Wonder White (tastes the same) bread and Smart Pasta (same great taste); however, some offerings that deliver extreme benefits use taste compromise to emphasise those benefits such as the use of ginger in mood enhancing juices.

4.2 Scoping phase - Proof of concept

For detailed information on the initial scoping of the concept of nutrient enhanced mince refer to Farouk et al., 2022b.

4.2.1 Regulatory requirements for nutritional claims

The Australia New Zealand Food Standards Code (FSANZ) was the main document reviewed plus some other nutritional guidelines published by government or food industry organizations. The emphasis on FSANZ was because its codes provide the guidelines that the food industry in Australia and New Zealand must adhere to.

4.2.1.1 *Understanding the regulatory barriers to making claims*

Regarding the use of beef cuts and offal in formulating a nutrient enhanced beef mince and the ability to make claims about the boosted nutrients, the search of FSANZ revealed among others, that:

1. Edible offal includes the brain, heart, kidney, liver, pancreas, spleen, thymus, tongue, and tripe from buffalo, cattle, camel, deer, donkey, goat, hare, horse, kangaroo, pig, possum, rabbit, sheep, and wallaby.
2. For labelling purposes, offal including brain, heart, kidney, liver, tongue, or tripe must be identified on the label as offal; or by the specific name of the type of offal; and any other type of offal must be identified by the specific name of the type of offal.
3. A nutritional content claim can be made about the presence or absence of fat, components of protein, minerals, and vitamins; but only the nutrients listed in FSANZ can be claimed.
4. The general condition for claiming a mineral or vitamin is that a serving of the food contains at least 10% RDI (recommended dietary intake) or ESADDI (estimated safe and adequate daily dietary intake) for that vitamin or mineral; and the claim is not for more of the specific vitamin or mineral than the amount permitted by FSANZ.
5. For a food to be claimed to be a “good source” of a mineral or vitamin, a serving of the food contains no less than 25% RDI or ESADDI for that mineral or vitamin.

4.2.2 Lab development and testing assess what is feasible in the lab

The preliminary and main laboratory scoping of the concept of nutrient enhanced mince considered different nutrient angles, variations, trade-offs, consumer acceptability and expectations, regulatory requirements, and other product formulary requirements in the prototypes mince products produced and tested by a focus consumer panel of 12 in New Zealand and through a qualitative focus and quantitative surveys of 800 consumers in Australia.

4.2.2.1 What level of enhancement can be achieved, based upon the key components available

A beef mincemeat can be formulated with liver, heart, and kidney at up to 30% level of incorporation without significantly affecting the appearance of the mince or the physical appearance of the patties made with the mince. However, the display colour stability of the enhanced patties and mince were affected (higher browning) by the addition of offal meats at the levels used in the initial scoping trial. The nutrient enhancement was much easier with liver than hearts and kidneys due to the significant difference in the desired nutrients between liver and the other two organ meats. [See nutrient composition in Beef + Lamb New Zealand (2022), and photos in Figure 4a&b]. The shorter colour shelf-life with the incorporation of offal is expected since iron at high concentrations and particularly free iron is pro-oxidant (Min et al., 2008); especially from a mince product where the muscle structure has been disrupted and exposed to oxygen. The use of overwrap packaging using oxygen permeable film yields the shortest colour shelf-life during display in retail. Other packaging formats such as modified atmosphere packaging (MAP) or vacuum as well as frozen product should be tested for enriched mince with liver or mixed offal to define their shelf-life.

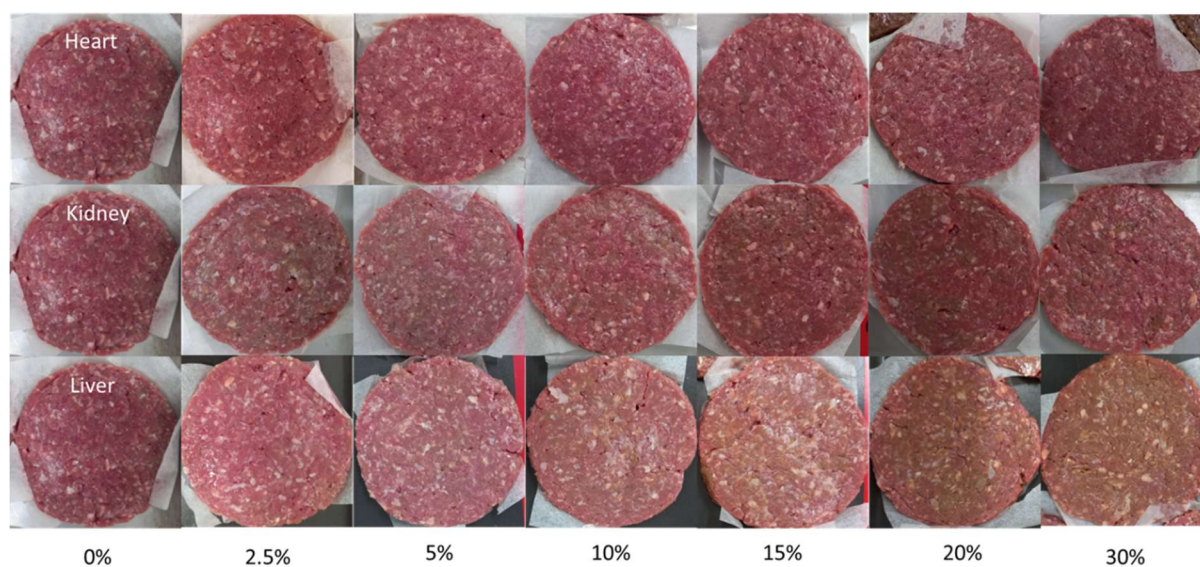


Figure 4a: Shows the preliminary lab trial beef mince patties formulated with seven levels of offal meats incorporation (from left to right: 0, 2.5, 5, 10, 15, 20, and 30 %) and held under simulated retail display at 4C for 8 days. The pictures were taken on the 8th day of display.

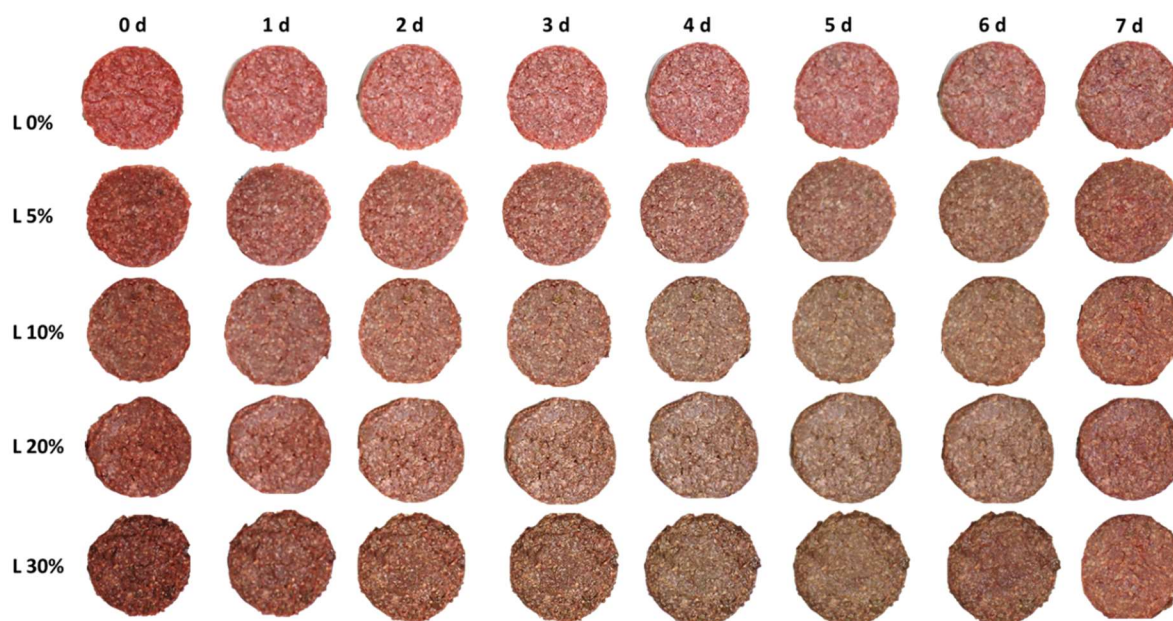


Figure 4b: Images of liver enriched patties (1 control plus 4 levels: 5, 10, 20 and 30%) during 1 week of simulated retail display. L = liver levels and d = display days at 4C.

4.2.2.2 Lab trials across a range of meat & offal combinations, at different levels of inclusion

A focus group of 12 tasted cooked patties formulated with offal at the labels shown in Table 1. and their feedback suggests they tolerated up to 20% liver addition and found 30% to be more noticeable; the group found addition of kidney to be too strong over 15% with higher levels being objectionable; hearts can be added up to 30% with no issues.

Table 1: Focus group sensory panellists’ preference for nutrient enriched patties.

Most Preferred	L20S	L30S	M20S	L10	L5	C	L20	M30S	L30	Least Preferred
	6	7	8	3	2	1	4	9	5	

(1) C: Control (just mince from chuck), (2) L5: Liver 5%, (3) L10: Liver 10%, (4) L20: Liver 20%, (5) L30: Liver 30%, (6) L20: Liver 20% + Spices, (7) Liver 30% + Spices, (8) M20: Organ Mix (2 liver:1 kidney:1 heart) 20% + Spices, (9) Organ Mix 30% + Spices.

Participants unanimously preferred the formulation containing 20% liver mixed with the burger spice blend and found it highly acceptable. All the formulations with the burger blends were acceptable overall and did better than those without the spice blends, except for mixed organ added at 30% with spices. This clearly underscores the potential role flavouring can play in the acceptance of offal nutrients enhanced mince as an offering.

4.2.3 Consumer testing of prototypes, in a focus group

Results of the qualitative survey in Australia of the concept of nutrient enhanced mince is reported in Farouk et al., 2022b. The nutrient enhanced mince concept in Figures 5 was shared with survey respondents, and their reactions to the concept were gauged.

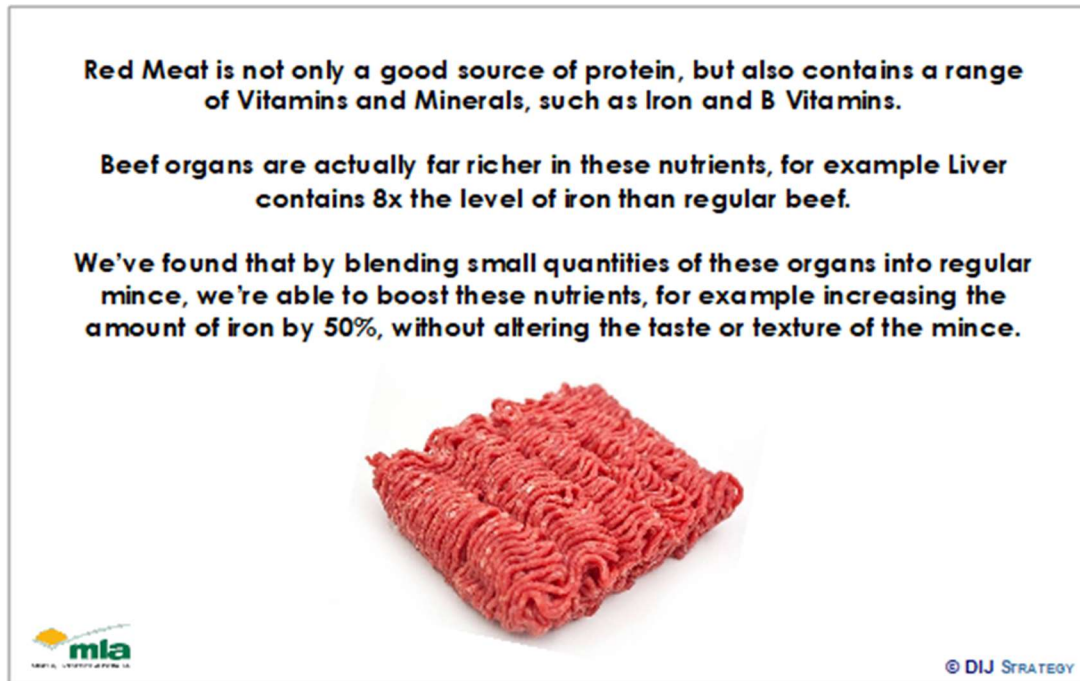


Figure 5: The concept shared with survey respondents to gauge their reaction to the nutrient enhanced mince concept.

4.2.3.1 What Health & Wellness benefits resonated most strongly with target consumers

Results of the initial qualitative survey in Australia of the concept of nutrient enhanced mince was reported in more detail in Farouk et al. (2022b).

All respondents reacted positively and consistently – an appealing idea and would want to try it. There is recognition that red meat contains important nutrients, particularly iron. They believe that we need more of these nutrients in our diet – our move to processed foods has removed many of the beneficial nutrients. Some recognise that liver is richer in these nutrients, though none knew the degree to which it is superior. Thus, the idea of blending a small quantity to deliver a big impact on the nutritional profile, whilst delivering a minimal impact on taste and texture, seemed credible.

Overall, respondents felt that adopting a healthier diet was an ever-evolving picture. What had previously been characterised by avoiding ‘nasties’, such as high sugar, or artificial ingredients, was increasingly focused on making positive health choices. So, whilst not making a conscious effort to learn more, such is the visibility of ‘Health & Wellness’ information and opinions, that one can’t but help getting swept along by the tide.

Consumers are highly motivated to source key nutrients in their families’ diets. Positive nutrition is no longer an alternative view but is now part of mainstream food drivers. Whilst Nutrient Rich Foods are the most popular and likely preferred source of key nutrients for one’s family’s diet, Supplements and Superfoods also play a significant role, suggesting consumers don’t believe they can satisfy all their nutritional requirements from food alone. Consumers are seeking a holistic nutrient boost, headlined by iron – they want more of what nutritionally they believe red meat does for them. However, further

underpinned by a range of nutrients resulting in some more specific health and wellness claims would increase desirability and value. Mince is the ideal beef version to carry a nutrient rich proposition, and there is already an expectation that mince delivers some H&W benefits, so dialling this up is appealing.

Consumers reasonably expect a 50% nutrient increase for it to be meaningful. What requires further investigation, is what proportion of consumers seek a higher nutrient boost, accepting a small trade-off in taste or other dimensions of usage compromise. As the data in Table 1 indicates, there is an underlying acceptance, that flavouring and cooking mince can cover up these trade-offs. This should then enable the incorporation of offal such as liver, heart, and kidney, which are rich in nutrients, in the formulation of mince to boost its nutrient content.

4.2.3.2 Knowledge and experience with offal

Outcomes of the initial focus consumer survey in Australia suggest respondents' knowledge and attitude towards offal is highly diverse. 30% of respondents define themselves as knowing nothing about offal and have never ever considered it. These were predominantly DINKS (30-somethings) who likely have never experienced it. Another 30% of respondents categorise themselves as 'Not liking it – Taste & Texture', skewing towards Empty Nesters (50-plus), likely because they were forced to eat it as a child. A further 15% of respondents had mixed feelings towards offal, seeing both the Positives and Negatives in it. Lastly some 25% of respondents eat offal these days, 20% occasionally and 5% regularly. The vast majority of these because it is part of their ethnic food culture.

Having discussed the merits of offal, all respondents appreciated the nutritional benefits it could bring, even blended in small quantities, to the mince. Hence, no one doubted the positive nutritional story. Where respondents had differences of opinion, it was generally in terms of the taste, texture and odour from the inclusion of offal. Broadly, respondents fell into one of three groups:

- **Rejectors** – have had bad experiences with offal as a child and whilst like the idea, these preconceptions of how bad and strong offal tastes, means they will likely believe it will taste bad, no matter whether they can or can't taste any difference.
- **Positive, but** – this group don't currently embrace offal, but recognise its properties and whilst they haven't been experimenting with it, anything that can overcome the negative side of offal, is worthy of interest. It is likely this group will try this offering, with an open mind, wanting to like it.
- **Embrace group** – already consumers of offal, likely because it is part of the 'foreign' food culture that reflects their origins. They have acquired the taste and are already sold on its nutritional benefits. Being able to get offal into their kids and eat it more often themselves, is welcome.

4.2.3.3 Understanding consumers reactions to conceptual prototype offerings

The following were the reactions of the respondents to the concept of offal nutrients enhanced mince (see Figures 6a&b):

- Respondents found this idea to be strongly appealing – 49%. They similarly felt it to be Believable (50%). However, there is also a group of respondents who, despite the reassurance, believe it to be Very Unappealing (14% Not at all Appealing). This group likely represents the sense that for some consumers the thought of it containing offal puts them off.
- The concept is seen as being completely different to what is currently available in the market – 46% Very Different and 49% Somewhat Different. This reinforces the idea that this offers a fundamentally new choice in the category (some might argue Grass Fed mince offers superior nutritional properties but is likely not seen by consumers in that way).

- Lastly, respondents indicated whether they would be likely to try it, 57% of respondents were (23% Definitely, 34% Probably).

TOP OF MIND THOUGHTS - WHAT'S GOOD ABOUT IT

Well it interests me if we can improve the health benefits
 Protein and vitamin and mineral rich I think it would be an amazing blend so that myself and my children can get all the extra nutrients without compromising on taste.
 I think this is a great idea and great way to get more nutrients
 It's the best source of protein to feed my baby and husband
 As long as it doesn't taste like organs, happy to incorporate into normal mince as it's extra 50% iron intake which is great for the body.
 Mince is versatile and affordable especially with current raise in cost of living.
 Love it This beef mince would be higher in iron and therefore really good for you and would make taking iron supplements less necessary.
 I think it's a brilliant idea. It's very smart thinking and very sustainable
 I'm all out getting the right nutrients from food I think it's Great. And kids won't know what they are eating.
 I believe it would have added health benefits, and increase nutrients in cooking i think it might be a good idea way to get your minerals and vitamins
 Kids wouldn't even know
 Very versatile.. can use it for a range of dishes

Excellent red meat. Easy to cook especially fry with onions and spices.
 Very versatile dish. The added iron as we aren't massive red meat eaters in my house
 More iron through food sources means less likely to need supplements. And using more of the cow means less waste
 It sounds like a great idea- less wastage, more nutritious, potentially less cost.
 It's a fantastic way to make meat and mince meat a super food
 Extra nutrients available and hopefully the taste is similar - my partner doesn't like offal it is a great idea
 Only I don't eat offal because i don't like the taste but if it was disguised in mince I would eat it as it is very good for me.
 It will provide all the nutrients and protein once blended with small quantities of all the essential organs.
 I think it's a fabulous idea to add offal. Offal is very good for you but on it's own doesn't taste too good
 Getting more vitamins in your diet without even trying. You can make almost anything with it
 Its kind of pure meal which has all the necessary nutrients which actually good for health. normally we fulfil our nutrient from supplements or vitamins but here I am happy to see I get those necessary nutrient for my body from this very special Beef Mince.



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Figure 6a: A sample of some of the positive comments regarding the Concept of boosting the nutrients in mince using offal meats.

TOP OF MIND THOUGHTS – ISSUES / DIS-LIKES

I don't like eating organs mixed into my beef mince. I believe organs aren't that healthy because they're used in the body to filter toxins, so they may still contain toxin. I also don't like the taste of them and don't believe they're meant to be eaten.
 I don't like the idea of eating those elements of an animal.
 I don't eat much meat and like to use lean and good quality meat when I do.
 I don't think there is any issues that I could think of. Unless there could be any contamination from the organs, decreasing proportion of meat and charging more
 Sometimes organ meats can have high levels of toxicity
 I would be concerned about quality It could just be a way for the producer to offload cheaper cuts of meat and make more profit from mince products.
 I also don't think it would be a good way of increasing ones iron levels. You probably won't absorb too much more iron, especially at the liver levels that would likely to be added without impacting the mince flavour and texture.
 I don't like the idea of having animal organs in my mince. It sort makes me feel sick thinking about it
 I wouldn't know which organs were mixed in. I don't think I could eat it and couldn't give it to my family knowing what is in it.
 Disgusting The idea does gross me out, not sure I could stomach it I think the thought of it being laced with offal is off putting

I don't have any real concerns but I don't think it's something I would jump to buy for my family. Not knowing exactly what it is .
 It sounds unappealing and unnecessary The taste could be impacted and not be good
 IF PEOPLE WANTED TO EAT THIS TYPE OF MINCE IT MUST BE SHOWN ON THE PACKET THAT OFFAL IS INCLUDED
 I don't and won't eat blood products, so this would be a definite n
 Just don't like the idea of offal it would have to be well indicated on the packaging to allow for people who would not want it in their mince as well as others from different cultural backgrounds and religions I think it would taste bitter and not healthy.
 There would be too much iron in the meat which I don't want I would be a bit worried about the safety of using offal
 My kids would not eat it. I wouldn't be able to force myself to eat it. I don't like the thought of eating organs
 Don't like the idea of eating organs I am concerned about the taste, especially from offal cuts
 I wouldn't personally buy it or consume it but I do think it's a good option for those who want to try it
 Knowing what's in it will affect my thoughts on eating it
 I'd avoid it in store I don't have any health concerns
 I guess , I'm honestly not sure but I don't like it this sounds disgusting.



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Figure 6b: A sample of some of the negative comments regarding the Concept of boosting the nutrients in mince using offal meats.

4.2.4 Consumer validation

4.2.4.1 Existing beef mince behaviour – role it plays

Beef mince is a household staple, it works particularly well for families, as there are multiple different ‘family favourites’ that can be cooked with it, many having a beef mince-based dish weekly. It is felt to deliver on many fronts, it is easy to cook with and hard to “stuff it up”, everyone in the family likes it and it represents good value for money (some get more than one meal out of a tray of mince). Most had a clearly preferred version when it came to the ‘star’ rating of mince, though some use different versions for different purposes (i.e., 3-star for making burgers). Whilst beef mince dishes aren’t generally as quick and easy as chicken (i.e., stir fry), the advantage is you can make more quantity and have enough for a meal another day, with no detriment to quality or safety. Beef mince also has positive nutritional properties, which fit well with its role for early / mid-week meals. In particular, respondents were looking for meals that delivered wholesome goodness – so that you know you’re doing the right thing by your kids.

Beef mince is consumed on a regular basis by consumers. Not only is penetration high, with 89% of respondents saying they have beef mince, at least monthly, but it is also consumed frequently, with 48% of respondents (total sample) indicating they consumed it weekly .

In terms of the type of mince respondents are buying, it is a wide spread of options. The leading variants are 4-star mince (49%) and 5-star mince (48%) of respondents. 3-star mince is also popular at 31% and more premium versions Grass Fed & Organic at 20% and 10% respectively (Appendix Figure 10). These numbers summing to more than 100% demonstrates that many respondents are repertoire buying (an average of 1.6 different versions) over the course of a month, suggesting they are buying to suit different purposes.

Beef mince is recognised for being the basis for a variety of different meals, with 70% having used it to make Spicy Meals (i.e., chili con carne), 86% using for Flavoured Meals (i.e., lasagna) and 67% using it for Mildly Flavoured Meals (i.e., rissoles).

4.2.4.2 Development of Consumer segmentation – identify target customer

Outcomes of the consumer survey in Australia identified four segments of consumers:

1. 30% have no idea about offal – primarily a younger generation
2. 30% are negative towards offal, reflecting negative experiences as a child – an older generation
3. 15% are impressed by its nutritional properties, but are wary of its taste and texture
4. 25% consume offal currently, so embrace its characteristics – many as part of their ethnic food beliefs.

Respondents were given a choice as to what version of mince they would buy in future, at realistic and intended prices. The choice was as follows (all were for 500g servings):

- ★ 4-star mince @ \$9-50
- ★ 5-star mince @ \$10-50
- ★ Nutrient Enhanced 4-star mince @ \$11-00
- ★ Grass Fed 4-star mince @ \$11-00
- ★ Organic 4-star mince @ \$13-75

The nutrient enhanced mince came out as the most preferred option, with 33% selecting it. Most of this volume came from existing 4-star mince buyers, who declined from 48% to 23% share. Grass fed beef mince purchasers declined from 20% to 10%, as another significant decline. Purchasers also came from previous 5-star purchasers, declining from 46% to 28%. For those respondents who currently only purchased 3-star mince, a reduced choice set was presented to them – either their existing 3-star mince, or Nutritionally Enhanced 3-star mince. 36% of respondents indicated that in future they would choose the Nutrient Enhanced version, paying the 16% price premium (\$9-00 vs. \$7-50).

On both these measures, the future opportunity for Nutrient Enhanced mince is considerable, trading consumers up from 4 and 5-star mince, to achieve equivalent volumes.

Assessing the Household Income level, there is minimal indication that this offering would only be bought by high-income families. Only those households with income below \$50K indicated less propensity to purchase the nutrient enhanced version (24% vs. 33% average).

4.3 Value proposition development

4.3.1 Carcass functional mapping - assess nutritional properties of beef muscles plus organ meats

For detailed information on the value proposition development for the nutrient enhanced mince refer to Farouk et al., 2022c.

4.3.1.1 Initial value proposition

Outcomes of the focus consumer studies suggest the hero nutrient for enhancement is iron and from the results of our literature survey we know that liver is the offal with the most iron content. Thus, the value proposition centres around the level of liver that can be incorporated in a mince to boost the iron content of the mince by at least 50% to meet consumer expectation without affecting the taste of the mince significantly. To preliminary test the proposition, an AgResearch in-house Focus tasting panel was conducted to evaluate four beef mince formulations as patties: liver added at 15% and 20% and heart added at 20% and 30%. Patties grilled in an oven pre-heated to 180°C and cooked for 20 min were cut into 6 portions and served to each assessor individually. Participants ranked the patties in order of preference and provided comments on each product. Panellists preferred the mince formulated with heart than with liver. Both levels of heart addition in mince had similar sensory acceptability by participants, while 15% addition of liver was slightly preferred over 20% addition. While panellists could detect the presence of liver, it was acceptable at both levels, and they were not able to detect the presence of heart at any added level in the patties. The texture of patties with heart addition was found to be like patties with mince only, while the texture of patties with liver addition was found to be more pasty (less granular) than regular mince. It was decided that 85:15 beef mince and liver formulation is to be progressed for trials in Australia using a bigger panel of consumers.

A mince formulated with 90CL beef with iron content of 1.5 mg/100g (FSANZ) and liver with iron content of 8.4 mg/100g (B +L NZ) at the ratio of 85:15 enhances single and combination of nutrients such as iron, manganese, omega-3, β -carotene, lutein, and vitamins by percentages that meets FSANZ requirement to claim the mince as a “source of”, “good source” or “complete source” of these nutrients based on their recommended RDIs. These nutrients have been reported to assist with strong immune system, brain health/cognition, and muscle building, and other functionalities (FSANZ, 2022), which could be used in the front of the pack labelling promotion of the nutrient enhanced mince.

4.3.1.2 Formulation for delivery of Value Proposition

The results of the nutrient analyses of six beef cuts and offal meats (See details in Farouk et al., 2022c) indicate there are sufficient variations in the compositions of cuts and offal meats for mince to be formulated, which will differ in the nutrients of interest to consumers. Overall, the iron content of the liver (6.47mg/100g) was lower than the one reported by Beef and Lamb NZ or the USDA and higher than what others have reported in the literature (See Tables 2 for the iron content analysed in this study and Table 3 for the variations in the reported iron contents in the literature).

Table 2: Concentrations (mg/100 g meat) of heme, non-heme, and elemental iron of chuck, offal (liver, heart, and kidney) and enhanced patties.

	Heme iron	Non-heme iron	Total Iron AgR internal	Elemental iron (External lab)
Chuck	2.24	0.34	2.58	1.95
Liver	4.64	1.83	6.47	5.49
Kidney	1.92	1.87	3.79	5.45
Heart	3.42	1.05	4.48	4.25
Chuck + Liver (5%)	2.44	0.38	2.81	2.27
Chuck + Liver (10%)	2.46	0.45	2.92	2.47
Chuck + Liver (15%)	2.72	0.53	3.26	2.33
Chuck + Liver (20%)	2.82	0.63	3.45	2.59
Chuck + Liver (30%)	2.84	0.67	3.51	2.87
Chuck + Heart (20%)	2.63	0.47	3.09	2.25
Chuck + Heart (30%)	2.77	0.55	3.32	2.54
Chuck + Mix* (20%)	2.51	0.52	3.03	2.80

*Mix is the mixture of liver: heart: kidney = 2 : 1 : 1 by weight.

Table 3: Iron contents (mg/100g) of beef liver from published literature.

List	Iron content	No of animals analysed	Reference
1	6.47	3	Farouk et al. (2023). MLA Donor Company Milestone 3a Report P.PHS.1388
2	5.8	n/a	Williams (2007). Section 2: Key nutrients delivered by red meat in the diet. Nutrition & Dietetics, 64 (Suppl. 4): S113–S119. DOI: 10.1111/j.1747-0080.2007.00197.x
3	8.40	6	https://www.beeflambnz.com/sites/default/files/interactive-guide-to-the-nutrient-composition-of-NZ-beef-and-lamb.pdf
4	8.44	1	https://fdc.nal.usda.gov/fdc-app.html#/food-search
5	12.63	15	Li et al. (2014). Nutritional Characteristics and Active Components in Liver from Wagyu×Qinchuan Cattle Korean J. Food Sci. An. Vol. 34, No. 2, pp. 214 -220. http://dx.doi.org/10.5851/kosfa.2014.34.2.214
6	20.50	15	Li et al. (2014) Korean J. Food Sci. An. Vol. 34, No. 2, pp. 214 -220. http://dx.doi.org/10.5851/kosfa.2014.34.2.214
7	16.07 (10.69-24.15)	100	Ahmed et al. (2021). Nutritive value and chemical quality indicators of imported cattle liver. Assiut Veterinary Medical Journal, Vol. 67 No. 168, 8-21. https://avmj.journals.ekb.eg/article_177843_5d918236191c41ebb27125285cfecde7.pdf
8	6.40 ± 0.25	20	Biel et al. (2019). Offal Chemical Composition from Veal, Beef, and Lamb Maintained in Organic Production Systems. Animals, 9, 489.
9	4.8 ± 1.35	20	Biel et al. (2019). Offal Chemical Composition from Veal, Beef, and Lamb Maintained in Organic Production Systems. Animals, 9, 489.
10	6.0±0.05	6	Valenzuela et al. (2009). Total Iron and Heme Iron Content and their Distribution in Beef Meat and Viscera. Biol Trace Elem Res (2009) 132:103–111. DOI 10.1007/s12011-009-8400-3.

The reported range of iron content of cattle liver differs widely with values ranging from 4.8–24.2 mg/100g. Thus, until and unless many cattle representative of the breeds, ages, and finishing systems in Australia and New Zealand are analysed, it is difficult to determine the liver iron content to be used in the calculations and formulations of mince with liver. One could use the average figure of 6.47 mg/100g that we obtained in this study, or the higher values reported by Ahmed et al. (2021) and Li et al. (2014) shown in Table 3. The 100 samples of liver Ahmed et al. (2021) analysed came from USA (n = 76), Australia (n = 8), Brazil (n = 8), and New Zealand (n = 1) and were collected over a period of two months. The iron content of the livers ranged from 10.69–24.15 mg/100g (mean 16.07 mg/100g) and their publication is the latest of all the other ones we reviewed. Currently, it appears the major beef producing countries of USA, Australia, and New Zealand are relying on the iron content of liver in the Beef and Lamb NZ guide (8.4mg/100g) in their food composition tables, therefore, we recommend the use of the value 8.4mg/100g iron content of liver for calculating the nutrient content of the mince formulated with liver until a comprehensive analysis of beef livers of the cattle in Australia and New Zealand are undertaken and published in FSANZ Standards.

4.3.2 Rapid non-invasive testing of nutrients (validation of nutrient composition)

The success of the nutrient enhanced mince value proposition will depend among others on the availability of a method of rapidly analysing the content of the hero nutrient iron in the mince for labelling purposes. A rapid non-invasive method of analysis would be more amenable to incorporation in a production setting for the real-time characterization of packaged mince for front of the pack labelling of desired nutrients, which in this case is primarily the iron content.

4.3.2.1 Capability required to assess nutrient composition in commercial set-up

Both outcomes of our preliminary and main studies using Hyperspectral Imaging (HSI) and UV-Vis-NIR spectrophotometer (NIR) suggest the two methods can rapidly determine the iron and other nutrient contents of mince. Tables 4 and 5 shows results of the significant R^2 predicted values against measured values for various attributes using UV-Vis-NIR spectroscopic data and HSI data, grouped, based on animals as well as cuts. Some of the nutrients like manganese (Mn), β -carotene and moisture showed very good predictions, with R^2 in the range of 0.71–0.98. Also, good predictions were obtained for magnesium (Mg), iron (Fe), zinc (Zn), potassium (K), lutein, and some other fatty acids with R^2 in the range of 0.50–0.63. Fatty acids, manganese (Mn), magnesium (Mg) and β -carotene showed good to very-good predictions with R^2 in the range of 0.60–0.96. Also, acceptable predictions were obtained for zinc (Zn), some fatty acids and lutein with R^2 in the range of 0.50–0.58. Results in Table 4 and 5 shows that many of the nutrients in the patties are predicted with good R^2 values by both HSI and UV-Vis-NIR, suggesting that these two methods have the potential to be used to non-invasively and rapidly determine/validate the nutrients of interest such as iron, manganese, and β -carotene, should nutrient enhanced mince become a commercial reality. The ability of the two non-invasive methods to predict meat quality attributes have been previously demonstrated (Dixit et al., 2020; 2021). The use of the two methods should be optimised for nutrient enhanced mince to improve the R^2 to that of mince alone or better.

Table 4: Summary of coefficient of determination in prediction (R^2) for the compositions of selected nutrient in patties prepared from beef only and offal enriched beef using Hyperspectral Imaging (HSI) and UV-Vis-NIR spectrophotometer (NIR).

Attributes	R^2 (HSI)			R^2 (UV-Vis-NIR)		
	All samples	Muscle	Muscle + offal	All samples	Muscle	Muscle + offal
% Moisture	0.71	0.71	0.89	0.49	0.72	0.90
% Fat	0.92	0.90	0.86	0.63	0.92	0.88
Elements						
Calcium	0.16	0.11	0.37	0.09	0.17	0.27
Copper	0.15	0.01	0.25	0.12	0.01	0.06
Iron	0.63	0.59	0.08	0.40	0.56	0.11
Magnesium	0.63	0.48	0.15	0.61	0.5	0.14
Manganese	0.97	0.03	0.89	0.94	0.02	0.89
Potassium	0.63	0.62	0.02	0.41	0.62	0.07
Sodium	0.27	0.31	0.12	0.20	0.31	0.3
Zinc	0.59	0.42	0	0.57	0.44	0
Vitamins						
β -carotene	0.90	0.17	0.8	0.85	0.19	0.80
Vitamin E	0	0.18	0.34	0.22	0.21	0.11
Vitamin A	0.19	0.07	0.12	0.18	0.01	0.04
Lutein	0.61			0.56		

Table 5: Summary of coefficient of determination in prediction (R²) for the compositions of fatty acids in patties prepared from beef only and offal enriched beef using Hyperspectral Imaging (HSI) and UV-Vis-NIR spectrophotometer (NIR).

Attributes	R ² (HSI)			R ² (UV-Vis-NIR)		
	All samples	Muscle	Muscle + offal	All samples	Muscle	Muscle + offal
Total FA	0.91	0.91	0.88	0.57	0.90	0.89
Total SFA	0.85	0.86	0.91	0.53	0.86	0.89
BC-SFA	0.77	0.79	0.90	0.50	0.79	0.94
MUFA	0.90	0.81	0.90	0.66	0.80	0.84
PUFA	0.89	0.86	0.78	0.69	0.87	0.75
n-3	0.91	0.81	0.82	0.83	0.82	0.81
n-6	0.87	0.71	0.54	0.80	0.73	0.56
C10:0	0.80	0.79	0.70	0.41	0.79	0.71
C12:0	0.50	0.89	0.04	0.18	0.89	0.04
C14:0	0.82	0.78	0.91	0.42	0.80	0.90
C15:0	0.79	0.81	0.93	0.35	0.81	0.94
C16:0	0.89	0.87	0.91	0.51	0.86	0.93
C17:0	0.80	0.78	0.92	0.53	0.81	0.91
C18:0	0.74	0.68	0.80	0.55	0.69	0.78
iso C15:0	0.86	0.86	0.83	0.55	0.88	0.83
anteiso C15:0	0.72	0.76	0.95	0.34	0.73	0.95
Iso C16:0	0.54	0.51	0.84	0.46	0.53	0.90
iso C17:0	0.81	0.82	0.97	0.58	0.82	0.94
anteiso C17:0	0.5	0.60	0.80	0.39	0.56	0.82
C14:1	0.40	0.29	0.55	0.53	0.31	0.44
C16:1	0.56	0.45	0.71	0.52	0.43	0.73
C17:1	0.79	0.68	0.77	0.52	0.67	0.81
C18:1 t9	0.59	0.69	0.62	0.52	0.66	0.69
C18:1 t11	0.74	0.73	0.81	0.31	0.72	0.89
C18:1 c9	0.91	0.81	0.88	0.62	0.83	0.84
C18:1 c11	0.80	0.69	0.74	0.56	0.67	0.75
C18:2 n-6	0.81	0.74	0.72	0.63	0.76	0.75
C18.3.n-3	0.82	0.82	0.69	0.53	0.81	0.67
c9 t11 CLA	0.72	0.65	0.38	0.43	0.67	0.41
C20:3 n-6	0.95	0.57	0.92	0.96	0.52	0.91
C20:4 n-6	0.88	0.03	0.74	0.87	0	0.75
C20:5 n-3	0.95	0	0.88	0.95	0.02	0.88
C22:5 n-3	0.95	0.63	0.90	0.95	0.60	0.89
C22:6 n-3	0.98	0.46	0.89	0.96	0.44	0.88

SFA = Saturated Fatty Acids, BC-SFA = Branched Chain Saturated Fatty Acids, MUFA = Monounsaturated Fatty Acids, PUFA = Polyunsaturated Fatty Acids, n-3 = Omega-3 Fatty Acids, n-6 = Omega 6 Fatty acids.

4.3.3 Large scale quantitative testing of specific vs. holistic wellness concepts

The addition of liver into beef mince significantly enhances the key nutrients red meat is valued for. This holds significant value for many consumers, who seek to incorporate wholesome and natural foods that deliver superior levels of nutrients to support their family's health and wellness goals. However, there are obvious concerns as to the impact this will have on the resultant taste, texture, and aroma of the mince. It is contended that whilst this might be noticeable in its raw form and if it was just cooked and eaten in isolation, in most of the normal, everyday usage of beef mince occasions where meals have sauces added and are further flavoured (i.e., Chilli con Carne), this difference isn't noticeable. To determine the desirability of the nutrient enhanced mince offering, the 'real world usage' of a prototype offering that delivered on the Value Proposition - an 85% beef mince and 15% beef liver blend had to be assessed.

4.3.3.1 Knowledge and experience with offal: Consumer segmentation

Consumers knowledge and experience with offal is pivotal as to whether, and how they embrace this concept, given it is led by the inclusion of liver. Yet consumers come from vastly different places when it comes to perceptions and experience with offal:

- Offal has many distinct properties that some consumers know about, whilst others have no idea.
- Some have never tried offal, or come across it, others had it as a child but not since, whereas others have it occasionally, or even regularly, particularly if it is part of their food culture.

Developing the consumer segmentation puts these perceptions and experiences with offal into meaningful groupings, resulting in the following 4 consumer segments (Figure 7):

- **Young, Sheltered Lives** – never tried it and don't know much about it, but it sounds gross.
- **Older, Bad Experiences** – made to eat it occasionally as a child and largely tried to relegate the memory as a bad childhood experience.
- **Mixed Feelings, Health** - have a progressive attitude to H&W, recognise the nutrient benefits of offal, but haven't found an 'easy way' to embrace.
- **Part of my Culture** – eating offal is a part of their food culture, a part of their life – they might not love it, but they've acquired the taste.

CONSUMER SEGMENT DEFINITIONS - EXPERIENCE WITH & ATTITUDE TOWARDS OFFAL

What **Experience** consumers have had with offal / liver – never eaten, last ate as a childhood, more recently, eat regularly

Perceptions of Offal / Liver – what's it good for & what's bad about it – agree with statements

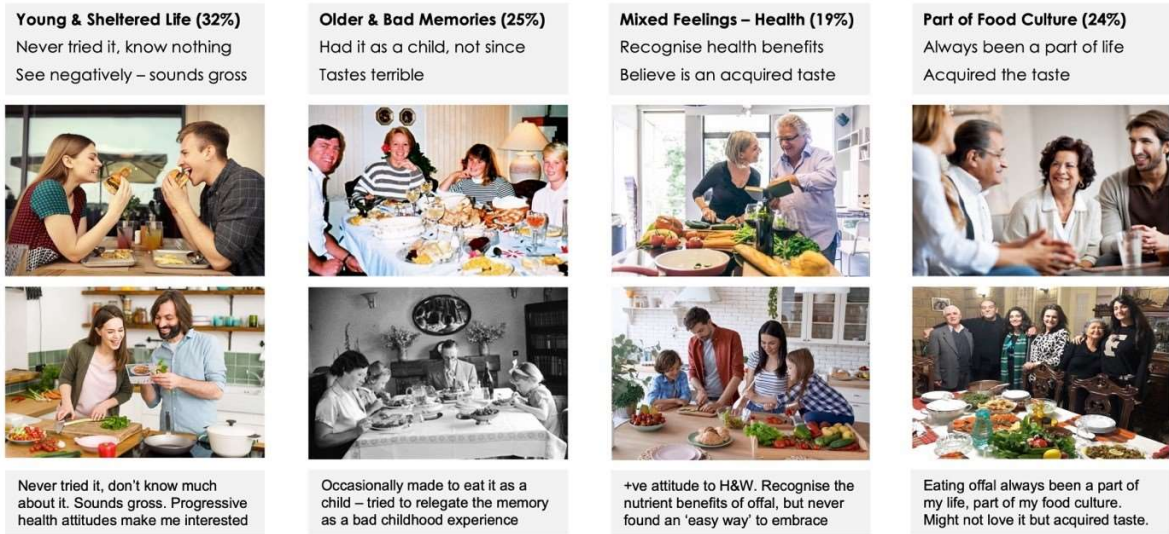


Figure 7: Consumer segments based on the perception of nutrient enhanced mince with liver.

4.3.3.2 Proposition appeal and likelihood to trial – Motivating & Unique

The beef-liver blend was portrayed to consumers via the concept statement in Figure 8.

Blending a small amount of liver into beef mince is a great way to get a nutrient boost.

Once the mince is cooked and flavoured in the normal way (i.e. Taco's, Bolognese, or Burgers) few people would notice the difference.



Figure 8: The concept statement used for the beef-liver nutrient enhanced mince.

The following are the summaries of the responses collated from the consumers surveyed using the statement in Figure 8 prior to delivering the concept product for Real World testing:

At a total population level, the concept of beef mince blended with offal has polarised appeal.

- 43% find it Somewhat or Very Appealing, highly valuing the nutrient benefits, whilst believing that the taste will not be overly compromised.
- 22% find it Somewhat or Very Unappealing, believing taste compromise will make it inedible.
- 35% are caught between the two extremes, interested in the nutrient benefits but unsure as to whether the taste will be significantly compromised.

In terms of how unique and different respondents felt this offering was.

- 22% Very Different / Unique.
- 45% felt it was Quite Different.
- 33% felt it was Not really that Different.

Perceptions of difference varied little across the consumer segments.

Amongst those respondents who had qualified by indicating they were willing to try using this beef-liver mince for themselves, the degree of enthusiasm across segments differed significantly. Interpreting through the consumer segment lens reveals stark differences in appeal, with 'Young & Sheltered Lives', closely followed by 'Old & Bad Experience', the most negative towards it / apprehensive. In contrast 'Mixed Feelings – Health' & particularly 'Part of my Food Culture' had far more positive expectations.

What of the proposition resonates most strongly?

Focusing on those respondents who would likely trial the beef-liver mince blend, further reinforces the appeal of nutrient enhancement.

Functional benefits, notably the promise of increased iron, resonate strongly with consumers, highlighting the appeal of the proposition in addressing nutritional needs.

Response to "organ meats" is polarised; while some find it a turn-off, others appreciate its functional benefits, particularly the promise of more iron.

The inclusion of liver, while impactful in enhancing nutrient content, is perceived as a potential deterrent for many consumers due to taste considerations.

There's uncertainty among consumers regarding the ability to seamlessly swap traditional beef mince with the nutrient-enhanced offering, particularly concerning taste and meal preparation outcomes.

Red meat isn't yet strongly associated with health and wellness benefits by consumers, indicating an opportunity for the proposition to shift perceptions and establish positive associations.

Reservations by segment.

Young & Sheltered Lives: Emotive response characterizes their reservations, perceiving the proposition as unappetizing and potentially impacting taste.

Older & Bad Experience: Past negative experiences with liver contribute to scepticism regarding taste impact, despite assurances of minimal difference post-cooking.

Mixed Feelings – Health: Concerns revolve around family acceptance, particularly regarding children's perception and taste sensitivity.

Part of My Culture: While more accepting of liver taste due to cultural familiarity, the desire remains for the mince to retain traditional beef flavour.

Positives by Key Themes.

Better for You: The proposition is perceived as delivering significant nutritional benefits, contributing to a healthier diet.

Sustainability: Utilising organ meats aligns with sustainability principles by reducing waste and maximizing resource utilization.

No compromise: The ability to use the nutrient-enhanced mince in familiar recipes without compromising taste or texture is a significant and positive aspect.

Hide the flavour: The flexibility to add flavours to mask any perceived liver taste enhances consumer acceptance and usage possibilities for this format.

Cheaper: Leveraging cheaper organ meats contributes to making red meat more affordable for consumers, potentially expanding its accessibility.

Nutrient enhancement: The introduction of a beef-liver mince blend with nutrient enhancement propositions has the potential to reshape consumer perceptions of red meat's healthiness and sustainability – both were mentioned spontaneously as the Positives of this offering.

Health concerns: By addressing health concerns and establishing positive health associations, the proposition aims to encourage more frequent consumption of red meat, positioning it as a desirable component of a balanced diet.

4.3.3.3 Real world evaluation – preparing a ('near complete' samples provided to consumers for real world trial of the offer)

The following are the summaries of the responses collated from the consumers surveyed after the concept product (85% beef mince and 15% beef liver blend):

Attitude towards Nutrient Enhanced Beef Mince: The primary association with nutrient-enhanced beef mince is its utility for providing a health boost, particularly due to its superior Iron proposition; many consumers perceive it as a modern way to eat healthily and a convenient solution for sustainable eating practices; and only a minority view it as suitable exclusively for strongly flavoured meals, indicating its broader applicability.

For when a health boost is needed: There is strong agreement across consumer segments that nutrient-enhanced beef mince is suitable for times when a health boost is needed. This resonates particularly with women needing more iron in their diets, but also families seeking overall health benefits, especially for children's development and energy requirements.

Sustainability as a significant secondary benefit: Many consumers appreciate the sustainability aspect of using the whole animal, seeing it as a positive step towards minimising waste and reducing the environmental impact without compromising in other ways. This resonates strongly with younger, more health-conscious consumers, reflecting a growing trend towards sustainable consumption practices and finding solutions that don't require to compromise in other ways.

A richer, fuller taste: While many consumers do not notice a discernible difference and are satisfied with the taste of their favourite beef-mince based meals, some perceive a slightly richer and fuller flavour profile, describing it as more flavoursome. Some consumers find the different flavour profile of nutrient-enhanced mince desirable, especially those familiar with liver/offal flavours, such as those in the "Part of my Culture" segment. This positive perception of taste is consistent across consumer segments, except for the Young, Sheltered Lives segment, who may be less familiar with liver/offal flavours and stronger tastes generally.

4.3.3.4 Usage experience: Stages through the cooking process

Understanding consumer experiences at each stage of the cooking process provides valuable insights for product refinement and addressing usability concerns.

First Impressions - Appeal of Packaging

Positive View:

- Vacuum-sealed packaging is perceived as modern and functional, offering benefits in freezer and fridge storage.
- Viewed as a more environmentally friendly option with less plastic usage.
- Believed to provide better shelf life compared to traditional packaging methods.

Negative View:

- Difficulty in removing the product from the pack, compounded by its sludgy nature, raises usability concerns.
- Some liken the packaging to low-quality pet food packaging, associating it with an undesirable category.
- Familiarity with existing packaging formats leads to apprehension about the unfamiliar vacuum-sealed packaging.

First Impressions - Product

Positive Mindset:

- Lean appearance with minimal visible fat, is perceived as premium.
- Noticeable smell is interpreted positively by some, described as "meaty" or "rich."
- Darker colour suggests a richer flavour, potentially appealing to those seeking a more robust taste.

Negative Mindset:

- Sludgy appearance and lack of strand-like consistency of regular beef mince raise concerns.
- Visible blood and strong smell, reminiscent of liver, contribute to negative perceptions.

Reasons for Choosing the Meal

Most consumers were apprehensive about potential liver taste overpowering the meal, leading them to select dishes with strong flavouring such as Chili con Carne or Tacos. These meals are familiar family favourites, and ingredients are readily available. Some consumers opted for dishes like Burgers or Rissoles to assess the true taste, texture, and flavour of the beef-liver mince blend, expressing confidence in the outcome.

Browning the Beef Mince

Browning the mince posed challenges due to its sludgy consistency, making it harder to break apart. Few noticeable aroma issues were reported, with most finding no significant difference from regular mince. While some felt the mince browned satisfactorily, others found it harder to break apart and likened the experience to dog food.

Finalizing the Meal / Adding Other Ingredients

Once browned, respondents added other ingredients, finding the process similar to working with regular mince. Some added extra flavouring as a precaution, but many started to feel more positive about the meal's outcome as it progressed.

Packaging & Frozen Format - After usage:

Vacuum-sealed packaging received a polarized response - positive feedback focused on compactness, clear visibility, and longer shelf life, while negatives centred around difficulty in product removal.

Frozen format elicited mixed opinions, with some preferring pantry stocking while others favoured immediate use, posing potential challenges in product placement within supermarkets.

4.3.3.5 Positioning of Beef-Liver Mince as a Bold & New Offering

The obvious and unique characteristics of beef-liver mince suggest positioning it as a bold and new offering rather than attempting to conceal its liver content. However, a change to standard packaging, texture adjustments to be more fibrous, and colour modifications could enhance its appeal to the more apprehensive consumers, without masking its liver inclusion. Emphasizing liver's role in achieving significant nutritional benefits and promoting positive health associations can differentiate the offering and attract health-conscious consumers, particularly those in the 'Mixed Feelings - Health' segment and further down the track, 'Young, Sheltered Lives'.

4.3.3.6 Assessment of how the meal turned out

Respondent's Assessment (the Cook)

Initial tasting after browning revealed a strong liver flavour or noticeable difference.

After simmering with other ingredients, the taste transformed into a metallic, earthy, or meatier flavour, perceived as good by most.

Few described a "livery" taste, but overall, the meal was deemed pretty good.

Some couldn't discern any significant difference, especially in meals like Chili con Carne.

Family Members Assessment

Positive reactions:

- Most chose not to inform the kids about the liver content, and they didn't notice any difference, enjoying the meal as usual.
- Those aware of the difference described it as good quality, leaner mince, without greasiness or fattiness.

Less favourable reactions:

- Those aware of the liver content beforehand were predisposed to a negative reaction.
- Meals like Burgers or Rissoles, with a noticeable taste difference, were less desirable for many family members.

Delivering on the Promise

Overall, the offering was perceived to deliver on its promise, except for minimally flavoured meals like Burgers or Rissoles, where the distinct liver flavour was discernible.

For moderately and strongly flavoured meals, the taste difference was acceptable, aligning with the promise this concept seeks to make.

Contrasting Respondents' Journeys – ‘Switching Sides’

Mixed Feelings & Part of my Culture:

- All approached with a positive mindset, confident in the product's qualities and how it would turn out.
- However, overconfidence in preparing minimally flavoured meals led to rejection by some family members due to obvious taste differences.

Young, Sheltered Lives & Older, Bad Experience:

- Initially concerned as to how the meal would turn out and the browning process did little to allay those concerns.
- They typically prepared a strongly flavoured meal, which once the flavouring had been added resembled the original meal.
- Surprised by the positive reception from family members, particularly children who didn't notice any difference in taste, having not been made aware of the use of different mince.

Overall liking of Nutrient-Enhanced Beef Mince

Consumers were overwhelmingly positive about the nutrient-enhanced beef mince, perceiving it as delivering significant nutrient enhancement while tasting just like normal beef mince (Figure 9).

Only 9% of respondents expressed negative sentiments, with strong liking predominantly observed among segments initially more disposed towards the product, such as ‘Mixed Feelings – Health’ & ‘Part of my Culture’.

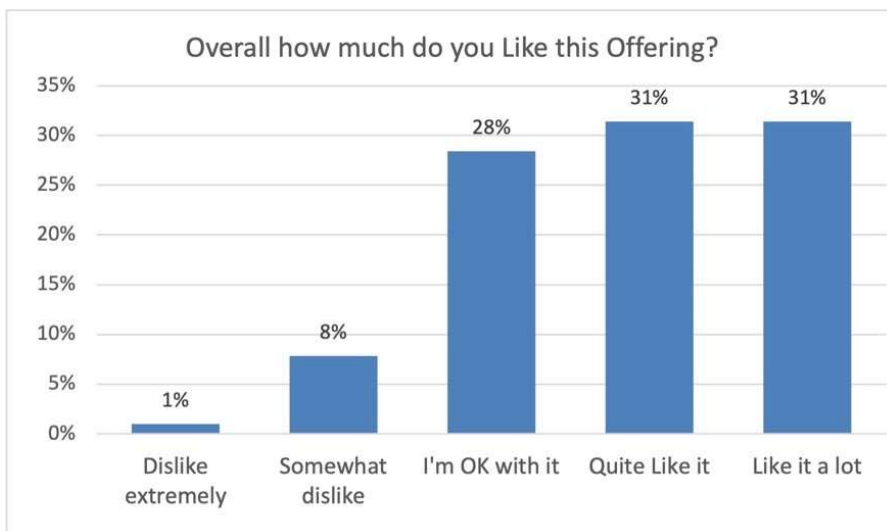


Figure 9: The overall liking of the beef-liver nutrient enhanced mince following a real-world trial.

4.3.3.7 Assessment of how the enhanced mince performed compared to standard mince

Assessment of Product Attributes, subsequent to usage, with a reference point of how it performed versus 'standard beef mince', highlighted some key differences:

- Overall assessment of each attribute was close to the average, though slightly positive.
- Only a minority agreed that it was 'About the same' on Taste & Texture – thus more had a positive, or negative view of it.
- In terms of Aroma and Visual Appeal, the majority felt it was About the Same as standard beef mince.

Product Attribute Assessment – Groupings

A correlation exists (Figure 10) between respondents' assessment of beef-liver mince attributes (aggregate of taste, texture, aroma, ...) compared to regular mince and their overall liking (1).

- 21% of respondents rated beef-liver mince poorly across attributes, resulting in lower overall liking (2).
- 42% considered beef-liver mince comparable to regular mince, contributing to a favourable perception based on its replaceability (3).
- 37% rated beef-liver mince better across attributes, leading to a strong overall liking of the product (4).

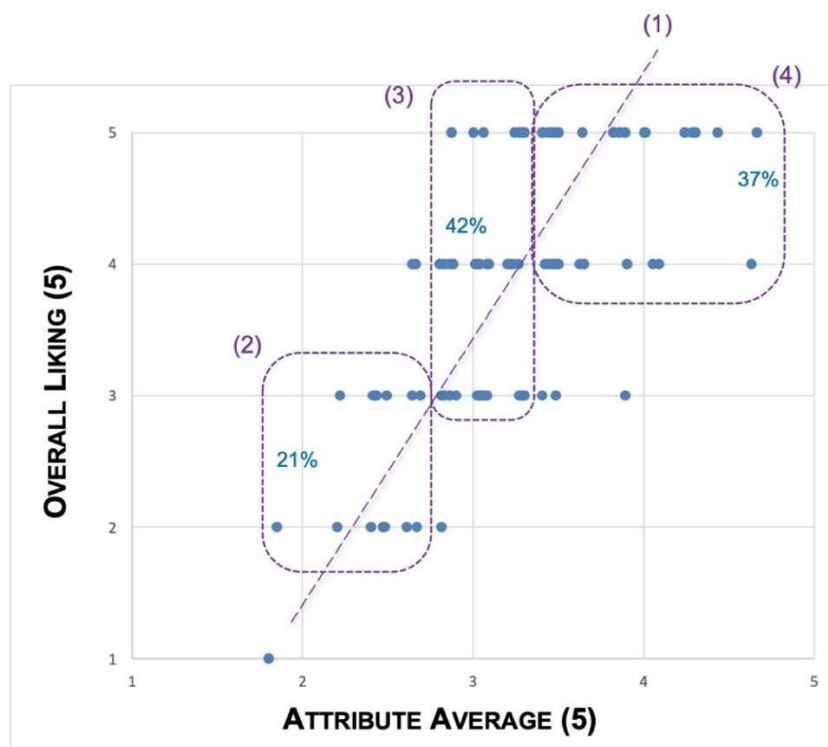


Figure 10: The overall liking of the beef-liver nutrient enhanced mince following a real-world trial.

4.3.4 Future Intent – Purchasing, Role in Repertoire & types of Meals

Future Purchase Intent: After using the nutrient-enhanced beef mince and receiving feedback from family members, most respondents (73%) are positive about ongoing usage / future adoption, particularly skewed towards the Mixed Feelings & Part of my Culture segments (Figures 11 a&b).

This indicates a strong likelihood of repeat purchases, especially among segments that initially showed more positivity towards the product.

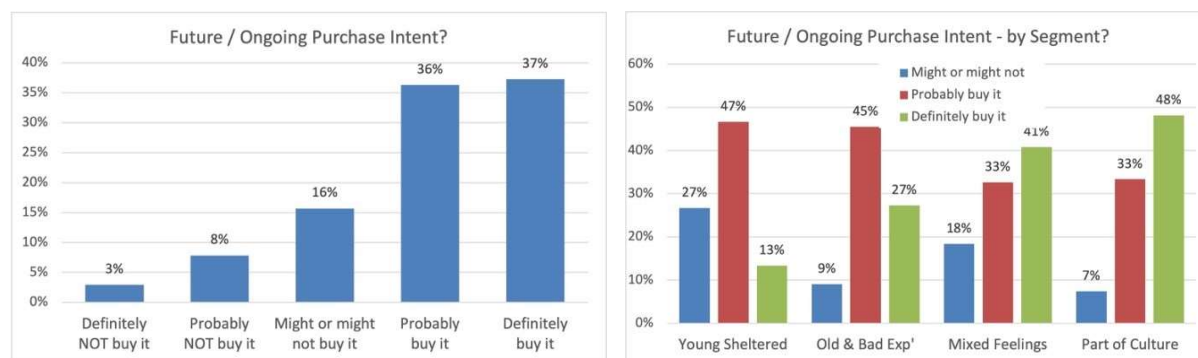


Figure 11 a&b: Overall future purchase intent of nutrient enhanced mince (a) and by consumer segments.

Proportion of Future Beef Mince Purchases

Consumers typically repertoire purchase different versions of beef mince to suit various meal types and considerations such as value.

The healthier option of nutrient-enhanced beef mince would see varied usage:

- 33% would purchase it exclusively or as the primary option, especially Part of my Culture.
- 41% would incorporate it prominently into their repertoire alongside other options based on meal choice.
- 18% would use it occasionally, primarily for health reasons.

This is particularly skewed towards the segments that are more positively disposed towards it:

This further emphasizes consumers' desire for repertoire purchasing and suggests that the product could become a significant part of consumers' beef mince choices.

Suitability for Different Meals

- Consumers anticipate using nutrient-enhanced beef mince differently based on its perceived suitability for various degrees of meal flavouring.
- Many believe it's not suitable for minimally flavoured meals where they seek the "true beef flavour," though many said they anticipate becoming more comfortable using it for meals like burgers over time.
- This usage pattern is consistent across all consumer segments.

Effect of 20% Price Increase

- Purchase intent declines when a 20% price premium is introduced, indicating that part of the beef-liver mince's appeal lies in its affordability. Whereas 73% expressed they would Probably / Definitely purchase in future, this declined to 36% once a 20% price premium was proposed.

- Consumers value the nutritional enhancement, especially the addition of iron, but the overt focus on the inclusion of liver (in this research), which consumers know is a cheap product, makes the idea of it being more expensive challenging.
- To justify a price premium, the focus should be on the nutritional enhancement, which is highly valued by consumers, rather than focusing on the inclusion of liver, which is 'merely' support to the proposition.

Targeting the Early Adopters

- The early adopters of this offering are likely to be the 'Mixed Feelings – Health' consumers who prioritize the nutritional enhancement benefits and making offal consumption accessible.
- They are willing to suspend judgment on the taste compromise, pay a premium for the offering and have an expectation that it is different in some way – appearance, texture etc..
- Mixed Feelings – Health segment should be the primary target market during the launch phase, emphasising the nutritional benefits and encouraging them to embrace the product while acknowledging slight taste differences that family members might detect.

Addressing Pain Points – Suggested Enhancements

Respondents were invited to share any thoughts / suggestions as to how this offering could be improved. Many didn't have any thoughts, but those that did, focused on the Pain Points they experienced:

A Toned-Down Version

- Offer a version with less liver content to reduce the strong taste and smell for consumers who find it overpowering.
- Experiment with different percentages of beef/liver to balance the flavour and improve packaging to enhance visibility.

Assistance in Embracing via Suggested Meals/Recipes

- Provide recipe ideas to help consumers incorporate the beef-liver mince into their meals and gradually adapt their palates.
- Include recipe suggestions to mask any taste issues and educate consumers on preparing the meat.

Go Further – More Offal/Nutrients & Bolder

- Highlight the broader health benefits for the family to emphasize the nutritional value.
- Consider incorporating additional organs such as kidney to further enhance the nutrient profile.
- Improve packaging to stand out more and highlight the nutritional benefits with brighter colours and clear labelling.

Different Leanness Versions

- Provide information on the fat content within the mince to cater to different preferences.
- Offer different versions with varying leanness levels, from premium grass-fed to more affordable options, to accommodate different consumer needs.

- Allow consumers to specify their preferred version, including leanness, liver content, and inclusion of other offal.

Recommendation: Development of a Toned-Down Version

- Develop a "half-strength" version with 7 to 10% liver content to appeal to consumers who are hesitant about the strong flavour. This version would allow consumers to gradually adjust to the taste.
- This offering would also fulfil a repertoire role for those who readily embrace the 85:15 version, providing an option for meals like burgers and rissoles, where the true beef taste is valued.
- It would help if this version appeared closer to existing beef mince offerings – texture & colour in particular.

4.4 Completion of the Business Model Canvas and launch strategy

4.4.1 BMC including feasibility and viability assessment under alternative scenarios

Working with a Commercial Partner it was determined how existing commercial beef mince production translates to the Business Model Canvas (Figure 12A-C). From this basis, feasibility (how a business makes its product offering) required to accommodate the production of beef-liver mince blend, and commercial viability (assessment of incremental costs and revenues) were assessed under 2 scenarios.

Value Proposition and Business Model Canvas for Regular Beef Mince

Regular Beef Mince Value Proposition: *Our beef mince*

Helps families looking for solutions for early / mid-week meals

Who have a heap of contrasting boxes to tick, on this occasion

By delivering beef mince which is always Quick & easy to prepare, Good value, Fail safe results, delivers a meal full of Wholesome Goodness and is the basis of a Variety of Family Favourite meals

And offers a choice of different levels of leanness

Unlike other animal proteins that are boring (crumbed chicken).

STRATEGIC PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENT
<p>Supply of Beef Trim – Meat Processors on an ongoing basis.</p> <p>3rd party Manufacturing – Vertically Integrated.</p> <p>Packaging supply & expertise.</p> <p>Supply chain logistics – delivery to store</p>	<p>Grinding beef trim -> mince</p> <p>MAP Packaging -> units</p> <p>Place into Cold storage</p> <p>Delivery to store</p> <p>Placement on supermarket shelves</p>	<p>Beef mince</p> <p>Helps families looking for solutions for early / mid-week meals</p> <p>Who have a heap of contrasting boxes to tick, on this occasion</p> <p>By delivering beef mince which is always Quick & easy to prepare, Good value, Fail safe results, delivers a meal full of Wholesome Goodness and is the basis of a Variety of Family Favourite meals</p> <p>And offers a choice of different levels of leanness</p> <p>Unlike other animal proteins that are boring (crumbed chicken).</p>	<p>Beef mince is a weekly staple – default item in the shopping trolley.</p> <p>Always have some in the freezer – versatile.</p> <p>Increasingly use different versions for different types of meals.</p>	<p>Core is Families, with both younger & older kids.</p> <p>Mid-week meals are an ongoing challenge, must be:</p> <ul style="list-style-type: none"> - Quick & easy to prepare - Be a proper meal – protein, vegies, ... - Good value (\$20) – weekly food budget - Fail safe – unlikely to stuff it up - Liked by whole family – empty plates - Not boring – if same week after week
<p>KEY RESOURCES</p> <p>Manufacturing plant</p> <p>Packaging set up</p> <p>Cold storage (centralized)</p> <p>Chilled Distribution</p> <p>Retail Display – fridges</p>				
<p>INCREMENTAL COSTS</p> <p>Raw Ingredients: Beef Trim</p> <p>Packaging: MAP packaging</p> <p>Labour costs – Manufacturing, Packaging, Supply chain & Retail</p> <p>Storage & Supply Chain</p> <p>Retail overheads</p>		<p>REVENUES</p> <p>Beef Mince comes in different leanness grades: 82cl = \$6-50, Lean - 90cl = \$9-00, Extra lean - 95cl = \$10-00 (30/5/2024)</p> <p>And Premium versions: Organic = \$10-00, Grass Fed = \$11-00</p>		

Figure 12a: Regular Beef Mince BMC.

4.4.1.1 Feasibility Assumptions and Consumer Research Implication

Commercial beef mince is produced daily with a 12-day shelf life (7 days min. required for retail).

Beef-liver blend mince:

- Can be manufactured in the same set up, might need to change grinding plates.
- Likely to have less than 7-day shelf life in MAP packaging.
- Required set-up & clean-down disruptions are quite significant.
- Likely create a splash in the market: target consumers will seek it out when purchasing.
- Could achieve comparable volumes to Lean / 4-star mince at a 16% price premium.
- Almost certainly will achieve volumes beyond Grass & Organic mince.
- Would not just take share from existing versions of beef mince but would grow the market: consumers motivated to eat beef mince more often.

4.4.1.2 Scenario 1: Use of Existing Chilled Supply Chain (Figure XXB)

Key Feasibility Challenges

To accommodate beef-liver mince offering, modifications need to be made:

- Key Activity: set up and wash down of mincing equipment.
- Key Resources: unit cost of VSP (or similar packaging) that delivers a longer shelf life for chilled.
- Key Activity: packaging into a different format vs existing MAP line.

Viability Implications

- Consumers prefer ‘vacuum sealed’ style packaging for its functional/storage advantages and its more modern feel – hence unlikely to impact consumer demand/revenue projections.
- Lamb liver is currently packaged in major supermarkets using VSP packaging, with a 17+ day shelf life. Hence, it is believed this format of packaging could work for beef-liver mince.

- Much of beef mince in UK supermarkets have moved to a similar format of packaging, with a “fresher for longer” tagline.
- Would require producing a new batch of beef-liver mince twice per week, interrupting the existing operations – incurring Set Up & Wash Down costs for each batch.
- Incorporating 15% liver into a beef mince offering, reduces the Cost of Goods by 7.5%, on the basis that Liver is only 50% the cost of Trim.

Implications

This approach is dependent on being able to find a format of packaging that provides the desired shelf life, for a chilled beef-liver mince.

- ➔ Assess alternative packaging options and undertake shelf-life testing

Critical to assessing incremental costs, is assessing the Set-up and Wash-down costs of incorporating beef & liver within an existing beef mince production system.

- ➔ Undertake a test run within a commercial operation

Conforming to the existing chilled supply chain mitigates against multiple down-stream incremental costs – storage, distribution, retail handing and display. Consumer research indicates that Thermoform type packaging is generally well received for its space saving functionality and more modern feel.

4.4.1.3 Scenario 2: Incorporate into a Frozen Supply Chain (Figure XXC)

Key Feasibility Challenges

To accommodate beef-liver mince offering, modifications need to be made:

- Key Activity: product frozen once it had been produced.
- Key Resources: unit cost of Thermoform packaging.
- Key Activity: packaging into a different format vs existing MAP line.
- Key Resources: frozen storage and distribution to retail.
- Key Activities: significant Capex to set up frozen display within existing chilled beef mince at retail.

Viability Implications

- 71% of beef mince consumers are willing to buy it frozen, as many already stock it in their freezers and are comfortable defrosting it in the microwave.
- Disruptions and costs would be minimal, as beef-liver mince could be produced once every 2 weeks or less often.
- While much Paleo mince sold by butchers is frozen with a 3-month shelf life, its market potential remains unclear.
- In newer supermarkets, chilled and frozen fish are displayed together for direct consumer choice, unlike established chicken bites which are separated.
- The impact of not displaying this offering alongside existing beef mince when encouraging consumer to switch is not known.

Implications

This approach can work in the market, but the major concern is whether it limits the opportunity for beef-liver mince. It remains a ‘big ask’ for consumers to look for beef-liver mince in the freezer section, as against weighing up their consideration when making a side-by-side comparison at point of purchase.

- ➔ Undertake a test market to assess how it performs if sold from the freezer section (alongside Birdseye & Steggle’s).
- ➔ Investigate the Capex required to set up a retail store with a freezer section alongside existing chilled beef mince.

A more radical approach would be to adopt a “Thawed for your convenience” solution (e.g., prawns sold from the deli area). Consumers would need to be informed to not re-freeze. It would also lead to a shorter shelf life.

STRATEGIC PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENT
Meat Processor – provide the Trim & Liver (JIT) Manufacturing – Hilton Foods, solely outsourced Supply chain partners – trucking companies	Trim & Liver processed through grinding plates Packaging into units Chilled Storage – central Supply chain – daily deliv’ Retail sales	Our beef-liver mince blend Helps families for whom beef mince meals are a weekly staple Who want to boost the nutrition in their families’ diets, without compromising on meal enjoyment or ease of meal preparation By delivering beef mince with an enhanced level of nutrients, particularly Iron And use more of the whole animal, for its sustainability benefits Unlike existing beef mince which has never emphasized its nutritional properties	Beef mince is a weekly staple – easy, versatile, good value & foolproof. Family favourite – basis of many popular meals Offal has nutrient appeal, but never found an easy way to embrace.	Mixed Feelings – Health focused. Families’ nutritional health is a priority – prefer wholesome, natural solutions, otherwise revert to supplements. Healthier choices are largely based upon simplistic ‘rules of thumb’. Pragmatic about meal choices – no good if the kids won’t eat it.
	KEY RESOURCES Manufacturing plant Packaging – VSP Storage - chilled Distribution - chilled Retail Display – fridge		CHANNELS Butchers & Supermarkets. Top of the shopping list – prompts purchase of other ingredients. Existing range is based on leanness, along with a few premium offerings	
RELATIVE COSTS Product: Using 15% Liver reduces COGS by 7.5% Packaging: unit cost of VSP vs. MAP packaging Labour costs: 2x weekly Set up & Wash down, plus Packaging labour Storage & Supply Chain: the same Retail: the same		REVENUES Unit Price @ 16% premium to equivalent leanness version (\$11 vs. \$9-50 for 90cl mince) Achieve 85% volumes of Lean / 4-star beef mince (22 / 26)		

Figure 12b: Scenario 1 – Chilled Supply Chain BMC.

STRATEGIC PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENT
Meat Processor – provide the Trim & Liver (JIT) Manufacturing – Hilton Foods, solely outsourced Supply chain partners – trucking companies	Trim & Liver processed through grinding plates Packaging into units Frozen Storage – central Supply chain – daily deliv’ Retail sales	Our beef-liver mince blend Helps families for whom beef mince meals are a weekly staple Who want to boost the nutrition in their families’ diets, without compromising on meal enjoyment or ease of meal preparation By delivering beef mince with an enhanced level of nutrients, particularly Iron And use more of the whole animal, for its sustainability benefits Unlike existing beef mince which has never emphasized its nutritional properties	Beef mince is a weekly staple – easy, versatile, good value & foolproof. Family favourite – basis of many popular meals Offal has nutrient appeal, but never found an easy way to embrace.	Mixed Feelings – Health focused. Families’ nutritional health is a priority – prefer wholesome, natural solutions, otherwise revert to supplements. Healthier choices are largely based upon simplistic ‘rules of thumb’. Pragmatic about meal choices – no good if the kids won’t eat it.
	KEY RESOURCES Manufacturing plant Packaging – Thermoform Storage – frozen Distribution – frozen Retail Display – freezer		CHANNELS Butchers & Supermarkets. Top of the shopping list – prompts purchase of other ingredients. Existing range is based on leanness, along with a few premium offerings	
INCREMENTAL COSTS Product: Using 15% Liver reduces COGS by 7.5% Packaging: Thermoform packaging is comparable to MAP Labour costs: Fortnightly Set up & Wash down, + packaging labour Storage & Supply Chain: Utilise more expensive frozen version Retail: Incremental Handling & Retail display costs		REVENUES Unit Price @ 20% premium to equivalent leanness version i.e., if 4-star mince = \$10, then similar beef-liver would be \$12		

Figure 12c: Scenario 2 – Frozen Supply Chain BMC.

5. Conclusion

This project is aimed to deliver to early adopters in the Australian Meat Industry a prototype of nutrient/functionally enhanced mince and a process for producing and rapidly characterizing such a mince formulated on knowledge gathered from the mapping of beef muscles and offal for the nutrients and functionalities relevant to the Australian meat consumer. A series of lab scoping, focus, and consumer, quantitative and qualitative surveys, were conducted and outcomes suggests Iron as the hero nutrient sought after by consumers, and that an 85% beef mince and 15% beef liver blend offering can be claimed as a “source of”, “good source” or “complete source” of Iron based on FSANZ’s RDIs. To determine the desirability of the offering, the ‘real world usage’ of a prototype of the 85% beef mince and 15% beef liver blend was assessed, and the following were observed:

- All respondents were motivated by superior nutritional properties but express concerns about the potentially overpowering taste of liver.
- Consumers approached the offering with either optimism or trepidation, and the mindset significantly influenced their subsequent (cooking) experience and ultimate satisfaction (meal) with the product.
- The product's distinctiveness, including its appearance and packaging, was perceived differently depending on the respondent's mindset (positive or negative).
- Many respondents became more optimistic about the product's similarity to regular mince once it has been browned during cooking, further reinforced with the addition of other ingredients / flavours.
- Satisfaction and ongoing usage favour consumers with a positive mindset. Acceptance among family members is crucial for continued usage.
- For many respondents, the product lives up to its promise of nutrient enhancement without compromising enjoyment. A significant portion perceives the enhanced mince to be better than regular mince.
- Most respondents view the product as suitable for moderately and strongly flavoured meals rather than those requiring a singular beefy taste, like burgers.
- The product’s significant nutritional enhancement shifts perceptions of red meat's healthiness to the positive.
- Using more of the 'whole beast' contributes to perceived sustainability.
- Future purchase intention declines significantly when a 20% price premium is introduced, indicating price sensitivity among consumers and recognition that liver is a cheap product.
- These insights provide valuable guidance for product positioning, marketing strategies, and pricing decisions to optimize consumer acceptance and adoption of the offering in the market.

Most respondents (73%) were positive about ongoing usage / future adoption of the nutrient enhanced mince. Thus, it is recommended that the beef-liver mince be positioned as a bold and new offering rather than attempting to conceal its liver content.

Overall, the adoption of the beef-liver nutrient enhanced mince concept by the Beef Industry will result in increased revenue, promote sustainable practices, and the emphasis on liver's role in achieving significant nutritional benefits and promoting positive health associations can differentiate the offering and attract health-conscious consumers, particularly those in the ‘Mixed Feelings - Health’ and ‘Part of my Culture’ segments and further down the track, ‘Young, Sheltered Lives’ ensuring the long term sustainability and profitability of the industry."

5.1 Key findings

Scoping phase – literature review

The literature review and analysis highlighted:

- Significant variability in nutrient content across beef cuts and organ meats enabling nutrient enhancement of beef mince.
- High consumer preference for beef mince due to its versatility.
- There is premium potential for nutrient-enhanced beef based on the premiums achieved by other products in the market.
- Limited commercial examples of mince incorporating organ meats for nutrient enhancement.
- Main challenge involves consumer aversion (“yuk factor”) to organ meats.

Scoping phase – proof of concept

The regulatory review, laboratory formulation of nutrient enhanced mince and consumer testing indicated:

- Regulatory guidelines support nutrient claims for enhanced mince.
- Acceptable formulations with 10, 20 and 30% kidney, liver and heart, respectively, enhance nutrients like iron, vitamins A and B12, and omega-3 fatty acids.
- Liver was most effective due to higher nutrient density.
- Qualitative and quantitative consumer trials showed significant potential for nutrient enhanced mince, particularly when flavoured dishes masked organ meat taste.
- Mince was seen as an ideal vehicle for nutrient enhancement, with consumers expecting a meaningful 50% nutrient increase.
- Enhanced mince versions can potentially trade up existing 4 and 5-star mince users and increase overall mince consumption, possibly reducing reliance on supplements.
- Offal inclusion may require adaptations in cooking and address concerns about smell and taste, with 15% of consumers finding the idea off-putting.
- Alternative packaging format is needed to address colour and shelf-life issues of mince with added offal.

Value proposition development

Nutrient mapping of beef cuts and organ meats, and prediction of nutrient profiles using hyperspectral imaging (HSI) and UV-Vis-NIR spectroscopy (NIRS) demonstrated:

- High variability in composition and nutrient profiles of different cuts and organ meats.
- Potential for rapid and non-invasive nutrient analysis: high R^2 values suggest the feasibility of using HSI and/or NIR for rapid nutrient analysis in commercial production, though more robust calibration with larger sample sizes is needed.
- An 85:15 beef-liver mince formulation was preferred by consumers, offering a balanced nutrient boost using 8.4mg/100g iron content of liver.

The consumer trial using a prototype 85% beef and 15% liver blend ("Super Mince") assessed real-world usage and perceptions providing the following insights:

- Enhanced nutrient content was highly appealing, particularly for health-conscious consumers, but they are worried about the strong taste of liver.
- Optimism about the product increases once it is browned and combined with other ingredients, making it more similar to regular mince.
- Taste and texture perceptions varied, with sauces and strong flavours masking organ meat differences, making the product suitable for strongly flavoured dishes rather than meals requiring a pure beef taste, like burgers.
- Younger consumers valued sustainability, using more of the animal and minimal packaging.
- 73% of participants expressed future purchasing intent, although enthusiasm decreased with a 20% price premium, indicating consumer price sensitivity and awareness of liver's low cost.

Business Model Canvas and commercial solution development

Two primary production paths were identified for integrating beef-liver mince into existing production systems with minimal adaptations affecting feasibility and commercial viability:

- *Chilled supply chain*: advanced packaging solutions are needed to extend shelf life. This approach may cause significant disruptions and costs to current beef mince production but maintains the normal downstream chilled supply chain operations.
- *Frozen supply chain*: this validated approach, used successfully by premium butchers, significantly extends shelf life through freezing. It causes fewer production disruptions but incurs Capex costs if frozen beef mince is sold alongside chilled mince in supermarkets.

The launch strategy defined the customer journey map and identified critical opportunities for engagement:

- Key stages: understanding the target customer's mindset, mapping their decision journey, and identifying touchpoints for effective engagement.
- By addressing preconceptions, meal preparation experiences, and advocating ongoing usage, the strategy aims to ensure a positive consumer experience and long-term adoption.

5.2 Benefits to industry

Adoption of this nutrient-enhanced mince by the beef industry is expected to boost revenue, promote sustainability, and highlight the nutritional benefits of beef. Implementing the findings of this study can help the nutrient enhanced beef mince offering create a distinct position in the market, attract early adopters, and drive positive perceptions of red meat consumption among consumers. The differentiation from the normal mince and beef on offer can attract health-conscious consumers, particularly those in the 'Mixed Feelings - Health' segment and eventually the 'Young, Sheltered Lives' segment, ensuring the industry's long-term sustainability and profitability.

6. Future research and recommendations

6.1 Future research

While specific challenges in implementing a beef-liver mince blend production and supply chain solution have been identified, a comprehensive assessment of these challenges is necessary to determine commercial viability. Therefore, it is recommended to conduct the following future research to obtain a complete picture:

Shelf-Life Assessment: Test alternative forms of chilled packaging with an 85% beef – 15% liver mince blend. This should be undertaken by a proper testing lab, under stringent testing requirements.

Operational Test Runs: Conduct commercial-scale test runs to evaluate the impact on production costs and disruptions to existing operations. This would also determine the size of a batch, and hence the minimum and maximum number of units that could be produced, at this time.

Test Market Deployment: Implement a test market for frozen beef-liver mince to assess consumer adoption, contrasting placement of frozen beef-liver mince alongside the existing chilled range vs. this offering being located 'at the other end of the store'. Assess switching behaviour against existing range of beef mince offerings, to determine an optimal future range, spanning Leanness, Nutrient Enhancement and Alternate Sources (Grass fed, Organic).

Test Toned-Down Versions of the enhanced blend: Develop a "half-strength" version with 7 to 10% liver content to appeal to consumers who are hesitant about the strong flavour. This version would allow consumers to gradually adjust to the taste. This offering would also fulfil a repertoire role for those who readily embrace the 85:15 version, providing an option for meals like burgers and rissoles, where the true beef taste is valued.

6.2 Recommendations

Within the scope and limitations of the present study, and with emphasis on enhanced iron nutrition from an 85% beef mince and 15% minced liver blend, the following are recommended to increase the viability, desirability and feasibility of the offer by the beef industry to meat consumers. Implementing these recommendations can help the nutrient-enhanced beef mince offering carve out a distinct position in the market, attract early adopters, and drive positive perceptions of red meat consumption among consumers:

Positioning Strategy: Position the nutrient-enhanced beef mince offering as a leading version in the market catering to consumers prioritising family nutrition. Emphasise its role in delivering key nutrients without compromising on taste.

Liver Inclusion: Maintain the inclusion of 15% liver as it strikes a good balance between providing a desired nutrient boost and being acceptable for normally flavoured meals. Highlight the use of liver to lend credibility to the nutrient enhancement.

Value Proposition: Focus on emphasizing the benefits of the product in terms of what it delivers in terms of nutrient enhancement rather than dwelling on how it achieves it. Consumers value the nutrient enhancement aspect, while downplaying the addition of liver may enhance perceived value.

Distinctive Branding: Portray the offering in a distinctive and bold manner through pack format and branding to highlight its uniqueness in the market. Bold packaging can draw attention and differentiate it from existing beef mince offerings.

Target Market: Initially target the "Mixed Feelings – Health" segment, as the Early Adopters for this offering, as they are most positively disposed towards new health-focused products. Encourage them to embrace the product initially for fully flavoured meals to help them acquire the taste and ensure family acceptance.

Perception Shifting: Position the offering to play a leading role in changing consumer perceptions of red meat, shifting the narrative towards a positive outlook on health and sustainability. Highlight the product's contribution to a healthier lifestyle and sustainable food choices.

Variety Expansion: Consider establishing a second version of the original product with a toned-down liver content (7%-10%) to cater to consumers who struggle with the difference in appearance and taste, or who prefer their minimally flavoured meals with a true beef flavour, such as burgers.

Proposition

Nutrient Enhancement Focus: Emphasise nutrient enhancement with a specific focus on iron, as it is the most motivating proposition for consumers. Highlight the health benefits associated with increased iron intake.

Liver Inclusion: While liver inclusion should be overt to maintain credibility, it should not be the primary focus of the proposition. Shift the emphasis towards the overall nutrient enhancement rather than the specific ingredient.

Wellness Benefits and Sustainability: Although wellness benefits may not currently resonate strongly, there is consumer interest. Educate consumers about the wellness benefits associated with the product. Highlight its sustainability aspect, which resonates with modern consumers.

Packaging

Vacuum Sealed Packaging: Continue using vacuum-sealed packaging as it is well-liked by consumers. Highlight its space-saving benefits, particularly for freezer storage, and its modern and contemporary format. Ensure easy and clean removal of the product from the pack.

Product

Liver Inclusion and Range Building: Maintain the 15% liver inclusion as it delivers on the promise of minimal difference once cooked. Start with a standard version (90% lean) and gradually build the range as acceptance grows.

Toned-Down Version: Introduce a toned-down version with incremental appeal for consumers who find the original offering too intense. This version can cater to minimally flavoured meals.

Pricing

Value-Based Pricing: Price the product with a 20% premium, reflecting the valued nutrient-led health benefits. This premium is motivating across a broad spectrum of consumers who prioritize health.

Promotion

Positive Initial Experience: Focus on ensuring consumers have a positive initial experience with the product. Encourage usage for moderately and strongly flavoured meals to enhance acceptance and satisfaction.

Word-of-Mouth Marketing: Capitalize on the likely word-of-mouth interest generated by satisfied consumers. Encourage sharing positive experiences with friends and family.

Place

Distribution Channels: Make the product available through existing beef mince channels. While a frozen product may not be preferred by all consumers, it is not a significant barrier. Display alongside premium beef mince versions like grass-fed and organic to position it as a high-quality offering.

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8. Appendix 1.

Process flow for optimising the matrix of 100kg (85:15 - beef, and liver) mince formulation.

Using Frozen beef and liver

1. Temper (partially thaw) the beef and liver until easily sliceable but not completely thawed or hold at -2°C until the core temperature of the meats equilibrates to that temperature.
2. Trim beef and liver of visible connective tissue materials and chunk the partially thawed beef and liver separately through a 20mm or kidney plate.
3. Weigh out 85kg of chunked beef and 15kg of chunked liver.
4. Mix the two thoroughly in the hopper of the mincer and grind through a 10mm plate.
5. Remix thoroughly the 10mm ground mixture of beef and liver and regrind through a 3mm plate (should look as defined/granular or better than seen in the attached photo with no visible chunks of liver although formulated with 20% liver)
6. Weigh out 500g portions of the 3mm mince in suitable packages.
7. MAP or VSP for labelling/storage/distribution.

Using fresh-never-frozen beef and liver

1. Trim beef and liver of visible connective tissue materials and chunk the beef and liver separately through a 20mm or kidney plate.
2. Weigh out 85kg of chunked beef and 15kg of chunked liver.
3. Mix the two thoroughly in the hopper of the mincer with all the drip in the packages if any and grind through a 10mm plate.
4. Remix thoroughly the 10mm ground mixture of beef and liver and regrind through a 3mm plate.
5. Weigh out 500g portions of the 3mm mince in suitable packages.
6. MAP or VSP for labelling/storage/distribution.



Note: Follow the same process if less amount of mince is to be formulated and do not discard any drip in the packaging as some of the nutrients go in the drip/exudate.