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Scoping the functional properties of red meat and opportunity spaces in preventative health and wellbeing

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Executive Summary

In recent years, there has been growing consumer demand for healthier and value-added nutritional food products, which has prompted the industry to focus on the relationship between food composition and human health and wellness. The Australian red meat industry can seize this emerging market opportunity by identifying opportunity spaces for new product development that could become additional sources of revenue. The aim of this project was to scope opportunity spaces for red meat consumption in the preventative health mega-trend, identify potential products that can impact these opportunity spaces and conduct market analysis on the two most promising product concepts.

In the first phase, this project reviewed the literature regarding four important preventative health areas including 1) weight management, 2) sarcopenia, 3) muscle development and 4) gut health and identified how these health challenges could be met through the consumption of red meat and related food products. The project identified fourteen opportunity spaces and defined the product concept, early adopter (commercialiser) and potential market for each of the opportunities. Two opportunities spaces were selected (following discussion with MLA) for a more detailed investigation into the market potential desirability, viability and feasibility using a methodology similar to the CSIRO ON programme. The two opportunities selected were 1) controlling blood glucose with high protein meat based snacks and meals and 2) lowering blood pressure with red meat solutions rich in anti-hypertensive peptides. In Australia, diabetes is one of the fastest growing chronic condition (1.7 million) and almost a quarter of the population (6 million) suffer from high blood pressure.

In the second phase, the project conducted two market surveys targeting individuals suffering from these conditions: 1) elevated blood glucose or type 2 diabetes (n = 93) and/or 2) diagnosed with high blood pressure or hypertension (n = 134), accessed through CSIRO's clinical research database. The survey showed similar trends for both health conditions. An extremely high percentage of individuals, 96% and 98%, were interested in consuming a high-protein snack from red meat to help control their blood-glucose and high blood pressure, respectively. The preferred product formats were, in decreasing order: snack bar, jerky and steak for both cases (45-50%). In addition, a high percentage of individuals, 90% and 98%, were willing to consume such a red-meat protein product at least once a day, and 54% and 64% would be willing to pay up to \$2.99, respectively. Accordingly, a market value of \$870 million and \$2.8 billion per year can be estimated for red meat based products for consumers suffering from elevated blood glucose and high blood pressure, respectively. This represents an excellent opportunity for the Australian red meat industry to transform commodities into value-added meat products and capture additional revenue. Realistically, over \$360 million could be captured annually from the sales of these products by Australian red meat producers.

Further work must focus on the definition of a business model canvas to translate these proof-of-concept ideas into commercial opportunities. CSIRO's 'ON Prime' programme provides a good framework to progress the work in this direction. In addition, further efforts will require collaboration between meat industry companies and industry associations, such as MLA and AMPC, in order to enable the research and development of the opportunities identified for the consumption of red meat in the preventative health space. Ultimately, clinical trials should validate the desired preventative health benefits of these red meat products.

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1 Background

1.1 Meat as a valuable nutrient source

Meat has been part of the human diet since ancient times. Incorporation of meat into our diet plays a key role in the evolution of the human brain and the social aspects of mankind as a remarkable species. Red meat, when included as part of a healthy and varied diet, provides a rich source of high biological value protein and essential nutrients, some of which are more bioavailable than alternative food sources. However, general over-consumption of meat, preparation at high temperatures, processing (such as addition of salt and nitrate), as well as its high saturated fat, has contributed to the general perception among consumers in Western markets that meat consumption should be reduced for health reasons. As such, many investigations have focused on limiting or reducing negative aspects of meat consumption, such as formation of heterocyclic aromatic amines, manipulation of lipid profile and reduction of salt content. Less focus has been given to the possible nutritionally advantageous aspects of meat consumption.

Red meat is an excellent source of proteins and amino acids. Furthermore, red meat can make an important contribution to the intake of micronutrients that are sometimes found to be lacking in the diets of some population groups. Meat can be a good source of micronutrients, such as vitamin A, B1, B2, B3, B6, B12, iron, zinc, phosphorous and magnesium (Cobiac and Syrette, 2000; Wyness, 2015). An intelligent red meat consumption that matches individual needs for preventative health and wellbeing is desirable and will provide health-associated advantages to the consumer. This report will address the positive aspects of red meat consumption in relation to preventative health and wellbeing, and provide avenues to target research aimed at fostering improved health through the consumption of red meat products.

1.2 Preventative health and wellness megatrend

The modern world is rapidly changing. Economies are growing, along with the world's population, which is ageing. This will result in the percentage of the population aged over 60 years significantly increasing over the coming years, and will increase the burden on health care systems. Furthermore, consumers are better informed and are more health-conscious than ever before. Hence, they demand more information on the food they consume and food that provides superior nutrition and deliver improved health and wellbeing. People want to be healthy and are willing to pay more for food products that provide them with extra nourishment and added benefits.

Prevention of diseases associated with age, such as cardiovascular disease, type 2 diabetes and cancer, is becoming increasingly important. Most metabolic diseases and associated conditions can be prevented by addressing risk factors, such as tobacco use, unhealthy diet, obesity, physical inactivity, hyper-lipidemia, diabetes and high blood pressure. Preventative measures can provide the consumer with tools to counteract and mitigate some of these symptoms and contribute to a better health status and wellbeing for different population groups, spanning from healthy adults to aged populations. Preventative health and wellbeing has been identified as a global mega-trend which highlights the need to use food to improve the wellbeing namely of health-conscious consumers and the ageing population. The red meat industry should embrace this megatrend and adapt their products to these consumer desires, allowing substantial market share to be captured.

1.3 Future digital technologies and preventative health foods

Future predictions in a number of mega-trend forecasts dramatic changes in the world by 2030. These will be wide ranging, from personalised foods and therapeutics to increased extreme weather events and human-free autonomous manufacturing environments. To help tackle these global challenges, CSIRO has developed a number of Future Science Platforms to develop advanced science capability and deliver the outcomes required by industry.

The Active Integrated Matter (AIM) Future Science Platform has a focus area around ‘Personalised Fabrication of Smart Food Systems’. AIM predicts a future where a personalised food revolution takes place i.e. food, nutraceuticals and other products will be personalised based on an individual’s genetic makeup, and where optimum wellbeing for each person is a reality.

The CSIRO team envisages a future where an intelligent ‘food generator’ will use personal information collected in real time, such as a consumer’s health status and what they are planning to do, combined with information such as their genetic makeup and age, to create a smart food matrix and nutrient load that is personalised to meet their requirements for that day. Ultimately, an intelligent food generator would prepare personalised foods or ‘inside-able’ material for each member of the family, on a daily basis¹.

In this regard, using smart/personalised foods, as well as wearable technology, will allow consumers to better manage their health and take preventative steps to avoid diseases, such as diabetes and cardiovascular disease. This project focuses on the concept of using value-added red meat products that could be used to control either blood glucose (for individuals with type 2 diabetes) or high blood pressure (for individuals with hypertension and increased cardiovascular disease risk).

With an ageing population, changing protein preferences, and an increasingly connected, well-informed and health-conscious society, the functional health properties of red meat for use in preventative health and wellness is an emerging market opportunity for the Australian red meat industry. A 2015 Nielsen report found that ‘nearly 80% are actively using foods to forestall health issues and medical conditions, such as obesity, diabetes, high cholesterol and hypertension’².

¹ <https://research.csiro.au/aim/>

² www.nielsen.com/content/dam/nielsen-global/eu/nielseninsights/pdfs/Nielsen%20Global%20Health%20and%20Wellness%20Report%20-%20January%202015.pdf

2 Project Objectives

The audience for the research will be key stakeholders across the red meat industry, working in operations, R&D, business and strategic marketing. CSIRO aims to deliver against the objectives of the research using a multi-stage approach including design-led methodology to identify opportunities for the red meat industry in the preventative health and wellness space.

2.1 Objectives

- Determining how the preventative health and wellness mega-trend is interpreted in relation to red meat, by assessing consumer behaviour and motivators and emerging science literature and influencers.
- Identifying opportunities for the red meat industry to address the global mega-trend on preventative health and wellness to bring to life and incite an imperative to act to grow high-value demand. This will provide guidance to target R&D investment in order to sustain the future of the Australian Red Meat industry in the field of four main areas – weight management, sarcopenia/muscle development and gut health.
- In addition to a final report, the key findings will be disseminated in Factsheets to relevant meat industry stakeholders via MLA to explore industry interest for customised R&D via MLA Donor Company as part of 2Morrow's Foods program.
- Recommendations for potential follow-up projects between MLA and/or CSIRO through the ON Prime program will also be considered in this mega-trend theme.

2.2 Outputs

- Development of an initial list of approximately 10 opportunities with further identification of at least two product-market opportunities for 'preventative health and wellness strategies based on red meat consumption' with product-market fit value proposition clearly presented.
- Assessment of market potential desirability, viability and feasibility of these two preventative health and wellness red meat opportunity spaces – includes size of these markets, what's the job to be done by red meat (pain and gain imposts for target market and value chain participants) and constraints in addressing this trend
- Discussion and preliminary recommendations for future research areas for further investment from initial longer list of portfolio of growth opportunities

2.3 Outcomes

- Use of a design-led strategy to integrate emerging science trends and consumer attitudes towards preventative health & wellness (including exposure to CSIRO's Total Wellbeing Diet program) and potential roles for red meat within high value food frontiers (2Morrow's Foods program).
- To support the development of a commercial strategy for partnerships to drive demand for red meat using and identification of 'insights2innovation' R&D gaps.
- Deck of final report material to present key findings and engage industry (this will be presented in the form of written reports, workshop presentation (including full deck + 5-10 slide key points) and a 1-2 page brochure/fact sheet that can be used by MLA for industry engagement).

3 Methodology

The project followed a design-led approach: literature search -> development of assumptions and questions -> targeted market research via SurveyMonkey -> data analysis.

Table 1. Project phases and methodologies.

	Phase	Task	Description
1	Identification of opportunity spaces for red meat consumption in preventative health and wellness	Develop a long list of opportunity spaces within the areas of 1) weight management, 2) sarcopenia, 3) muscle growth and 4) gut health.	Literature review and description of the product concept, early adopter (commercialiser) and potential market for each of the identified opportunities
		Select two opportunities from the extensive list	Discussion between MLA and CSIRO to agree on two opportunities for the next phase
2	Market assessment	<p>Elaborate three case studies of market examples of preventative health food products</p> <p>Undertaking a study of the market potential desirability, viability and feasibility for the two selected opportunities using a methodology similar to the CSIRO ON programme</p>	<p>Desktop activity to define the scientific principle, product description, market niche and market failure or success of each case study.</p> <p>Conduct a market survey with targeted individuals suffering from 1) elevated blood-glucose level or type 2 diabetes and/or 2) high blood pressure or hypertension. The survey was an on-line questionnaire (SurveyMonkey). Prior to conduct the study a Human Research Ethics application was required to be lodged and approved.</p>

4 Results

4.1 Phase 1. Identification of opportunity spaces for red meat consumption in preventative health and wellness

4.1.1 Key findings

Listed below are the fourteen opportunity spaces that were identified for red meat in preventative health and wellbeing:

1. Controlling appetite and food intake (and body weight) with high protein meat based snacks
2. Controlling blood glucose with high protein meat based snacks and meals
3. Increasing lean muscle mass in older populations with focus on overweight and obese individuals
4. Lowering blood pressure with meat rich in anti-hypertensive peptides
5. Restructured meat products for dysphagia and dementia sufferers
6. Building muscle mass and function in athletes/bodybuilders
7. Building muscle mass and function in mature-age and older people
8. Improving muscle strength using collagen-derived peptides and muscle protein isolate (MPI)
9. Improving gut health, immune function, and microbiota diversity by consuming zinc-rich red meat
10. Improving gut health with consumption of a red meat diet enriched with resistant starch
11. Characterisation of dietary patterns in the elderly and optimising their dietary patterns to improve gut and immune health
12. The role of red meat in modulating the gut-brain axis
13. Fermented meat / collagen drink to improve gut health
14. Tackling iron deficiency in pregnant women and non-pregnant women of childbearing age through consumption of red meat

Detailed information on each of these fourteen opportunity spaces, including the product concept, early adopter (commercialiser) and potential market, can be found in the Appendix (Section 9.1 and 9.2).

4.1.2 Selection of two opportunities

The two opportunities that were selected for further CSIRO ON type investigation were as follows:

- Opportunity space A: Controlling blood glucose with high protein meat based ‘snacks’ and meals (opportunity 2)
- Opportunity space B: Lowering blood pressure with red meat solutions rich in anti-hypertensive peptides (opportunity 4).

These two opportunities were selected due to the impact of these diseases on the health and wellbeing of the Australian population. There are 1.7 million³ people that suffer from diabetes and 6 million⁶ from high blood pressure.

4.2 Phase 2. Market assessment

4.2.1 Case studies of preventative health food products in the Australian market

Three case studies were undertaken on existing and successful preventative health food products in the Australian market to understand how some of the learnings from these examples could be used by the red meat industry. The three products selected for the case studies were:

- Case study 1. Margarine for lowering cholesterol e.g. ProActive
- Case study 2. Glucose control with Faulding® GlucoControl™ to control blood sugar spike after a meal
- Case study 3. BARLEYmax, a wholegrain developed by CSIRO with superior health benefits that can help combat cardiovascular disease, Type 2 diabetes and colorectal cancer.

Detailed information on each of these examples of preventative health food products including the scientific principle, product description, market niche and market failure or success is included in the Appendix (Section 9.3).

4.2.2 Market assessment of the two selected preventative health opportunities for red meat

In collaboration with MLA, it was decided to evaluate the two selected opportunities with targeted consumers i.e. consumers suffering from type 2 diabetes and high blood pressure. These consumers were selected from CSIRO's Clinical database following Human Research Ethics approval. A questionnaire was prepared for each of the opportunities and a link to the SurveyMonkey questionnaire was emailed to the targeted consumers. The questionnaire for each preventative health opportunity and the complete results from the SurveyMonkey for both opportunities are included in the Appendix (Section 9.4, 9.5 and 9.6). A brief analysis of the results highlighting the most important findings are summarised below.

4.2.3 Opportunity space A. Controlling blood glucose with high protein meat based 'snacks' and meals

Market Segment

- Individuals with impaired glucose tolerance (pre-diabetes) and type 2 diabetes is a growing market in Australia.
- Consumers that have high engagement/interaction with the Internet of Things and monitoring devices (e.g. FitBit health trackers)
- 1.7 million Australians suffer from diabetes resulting in an annual cost of \$14 billion (i.e. each diabetes sufferer cost has an annual negative economic impact of \$8,500).
- 85% are type 2 diabetes cases which represent the target market for this opportunity resulting in domestic target market of 1.4 million.
- Diabetes has been describes as the 'fastest growing chronic condition in Australia'³.

³ www.diabetesaustralia.com.au/diabetes-in-australia

Survey Findings

93 respondents, all 30+ years, majority 50-64 years old. For this survey 'red meat' included beef, lamb, veal and goat, and the various market size calculations are based on a target market of 1.4 million people:

- **98% eat red meat at least once per week** (~1.37 million)
- 57% eat red meat at 2-3 times per week (~800,000)
- **26% eat red meat 4+ times per week** (~365,000)
- Majority consume red meat as steaks, mince, roasts or sausages
- Even split between "desire to eat more red meat" i.e. 48% yes vs 52% no
- 87% consider pork healthy
- 96% consider chicken healthy
- **94% consider red meat healthy** (~1.31 million)
- 97% were interested in a food or beverage product to supplement their current diet (~1.35 million)
 - o Only 10% (~140,000) were currently using a food or beverage to manage their blood glucose levels (examples were margarine, nuts, diet soft drinks, BelVita biscuits⁴)
- 73% (~1 million) have at least one between-meals snack per day. Usual choices were:
 - o Nuts, cheese, fruit, jerky, chips, biscuits, yoghurt, cake, tea, coffee, chocolate, vegetables
 - o Only 5% never consume a between-meals snack (~70,000).
- **96% (~1.34 million) were interested in consuming a high-protein snack (from red-meat) to help control their blood-glucose response, post-meal**
 - o **90% (~1.26 million) would be willing to consume such a red-meat protein snack at least once/day**
 - o Preferred snack format was snack bar, followed by jerky & steak (all >49%)
 - o Dressings, sauces & powders for beverage were not popular (all <29%)
 - o **Willing to pay up to \$2.99 for this red-meat protein snack (54%)**
 - o Only 25% willing to pay >\$3 and only 11% willing to pay >\$4
- 77% (~1.08 million) were interested in continuous real-time monitoring of their blood glucose level
 - o Most used finger prick monitor, some used doctor visits and HbA1c tests 2-3 times per year

Other markets that could add to the above number:

- Health-conscious consumers, trying to prevent/reduce the long-term associated symptoms and complications of diabetes (i.e. active agers with middle to high wealth status). For instance, an Early Adopter could be baby boomers who are already loyal purchasers of lower cholesterol butter substitutes.
- Elderly / aged-care homes – incidence of diabetes higher in those over 65.
- Younger generations are also more willing to pay a premium for products with health attributes².
- Assumption is that an additional 700,000 consumers (3% population) could be added to the target market.

Therefore, with 96% of all individuals with type 2 diabetes surveyed willing to consume a high-protein, red-meat-based snack to help control their post-meal blood glucose response, and 73%

⁴ www.belvitabreakfast.com

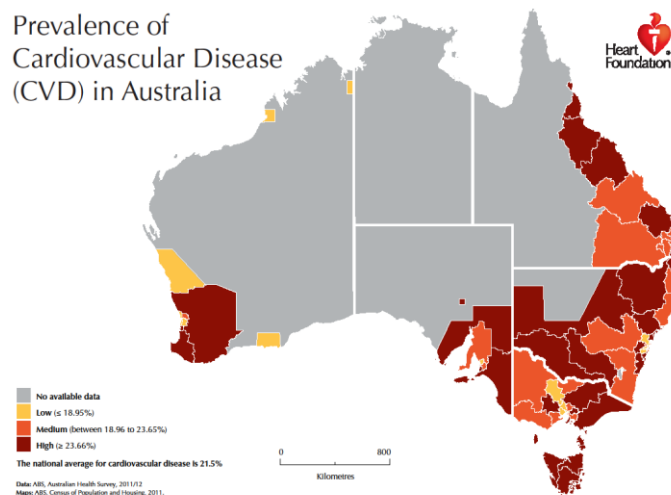
eating this snack daily, paying \$2.99 per snack bar/jerky, the total estimated Australian market is valued at up to \$2.07 billion per year.

This is estimated from 1.2 million with type 2 diabetes diabetics + 700,000 health-conscious consumers spending \$2.99 per day on the above-mentioned snack. Assuming individuals do not buy this every day for 365 days straight (assume 70% of the time) and that only 60% of the 1.9 million consistently purchase the product (60% customer retention rate, assumes a 40% attrition rate). Aim is to have a customer retention rate >85%⁵, that's still an **estimated Australian market of \$870 million per year**.

4.2.4 Opportunity space B: Lowering blood pressure with red meat solutions rich in anti-hypertensive peptides

Market Segment

- 6 million Australians suffer from high blood pressure resulting in annual costs of \$2 billion.
- Almost a quarter of all Australians (national average is 21.5%) suffer from high blood pressure.
- Risk factor - drastically increased likelihood of heart attack and hospitalisation.
- 68% of the 6 million have uncontrolled/unmanaged high blood pressure⁶.
- Risk of having high blood pressure increases in people over 55.



www.heartfoundation.org.au/about-us/what-we-do/heart-disease-in-australia/prevalence-of-cardiovascular-disease-cvd-in-australia

Survey Findings

134 respondents, all 30+ years, majority 50-64. For this survey 'red meat' included beef, lamb, veal and goat, and the various market size calculations are based on a target market of 6 million people:

- **99% eat red meat at least once per week** (~5.94 million)
- 61% eat red meat at 2-3 times per week (~3.66 million)
- **20% eat red meat 4+ times per week** (~1.2 million)
- Majority consume red meat as steaks, mince, roasts or sausages

⁵ <http://blog.clientheartbeat.com/customer-retention-rate/>

⁶ www.heartfoundation.org.au/images/uploads/publications/High_blood_pressure-Factsheet_2016.pdf

- Even split between 'desire to eat more red meat' i.e. 47% yes vs 53% no
- 89% consider pork healthy
- 96% consider chicken healthy
- **92% consider red meat healthy** (~5.52 million)
- 90% were interested in a food or beverage product to supplement their current diet (~5.40 million)
 - o Only 4% (~240,000) are currently using a food or beverage to manage their high blood pressure (examples were margarine and gelatin)
- 62% (~3.72 million) have at least one between-meals snack per day. Usual choices were:
 - o Nuts, cheese, fruit, jerky, chips, biscuits, yoghurt, cake, tea, coffee, chocolate, vegetables, toast, muesli bars, popcorn
 - o Only 5% never consume a between-meals snack (~300,000).
- **98% (~5.88 million) were interested in consuming a high-protein snack (from red-meat) to help control their high pressure**
 - o **91% (~5.46 million) would be willing to consume such a red-meat protein snack at least once/day**
 - o **Preferred snack format was snack bar, followed by jerky & steak (all >45%)**
 - o Dressings, sauces & powders for beverage were not popular (all <27%)
 - o **Willing to pay up to \$2.99 for this red-meat protein snack (64%)**
 - o Only 30% willing to pay >\$3 and only 11% willing to pay >\$4
- 83% (~4.98 million) were interested in continuous real-time monitoring of their blood pressure
 - o Most use doctor visits (often monthly) and some have blood pressure monitors at home, but most don't monitor it, they just take their medication and have 6-monthly/yearly check-ups

Other markets that could add to the above number:

- Health-conscious consumers, trying to prevent/reduce the long-term associated symptoms and complications of high blood pressure (i.e. "active agers" with middle to high wealth status).
- Elderly / aged-care homes – incidence of high blood pressure higher in those over 65
- Younger generations are also more willing to pay a premium for products with health attributes².
- Assumption is that an additional 700,000 consumers (3% population) can be added to the target market.

Therefore, with 98% of all high blood pressure sufferers willing to consume a high-protein, red-meat-based snack to help control their high blood pressure, and 91% eating this snack daily, paying \$2.99 per snack bar/jerky, the estimated Australian market is valued at up to \$6.7 billion per year.

This is derived from 5.4 million sufferers of high blood pressure + 700,000 health-conscious consumers spending \$2.99 per day on the above-mentioned snack. Assuming they don't buy this every day for 365 days straight (assume 70% of the time) and that only 60% of the 6.1 million actually purchase the product (60% customer retention rate, assumes a 40% attrition rate). Aim is to have a customer retention rate >85%⁵), that's still an **estimated Australian market of \$2.8 billion per year**.

5 Discussion

5.1 Phase 1. Identification of opportunity spaces for red meat consumption in preventative health and wellness

In this study, fourteen opportunity spaces for red meat consumption were identified within four preventative health areas: 1) weight management, 2) sarcopenia, 3) muscle growth and 4) gut health. Although only two of the fourteen opportunity spaces were investigated further, the other opportunities provide a valuable dataset and information for MLA as a foundation for future targeted research investment in research projects within the identified opportunity spaces.

5.2 Phase 2. Market assessment

5.2.1 Market examples of preventative health food products

The three market examples provided a reference to the red meat industry in relation to successful food products targeting the preventative health market. The food products selected targeted lowering cholesterol, control of blood glucose levels, reducing cardiovascular disease, type 2 diabetes and colorectal cancer. Meat products designed to impact on these health issues also have great potential.

5.2.2 Opportunity space A. Controlling blood glucose with high protein meat-based 'snacks' and meals

Red meat industry impact

Australians are significant red meat consumers, with MLA data showing that, on average, each Australian eats 92 kg of meat protein per year⁷. This equates to 25 g/day. In general only 30% of beef produced in Australia is consumed domestically, with 70% exported.

Assuming the concept snack was sold (for \$2.99) at 100 g and comprised 75% red meat, that would equate to \$22.40/kg retail cost of the red meat. Assuming a 3X multiplier to get retail price that would be \$7.46/kg value for a red meat protein snack. With the average cost of production at \$1.75/kg⁸ and assuming an animal cost of \$3.50/kg (long-fed steer) that is a **\$2.21/kg profit** to producers. This is 9.9% of the retail price.

Therefore, impact to the red meat industry could be 9.9% of the \$870 million i.e. \$86 million to Australian red meat producers, annually.

⁷ www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/os-markets/red-meat-market-snapshots/mla-australia-beef-snapshot-2017.pdf

⁸ www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/abares-farm-survey/costofprod_austbeefandsheep_2016_v1.0.0.pdf

5.2.3 Opportunity space B: Lowering blood pressure with red meat solutions rich in anti-hypertensive peptides

Red meat industry impact

With 98% of all high blood pressure sufferers willing to consume a high-protein, red-meat-based snack to help control their high blood pressure, and 91% eating this snack daily, and paying \$2.99 per snack bar/jerky, the estimated Australian market is valued at up to \$6.7 billion per year.

This is derived from 5.4 million sufferers of high blood pressure + 700,000 health-conscious consumers spending \$2.99 per day on the above-mentioned snack. Assuming consumers do not buy this every day for 365 days straight (assume 70% of the time) and that only 60% of the 6.1 million actually purchase the product (60% customer retention rate, assumes a 40% attrition rate. Aim is to have a customer retention rate >85%⁹), that's still an **estimated Australian market of \$2.8 billion per year**.

Assuming the concept snack product was sold (for \$2.99) at 100g and comprised 75% red meat, that equates to \$22.40/kg retail cost of the red meat. Assuming a 3X multiplier to get retail price that would be \$7.46/kg value for a red meat protein snack. With the average cost of production at \$1.75/kg⁹ and assuming an animal cost of \$3.50/kg (long-fed steer) that is a **\$2.21/kg profit** to producers. This is 9.9% of the retail price.

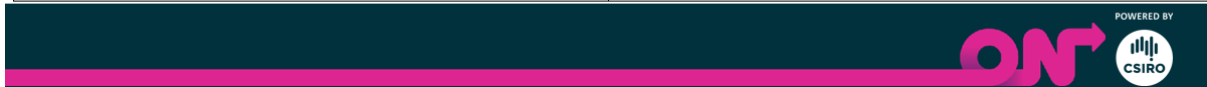
Therefore, impact to the red meat industry could be 9.9% of the \$2.8 billion i.e. \$277 million to Australian red meat producers, annually.

⁹ www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/abares-farm-survey/costofprod_austbeefandsheep_2016_v1.0.0.pdf

5.2.4 Business Model Canvas

Business Model Canvas:
Meat products for control of blood-glucose and lowering of high blood pressure

<p>Key Partners</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 150px;"> <p>MLA and AMPC, red meat processors (DON, JBS, Primo, Hans, etc.), retailers (Coles, Woolworths, Aldi), gyms, health-food stores</p> </div>	<p>Key Activities</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>Developing a low-salt, shelf-stable red meat snack product. Marketing to the health-conscious and diabetes / cardiovascular disease markets.</p> </div> <p>Key Resources</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>Product development and marketing resources. Need to highlight difference/benefits from protein shakes/balls and other 'healthy' snacks, to overcome stigma around 'fatty'/'unhealthy' red meat.</p> </div>	<p>Value Proposition</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 150px;"> <p>Healthy, high-protein, red meat, between-meals snack to help control blood-glucose/high blood pressure.</p> </div>	<p>Customer Relationships</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>Determine interest and roll-out plan with red meat producers and potential retailers.</p> </div> <p>Channels</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>industry seminars and meetings via MLA, direct marketing, health-focus via gyms and health-food stores</p> </div>	<p>Customer Segments</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 150px;"> <ol style="list-style-type: none"> 1. Health-conscious consumers 2. Consumers with diabetes or blood-glucose levels 3. Consumers with cardiovascular disease or high blood pressure </div>
<p>Cost Structure</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>R&D costs, production costs, manufacturing costs</p> </div>		<p>Revenue Streams</p> <div style="border: 1px solid #e91e63; padding: 5px; min-height: 80px;"> <p>Sale of product in retail channels, as well as potentially gyms and health-food stores</p> </div>		



6 Conclusions and Recommendations

- This study identified fourteen opportunity spaces for red meat products in the preventative health and wellness area. This represents a valuable foundation for a targeted investment within the identified opportunity spaces. Research investment in these specific areas could result in new product concepts addressing the emerging preventative health and wellness market.
- The results of the surveys indicated there is a potential market for red meat products targeting the control of blood glucose levels and/or high blood pressure. The survey conducted with individuals suffering these conditions (identified through CSIRO's clinical research database) showed similar trends for the potential products for both conditions. A very high percentage of individuals, 96% and 98%, were interested in consuming a high-protein snack from red-meat to help control their blood glucose and high blood pressure, respectively.
- The preferred product formats were, in decreasing order: snack bar, jerky and steak for both cases (45 - 50%). In addition, a high percentage of individuals, 90% and 98%, were willing to consume such a red meat protein product at least once a day, and 54% and 64% would be willing to pay up to \$2.99, respectively. Accordingly, the total market value for these potential preventative red meat products is estimated to be worth \$870 million and \$2.8 billion per year, for control of blood glucose and for control of high blood pressure, respectively.
- This represents an excellent opportunity for the red meat industry to transform commodities into value-added meat products and capture additional revenue. Additional revenue of \$86 and \$277 million – a total of \$363 million annually – from the sales of these products could be captured as impact for Australian red meat producers.
- Most significant is the positive impact these potential products could have on people with diabetes or cardiovascular disease, allowing them to control their appetite, obtain necessary protein and have a tasty snack, while not feeling guilty for having a high-fat/high-salt product. The reputational benefits these products could provide the red meat industry are incalculable.
- It is recommended that business model canvas is used to translate these proof-of-concept ideas into commercial opportunities by evaluating these ideas on CSIRO's 'ON Prime' type programme. This could result in new business opportunities for the Australian red meat industry.
- Collaboration between meat industry companies and industry associations, such as MLA and AMPC, is recommended to enable research and development of these opportunities into commercial products, potentially via MLA Donor Company as part of 2Morrow's Foods program.
- Ultimately, clinical trials should be used to validate the desired preventative health benefits of these red meat products.

7 Key Messages

- The Australian red meat industry has the opportunity to develop and commercialise meat products for controlling blood glucose and lowering blood pressure, though further research and development activities are required to achieve successful and fully-developed products with such beneficial properties.
- The red meat industry should invest in and foster research and development programmes to conduct impactful science that enables the positioning of new meat products for the preventative health and wellness market.

8 Bibliography

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Wyness, L.A (2015) The role of red meat in the diet; nutrition and health benefits. *Proceedings of the Nutrition Society*, 1-6.

9 Appendix

9.1 Summary table of identified opportunity spaces for red meat consumption in preventative health and wellness.

No.	Preventative health area	Opportunity	Product concept	Early adopter	Potential market
1	Weight management	Controlling appetite and food intake (and body weight) with high protein meat based 'snacks' and meals	<ul style="list-style-type: none"> – Meat based protein snacks or shakes (high protein) – Pre-prepared meals and/or meals kits 	<ul style="list-style-type: none"> – Meat products manufacturers – Food companies and health and wellness program providers that are delivering meal kits and/or health programs 	Individuals who are overweight, obese or weight conscious
2	Weight management	Controlling blood glucose with high protein meat based 'snacks' and meals	<ul style="list-style-type: none"> – Meat based protein snacks or shakes (high meat protein) 	<ul style="list-style-type: none"> – Meat products manufacturers 	Individuals with impaired glucose tolerance (pre-diabetes) and type 2 diabetes
3	Weight management	Increasing lean muscle mass in older populations with focus on overweight and obese individuals	<ul style="list-style-type: none"> – Protein based products incorporating meat protein that can trigger and optimise muscle protein synthesis 	<ul style="list-style-type: none"> – Meat products manufacturers – Food nutrition companies 	The overweight and obese aging population
4	Weight management	Lowering blood pressure with meat rich in anti-hypertensive peptides	<ul style="list-style-type: none"> – A portion of meat (e.g. steak) – A meat product (e.g. a patty or sausage) containing as an ingredient a meat protein hydrolysate 	<ul style="list-style-type: none"> – Meat processors supplying retail-packs of steaks or meat products to supermarket chains which are willing to go 	People suffering from high blood pressure

No.	Preventative health area	Opportunity	Product concept	Early adopter	Potential market
			<ul style="list-style-type: none"> – A pill containing a meat protein hydrolysate 	<ul style="list-style-type: none"> – into the food preventing health market. – Meat processors exporting primal cuts – Pharmaceutical companies 	
5	Sarcopenia	Restructured meat products for dysphagia and dementia sufferers	<ul style="list-style-type: none"> – A range of restructured red meat products; tenderised, mixed with binders, fortified with nutrients and frozen. Product formats; steaks, strips and diced meat 	<ul style="list-style-type: none"> – A supplier of red meat to aged care homes and hospitals 	People suffering from dysphagia
6	Muscle development	Building muscle mass and function in athletes/bodybuilders	<ul style="list-style-type: none"> – Protein 'shot' / protein drink (high protein) – Meat-based protein 'snack' supplemented 	<ul style="list-style-type: none"> – Sport nutrition companies – Food processing companies in collaboration with health and wellness processing companies 	Athletes, body builders, health and fitness-aware adults
7	Muscle development	Building muscle mass and function in mature-age and older people	<ul style="list-style-type: none"> – Meat based protein meals and snacks for mature age people – Restructured meat products for older people 	<ul style="list-style-type: none"> – Meat products companies – Red meat suppliers to aged care homes and/or supermarkets 	Older people (>65 years) and mature-age people (50-65 years) for prevention of age-related muscle loss
8	Sarcopenia /muscle mass	Improving muscle strength using collagen-derived peptides and muscle protein isolate (MPI)	<ul style="list-style-type: none"> – Collagen peptides consumed as supplements or a drink – Collagen peptides mixed with meat protein isolate (MPI) and formulated into drinks 	<ul style="list-style-type: none"> – Collagen drinks producers – Pharmaceutical companies 	People with requirements for or desire to increase muscle strength.

No.	Preventative health area	Opportunity	Product concept	Early adopter	Potential market
			<ul style="list-style-type: none"> – Snack-bar mixture of isolate meat protein with the healthy cereals (e.g. CSIRO BARLEYmax) – Protein soup rich in MPI and low in salt 	<ul style="list-style-type: none"> – Small and start-up companies looking to enter the formulated drinks and health companies – Soups and dressing companies 	
9	Gut Health	Improving gut health, immune function, and microbiota diversity by consuming zinc-rich red meat	<ul style="list-style-type: none"> – Processed meat with enriched mineral and vitamins. 	<ul style="list-style-type: none"> – Farmers, Organic Meat Industries 	<p>General wellbeing</p> <p>Overweight/obese elderly</p>
10	Gut Health	Improving gut health with consumption of a red meat diet enriched with resistant starch	<ul style="list-style-type: none"> – Processed meat with added resistant starch/dietary fibre – Meal plans with meat and resistant starch. 	<ul style="list-style-type: none"> – Organic Meat Industries 	<p>General wellbeing</p>
11	Gut Health	Characterisation of dietary patterns in the elderly and optimising their dietary patterns to improve gut and immune health.	<ul style="list-style-type: none"> – Meal plans with optimal dietary pattern – including meat as a protein source, fibre, macro- and micronutrients. 	<ul style="list-style-type: none"> – Nursing homes 	<p>Elderly population, elderly with frailty</p>
12	Gut Health	The role of red meat in modulating the gut-brain axis	<ul style="list-style-type: none"> – Processed meat with enriched micronutrients/resistant starch 	<ul style="list-style-type: none"> – Organic Meat Industries 	<p>Individuals with cognitive impairment, such as Alzheimer’s or dementia; Autism; people suffering</p>

No.	Preventative health area	Opportunity	Product concept	Early adopter	Potential market
					from Irritable Bowel Syndrome; Parkinson's
13	Gut Health	Fermented meat / collagen drink to improve gut health	– Fermented meat / collagen drink	– Food/ biotechnological companies willing to take risks	General population for improving health and wellbeing
14	Others	Tackling iron deficiency in pregnant women and non-pregnant women of childbearing age through consumption of red meat	– A portion of meat (e.g. a steak) – A meat product (e.g. a patty or sausage)	– Meat processors supplying retail packs – Meat processors producing meat products	Population groups with potential iron deficiency

9.2 Description of identified opportunity spaces for red meat consumption in preventative health and wellness

The opportunity spaces identified are categorised within five targeted preventative health spaces:

- 1) Weight management
- 2) Sarcopenia
- 3) Muscle development
- 4) Gut health
- 5) Others

9.2.1 Opportunity 1. Weight management. Controlling appetite and food intake (and body weight) with high protein meat based 'snacks'

Description

Australia is currently experiencing an epidemic obesity, with ~65-70% of all Australians classified as overweight or obese. Excessive body weight can lead to several chronic diseases and correlates with significant economic and social impact. Weight gain is fundamentally caused by a positive energy imbalance, in which energy intake exceeds energy expenditure. The challenge is to identify effective strategies to reduce food and energy intake, which would reduce body weight and better control weight status.

It is well established that consumption of protein (compared to carbohydrate and fat) and protein-rich foods, including meat has high satiating properties that can suppress appetite and reduce subsequent food intake (Phillips et al., 2016). Moreover, clinical studies have shown that a dietary plan higher in protein and lower in carbohydrate (such as the CSIRO Total Well Being Diet) can promote greater weight loss, compared to a dietary plan that has a higher carbohydrate-to-protein ratio (Noakes et al., 2005).

This evidence suggests that consumption of meat-based protein meals and related 'snacks' consumed between meals can provide satiety-inducing responses. These meals/snacks can assist to better control food consumption throughout the day and promote an overall energy intake reduction.

Application

a) Product Concept. A portfolio of energy-controlled meat-based protein snacks (quantification to be defined with dietary modelling to incorporate as part of an energy-balanced diet) or meat-derived protein added to conventional snack products and foods to increase their protein content. These high-protein snacks could be consumed as 'in-between meals' snack options, in preference to typical carbohydrate-rich, low-protein snacks. Another potential product format is a meat – derived protein-rich shake (meal replacement) that contains meat-based protein that delivers similar functional properties. It is proposed that consumption of these snacks/shakes would assist to suppress appetite between meals and promote an overall reduction in food consumption and energy intake.

Early Adopter. Food companies that produce meat-based products or food products, with interest in commercialising a product line to increase product extension and market share.

b) Product Concept. Pre-prepared meals and/or meal kits that assemble pre-measured portions of meal components, including red meat, that align a high-protein based commercial dietary plan currently available in the marketplace (i.e. CSIRO Total Wellbeing Diet).

Early Adopter. Food companies and health and wellness program providers that are delivering meal kits and/or health programs into the marketplace, with the option of providing product extension offerings.

Potential market

Individuals who are overweight, obese or weight-conscious.

Example of meat, nuts and dried fruit snack mix:

Jerky mix from Dick Stevens

www.dickstevens.rocks



Example of snack bar:

'Epic Bar', Wagyu Beef Steak Strip, US Market

www.jacklinks.eu/se/products/beef-snacks



9.2.2 Opportunity 2. Weight management. Controlling blood glucose with high protein meat based 'snacks' and meals

Description

In response to the obesity epidemic, there is an increasing prevalence of metabolic disorders with a dramatic increase in type 2 diabetes in Australia and globally. Type 2 diabetes is associated with significant health complications that are underpinned by poor blood glucose (glycaemic) control.

Research has shown that the consumption of a dietary pattern that replaces some carbohydrate for protein can improve glycaemic control (acute and dynamic blood glucose control) in individuals with type 2 diabetes (Tay et al., 2015; Gannon et al., 2003). A separate body of evidence also shows that pre-consumption or ingestion of protein before a carbohydrate rich meal can suppress the post-prandial blood glucose rise in response to meal consumption by inducing an incretin response (release of gastric hormones that delay gastric emptying) (Ma et al., 2009). Elevated post-prandial glucose peaks are associated with increased risk of diabetes-related complications and strategies that can assist to blunt these peaks will reduce the risk of diabetes-related complications (Ceriello et al., 1993; Tay et al., 2015).

This evidence suggests that consumption of meat-based protein meals and related 'snacks' consumed between meals can provide blood-glucose lowering effects and could assist to better control blood-glucose post-meal response and throughout the day reducing the risk and development of diabetes-related complications.

Application

a) Product Concept. A portfolio of energy-controlled meat-based protein snacks (quantification to be defined with dietary modelling to incorporate as part of an energy balanced diet) or meat derived protein that has been added to conventional snack products and foods to increase their protein content. These high-protein snacks could be consumed as 'in-between meal' snack options in preference to typical carbohydrate-rich snacks. Another potential product format is a meat protein-derived shake (meal replacement) that delivers similar functional properties. It is proposed consumption of these snacks/shakes would assist to suppress blood-glucose peaks between meals and promote an overall improvement in blood glucose control.

Early Adopter. Food companies that produce meat based products or food products with interest in commercialising a product line to increase product extension and market share.

Potential market

Individuals with impaired glucose tolerance (pre-diabetes) and type 2 diabetes, a growing market in the Australian population.

9.2.3 Opportunity 3. Weight management. Increasing lean muscle mass in older populations with focus on overweight and obese individuals

Description

Both aging and obesity are associated with declines in muscle mass and the increased prevalence of both factors has led to a dramatic rise in sarcopenic obesity. Loss of muscle mass has important implications for maintenance of physical function and the ability to perform daily tasks to maintain independence. Therefore there is a priority need to explore nutritional strategies that will promote muscle protein synthesis and muscle mass gain.

One option is to increase intake of dietary protein. One of the challenges in aging muscle is that muscle responsiveness to trigger muscle protein synthesis is blunted (i.e. a greater amount of protein is required to trigger the same muscle protein synthesis than in younger people) (Paddon-Jones and Rasmussen, 2009). Branch-chain amino acids (BCAA), in particular leucine, of which red meat contains naturally high levels, are integral to muscle protein synthesis (Layman et al., 2015).

There is an opportunity to extract meat protein to develop products that provide a meal threshold of >20g protein containing >2.2 g leucine to optimise anabolic response in skeletal muscle of older adults (Bauer et al., 2013). Strategic selection of specific foods or combinations of different foods, at meals and snacks throughout the day will not only result in optimisation of protein intake, but also contribute to achieving other essential nutrient needs.

In a comparison of food compositions that typically provide 2 grams or more of leucine, meat is one of the more leucine-dense foods that can provide this level of leucine, without an excessive calorie intake.

** The science piece that requires further literature search and research to support this potential product concept is the digestion rate of meat protein and meat protein based leucine product to achieve an appropriate muscle protein synthesis response.

Application

a) Product Concept. A product portfolio of meat protein-based products that can trigger and optimise muscle protein synthesis. It is proposed that consumption of these products will assist in stimulating muscle protein synthesis and muscle protein to promote greater gain and maintenance of lean muscle mass and physical function.

Early Adopter. Meat products manufacturers and food nutrition companies

Potential market

The overweight/ obese and aging population - a large growing market in the Australian population

9.2.4 Opportunity 4. Weight management. Lowering blood pressure with meat rich in anti-hypertensive peptides

Description

Cardiovascular disease (CVD) is recognised as the number one cause of death globally by the World Health Organisation (2011). High blood pressure is a key aggravating factor of CVD, and lowering blood pressure prevents atherosclerosis development, heart failure and the harmful health-effects of diabetes. Lowering blood pressure is possible through the consumption of foods rich in bioactive peptides with anti-hypertensive activity (Arihara and Ohata, 2008). Moreover, it has been found possible to lower blood pressure in hypertensive people by partial substitution of carbohydrate intake with protein intake from lean red meat (Hodgson et al., 2006). This evidence reinforces the concept of targeting a lowering of blood pressure through consumption of lean red meat.

Anti-hypertensive peptides can be generated from hydrolysis of muscle proteins. During the natural ageing of meat, bioactive peptides are formed and some of these peptides have anti-hypertensive activity (Ahmed and Muguruma, 2010). In this regard, peptides inhibiting the Angiotensin Converting Enzyme (ACE) are a pharmaceutical target to lower blood pressure, and can thus exert anti-hypertensive activity when consumed and enough is absorbed in the gut (Ahmed and Muguruma, 2010; Escudero et al., 2012). The amount of peptides in beef generally ranges from 1 to 5 mg/g of meat (Arihara, 2006) and will increase during aging depending on aging conditions, duration and specific primal cuts. Currently, the exact amount of these peptides required to lower blood pressure in humans is unknown, however clinical research results from rats studies has shown that peptides extracted from dry-cured ham and administered to rats at the dose of 1.5-9 mg of peptides per kg of body weight reduced systolic blood pressure by approximately 30 mmHg (Escudero et al., 2012). This is an emerging area of science, and hence, further research is warranted to quantify the formation of these peptides with antihypertensive properties in aged beef, and the subsequent effect of cooking and gastrointestinal digestion on bioaccessibility and bioavailability of these peptides. Recently, research conducted in our group has shown that these peptides are resistant to cooking, which will ensure the delivery after standard cooking (Mora et al., 2017). The amount of peptides required to lower blood pressure can vary greatly as this depends on the inhibitory effect of the specific peptides formed to the Angiotensin Converting Enzyme (ACE) activity, but given the specificity of these peptides, it could be in the range of mg/kg of body weight or even lower.

Application

a) Product concept. A portion of meat (e.g. a steak) containing the required amount of bioactive peptides with anti-hypertensive activity to lower blood pressure. The consumption of lean meat containing the required dose of anti-hypertensive peptides will help to control blood pressure. Investigation and clinical studies are required to develop a process that would ensure the required amount of anti-hypertensive peptides are present in the meat and the validation of the effect in human studies, respectively.

Early adopter. Meat processors supplying retail-packs of steaks to supermarket chains, willing to enter the health prevention food market. Meat processors exporting primal cuts to markets with interest in functional foods (e.g. Japan or USA).

b) Product concept. A meat product (e.g. patty) containing as an ingredient a meat protein hydrolysate, which has the required amount of bioactive peptides with anti-hypertensive activity to effectively lower blood pressure. Figures need to be optimised for the particular product

specification. Product development studies are required to design healthy products (low salt/fat) with shelf stability. Clinical studies are required to ensure the desired anti-hypertensive effect.

Early adopter. Meat processors of meat products willing to enter the healthy food market.

- c) **Product concept.** A pill and supplement containing a meat protein hydrolysate, which has the required amount of bioactive peptides with anti-hypertensive activity to effectively lower blood pressure.

Early adopter – Biotechnology and pharmaceutical companies.

Several food containing ACE inhibitory peptides have been successfully marketed for hypertensives. For instance, there are two commercial dairy products containing the peptides, Ile-Pro-Pro and Val-Pro-Pro, which are generated from milk protein by fermentation. Calpis Amiel-S drink has been approved as a functional food in Japan. The Finnish fermented milk drink Evolus, developed by Valio Ltd., also contains the same peptides (Arihara and Ohata, 2008).

Potential market. People suffering from high blood pressure.

9.2.5 Opportunity 5. Sarcopenia. Restructured meat products for dysphagia and dementia sufferers

Description

Australia, along with the rest of the world, has an aging population. Therefore, age-related issues with food consumption will continue to increase. These include difficulties in chewing and swallowing food, loss of appetite, and reduced palatability due to the decline in taste, smell and absorption of micronutrients. Reduced consumption of food can lead to loss of muscle mass and strength, hence maintaining the muscle mass through consumption of sufficient protein is really important. Red meat is one of the best sources of protein and iron, however the quality of the meat and how it is prepared and cooked often determines if the meat can be consumed safely by an elderly person.

As people age, they often have issues with chewing tougher cuts of meat because of the decline of their dental condition. This inability to chew tough meat is one of the main reasons why red meat is the most rejected food in aged care homes. Lack of protein consumption leads to muscle wastage in the elderly, which negatively impacts their quality of life.

The aged care industry is a price-sensitive industry, and therefore the red meat that is bought tends to be lower value, tougher cuts of meat. If this meat is not prepared and cooked properly, it often results in tough cooked meat, which is rejected and not consumed by the aged care residents. Approximately 35% of the patients in aged care homes require texture modified foods (TMF) due to difficulty in chewing and swallowing (dysphagia). TMF foods (including meat) are prepared by mincing and pureeing cooked food in a food processor and then served using an ice-cream scoop, which has very poor visual appeal and taste. Hence there is large scope for restructured meat products for this market – both for dysphagia, dementia and elderly people who might no longer be able to consume a whole steak.

Application

a) Product concept. A range of restructured red meat products, where the lower value meat trim and primals have been minced (tenderised), mixed with binders, fortified with nutrients (if needed), frozen and cut into a range of free-flow frozen products, such as steaks, strips and diced meat. This product has a range of advantages:

- i. consistently tender,
- ii. kitchen staff only need to remove the required meat/steaks from the freezer,
- iii. product can be cooked from frozen,
- iv. product can be cooked within 10 minutes, and
- v. adds value to cheaper cuts and trim.

Early Adopter. A supplier of red meat to the aged care homes. In general, aged care homes minimise preparation of meal components and hence purchase meat and vegetables that are pre-prepared e.g. peeled onions and potatoes, diced and minced meat, etc. Hence the supplier would need to sell these restructured products to the aged care home.

Potential market

Aged care homes, hospitals, meals on wheels – mainly for elderly people who have difficulty with eating a whole steak. If the protein is presented in a manner in which it is easy to prepare, consume and is easily digested, it would increase the consumption of protein in a vulnerable population, especially those suffering from dysphagia.

9.2.6 Opportunity 6. Muscle development. Building muscle mass and function in athletes/ bodybuilders

Description

Building muscle takes more than just hours in the gym. Whilst important, an athlete must also have the appropriate nutrients and vitamins in their diet for adequate muscle recovery and repair. Supplementation can help boost an athlete's protein intake, but meat should be the preferred source to support muscle growth. Weight lifters and body builders require between 1.2–1.7 g of protein per kg of body weight per day and endurance athletes need a protein intake of 1.2–1.4 g protein per kg of body weight per day (Philips et al., 2007). A 230 g steak contains around 50 g protein to 6 g fat. This is an impressive ratio that promotes the ability for an individual to meet recommended protein requirements.

Grass-fed animals contain higher levels of the 'healthy' fats (unsaturated fats and conjugated linoleic acid) than grain-fed animals. In addition to the benefits of protein and fats in red meat, other nutrients and micronutrients such as the B vitamins, zinc, selenium, iron and creatine are naturally found in red meat. High creatine content aids in muscle size and strength, however habitual meat eaters get less response with creatine supplements than non-meat eaters.

Application

a) Product concept. Protein 'shot' / protein drink – high protein content drink, with meat protein enriched with essential branch chain amino acids, such as leucine, and peptides important for muscle growth.

Early adopter. Health and wellness processing companies.

b) Product concept. Meat-based protein 'snack' supplemented with essential amino acids for muscle growth.

Early adopter. Food processing companies with an interest in extending product range in collaboration with health and wellness processing companies.

Potential market

Athletes, body builders, health and fitness-aware adults.

9.2.7 Opportunity 7. Muscle development. Building muscle mass and function in mature-age and older people

Description

Protein loading to improve muscle performance isn't just for athletes and body builders. Muscle is harder to build and maintain as men and women age. However, similar to athletes, muscles in mature-age (50–64 years) and older (65 years and older) people need additional stimulation (exercise) to grow and also a quality diet to support this. A Deakin University study (Daly et al., 2014) has found that a protein rich diet incorporating lean red meat, combined with strength training, improved the size and strength of muscles in elderly women. This could be essential in reducing the impact that age-related muscle loss has on the risk of falls and the ability of older people to undertake daily living activities, such as getting out of a chair and to maintain independent living. In addition to the increase in muscle mass and strength, it was also found that a lean red meat diet increased a hormone central to muscle growth and reduced a pro-inflammatory marker that has been linked to muscle loss and other chronic diseases.

In this opportunity space, it is also important to promote the benefits of a higher protein diet at different life stages, for example, mature-age people, as a prevention to the impacts of age-related muscle loss and function.

Application

a) Product concept. A portfolio of convenient, meat based protein meals and snacks for mature-age people, with a nutrition profile appropriate for building and maintenance of muscle mass and strength, also providing an enjoyable eating experience.

Early adopter. Meat companies potentially interested in commercialising meat based protein meals with preventative health properties.

b) Product concept. Restructured meat products (opportunity 5) for older people, ensuring protein content and amino acid profile.

Early adopter. Supplier of red meat to aged care homes or supermarkets addressing this growing niche market.

Potential markets

Older people (>65 years) and mature-age people (50-65 years) for prevention of the impacts of age-related muscle loss.

9.2.8 Opportunity 8. Sarcopenia / muscle development. Improving muscle strength using collagen-derived peptides and muscle protein isolate (MPI)

Description

A recent randomised control trial showed that consumption of collagen peptides combined with resistance training, increases muscle strength (Zdzieblik et al., 2015) (peptides from BODYBALANCE™ – Gelita). This evidence suggests that supplementation of collagen peptides may be an effective strategy of improving muscle strength in aged populations. Currently, bones/offcuts and skin either go through a rendering process or get sold off in bulk. It is now known that collagen can be extracted from meat and further processed for valorisation (e.g. patent US 5229497 A). This utilisation could not only minimise waste, but provide a high value end product that could be sold at a premium price into developed markets in South East Asia (e.g. Japan and South Korea).

Furthermore, muscle protein isolates (MPI) can be an excellent source of protein and can be used to formulate atypical meat products, such as snacks. The incorporation of “Barley-max” into a snack bar adds the benefits of having excellent carbohydrate complexes with the red meat MPI, therefore also addressing satiety and blood glucose control. It must be noted that clinical studies that have shown positive effects have been conducted always with physical training as part of their intervention. Therefore, any products designed for enhancing muscle development would need to be complimented with an appropriate exercise training regime/protocol.

Application

a) Product Concept. Collagen peptides extracted from meat/skin/bones and consumed as supplements or as a collagen drink.

Early Adopter. Collagen drinks are already very popular in Asia, though these are currently produced using fish collagen. Current producers of this product could be informed of the research indicating the excellent benefits of beef collagen effect.

b) Product Concept. Collagen peptides mixed with MPI and formulated into a drink – similar to the current offerings of UP&GO, protein shakes, morning breakfast drinks, thickened fluids (e.g. for dysphagia patients), pre-workout drinks.

Early Adopter. Small start-up companies looking to enter the formulated drinks market. Health companies looking to sell something new and innovative.

c) Product Concept. A product mixture of MPI from red meat, combined with CSIRO’s BARLEYmax™, to create a range of snacks (e.g. quick breakfast bars, afternoon pick me ups, post/pre workout bars, meat chips) which have the goodness of pure meat protein and wholesome resistant starch.

Early Adopter. Food companies that produce meat-based products or food products with interest in commercialising a product line to increase product extension and market share.





d) Product Concept. Packet soups/dressing have a bad reputation for high sodium and low protein, therefore developing a soup that has reduced salt, but high protein content from red meat (either via MPI or hydrolysed collagen) could be a viable product.

Early Adopter. Soups and dressing companies with interest in commercialising healthier choices.

Potential Market

People with requirements for or desire to increase muscle mass and strength. Asia has already accepted formulated drinks, thus there is already some groundwork to build this concept product. Other market niches could be elderly, time-poor young professionals or children’s lunch boxes. A

successful marketing strategy would need to be customised to ensure a good receptiveness from the target market.

<p>a) Example of a collagen drink currently being sold in Asia https://www.shiseido.co.jp/collagen/en/product/en-drink.html</p>	<p>b) Collagen peptides sourced from bovine skin (already on market) https://www.myprotein.com/home.dept</p>
	
<p>c) Example of a snack-bar containing a mix of meat protein isolate and barley</p>	<p>d) Protein soup</p>
	

9.2.9 Opportunity 9. Gut Health. Improving gut health, immune function, and microbiota diversity by consuming zinc-rich red meat

Description

Diet has a major influence on the composition of the gut microbiota, whose importance for gut health and overall well-being is increasingly recognised. Knowledge is limited regarding a red meat/high protein diet on the health implications of the effects on the gut barrier function and gut microbiota.

There is growing evidence that micronutrient deficiency is associated with a higher risk of overweight/obesity and other debilitating health conditions and diseases such as diabetes. These micronutrient deficiencies include zinc, selenium, folate, vitamin B1, vitamin B12, vitamin A, vitamin E and 25-hydroxyvitamin D. Imbalances or deficiencies of essential micronutrients significantly influence day-to-day performance, behaviour and emotional state, as well as intellectual and physical activity. These deficiencies may be due to inadequate eating habits, but can also be due to increased demands among overweight people, which are under-estimated by dietary reference intakes intended for the general population. Furthermore, it may be impaired gut function/health, and consequently, compromised absorption capacity that is contributing to the micronutrient deficiency.

The key outcome for this whole food intervention study will be that feeding a whole food rich in zinc, such as meat, in overweight/obese elderly will improve gut leakiness and microbiome diversity, reduce inflammatory cytokines and reduce morbidity (such as infection, zinc deficiency) associated with consuming a non-rich zinc (control) diet.

The overall aim would be develop a meat product enriched in zinc to improve gut health, immune function and microbiota diversity.

Application

a) **Product concept.** Processed meat with enriched minerals and vitamins.

Early adopter. Farmers, Organic Meat Industries.

Potential market

General wellbeing, as well as the overweight/obese elderly, an increasing population demographic.

9.2.10 Opportunity 10. Gut Health. Improving gut health with consumption of a red meat diet enriched with resistant starch

Description

Digestion of red and processed meat has been linked to the formation of harmful agents such as genotoxic N-nitroso compounds (NOCs) and lipid peroxidation products (LPOs) in the gut [Hemeryck *et al.*, 2017]. Some of the important influencing factors on gut health include diet and lifestyle, in particular the adoption of the Western dietary pattern with the excessive consumption of fat and processed meat and poor in fruits and vegetables [Bouvard *et al.*, 2015, Cancer, 2015]. However, researchers at CSIRO have demonstrated that the addition of resistant starch (RS) to the red meat diet exerted a beneficial effect in acute dextran sulphate sodium (DSS)-induced colitis, possibly, by modifying the gut microbiota abundance with RS treatment. The possibility exists to allow the consumption of red meat to improve the gut microbiome [Le Leu *et al.*, 2013].

The key outcome for this opportunity is the beneficial effects of consuming resistant starch and/or dietary fibre with red meat.

Application

a) **Product concept.** Processed meat with added resistant starch/dietary fibre.

Early adopter. Organic meat industries.

b) **Product concept.** Meal plans with meat and resistant starch.

Early adopter Organic meat industries.

Potential market

General wellbeing

9.2.11 Opportunity 11. Gut Health. Characterisation of dietary patterns in the elderly and optimising their dietary patterns to improve gut and immune health.

Description

There is compelling evidence to suggest a link between healthy eating patterns and healthy aging [Baugreet *et al.*, 2017]. Frailty in the older population is common mainly due to diminished appetite, reduced protein intake and reduced physical activity. Healthy dietary patterns, such as the Mediterranean diet, have been linked to improved muscle strength, eating habits and frailty prevention [Yannakoulia *et al.*, 2017]. The dietary pattern in elderly Australians is not well characterised, regarding the intake of protein, energy and specific micronutrients.

The key outcome for this opportunity will be an up-to-date picture of the dietary patterns of a cross-section of elderly Australians and that this cohort will be sub-optimal in protein, fibre, macronutrients, micronutrients, and total energy (caloric) intake. An additional outcome will be that feeding optimised dietary patterns to a free living elderly Australian cohort will improve gut leakiness, reduce inflammatory cytokines and reduce morbidity (such as infection and micronutrient deficiency) associated with consuming sub-optimal dietary patterns. When designing foods for this cohort, the following parameters should be considered: foods should be energy dense, nutritionally adequate, and, most importantly, palatable.

Application

a) **Product concept.** Meal plans with optimal dietary pattern – including meat as a protein source, fibre, macro- and micronutrients.

Early adopter. Nursing homes.

Potential market

Elderly population, or elderly with frailty

9.2.12 Opportunity 12. Gut Health. The role of red meat in modulating the gut-brain axis

Description

There is increasing evidence to suggest that the barrier function and gut microbiome influences cognitive function via the gut-brain axis. Intestinal permeability, which impacts bacterial translocation, is elevated in neurological conditions including Parkinson’s disease [Mulak *et al.*, 2015]. The increased permeability in the gut (and then subsequently the blood brain barrier) makes the brain more vulnerable to the influx of deleterious substances from blood circulation. Increased gut permeability appears to be the cornerstone of the microbiome-gut-brain interaction.

The key outcome for this opportunity would be the potential modulation of intestinal permeability by red meat, and subsequently, the gut microbiota for clinical benefit.

Application

a) Product concept. Processed meat with enriched micronutrients/resistant starch e.g. a combination of a variety of active ingredients such as zinc, glutamine and iron.

Early adopter. Organic Meat Industries.

Potential market

Individuals with cognitive impairment, such as Alzheimer’s or dementia; Autism; people suffering from Irritable Bowel Syndrome; Parkinson’s.

9.2.13 Gut Health. Fermented meat / collagen drink to improve gut health

Description

A healthy population of bacteria in the gut (microbiome) can leverage the health status of an individual. This product will be a source of probiotic bacteria that can pass through the stomach and colonise the gut where they have beneficial health interactions.

Application:


a) Product concept. Fermented meat/collagen drink.

Early adopter. Food/ biotechnological companies willing to take risks

Potential market

General population for improving health and wellbeing

Example of a dairy fermented drink source of probiotics (<http://yakult.com.au/>)

	NUTRITIONAL INFORMATION	
	SERVINGS PER PACKAGE: 5 SERVING SIZE: 65ml	
AVERAGE QUANTITY	PER 65ml	PER 100ml
ENERGY	210 kJ	323 kJ
	50 Cal	77 Cal
PROTEIN	0.8 g	1.3 g
- GLUTEN	NOT DETECTED	NOT DETECTED
FAT - TOTAL	< 0.1g	< 0.1g
FAT - SATURATED	< 0.1g	< 0.1 g
CARBOHYDRATE - TOTAL	11.5 g	17.7 g
CARBOHYDRATE - SUGARS	11.2 g	17.2 g
SODIUM	10.1 mg	15.5 mg
<i>Lactobacillus casei</i> Shirota	6.5 billion cfu* (min)	10 billion cfu* (min)
*colony forming units		
Ingredients list: Water, Skim Milk Powder (Reconstituted), Sugar, Dextrose, Flavouring, Live <i>Lactobacillus casei</i> Shirota strain.		

9.2.14 Opportunity 14. Other. Tackling iron deficiency in pregnant women and non-pregnant women of childbearing age through consumption of red meat

Description

There is variable incidence of iron deficiency in different population groups such as young infants, pregnant women and non-pregnant women of childbearing age (Wyness, 2015). The high content of iron present in red meat and its superior bioavailability is clearly established in the scientific literature (McNeill, 2014). Consumption of appropriate amounts of red meat can contribute to overcome this deficiency.

The red meat industry should exploit this functional property of red meat even further than what has been done so far. There exists a large potential for developing marketable products targeting the different population groups with potential iron deficiencies.

Application

a) Product concept. A portion of meat (e.g. a steak) containing the required amount of iron to address the iron deficiency of a specific target population (e.g. pregnant women and non-pregnant women of childbearing age, young infants, older adults). The iron content in different meat primal cuts of cattle of different breeds and ages should be reviewed in order to select an appropriate animal format which provides a consistent source of highly-available iron.

Early adopter. Meat processors supplying retail packs of steaks to supermarket chains.

b) Product concept. A meat product (e.g. a patty or sausage) containing the required amount of iron to address the iron deficiency of a specific target population. These meat products could be manufactured using offal rich in iron (e.g. liver or kidney). Formulation needs to be optimised for the specific meat product to comply with the recommended dietary intake (RDI). Product development studies are required to design a healthy product, with a good sensory acceptability and shelf life stability.

Early adopter. Meat processors willing to enter the preventative health food market.

Potential market

Population groups with potential iron deficiency.

9.2.15 References

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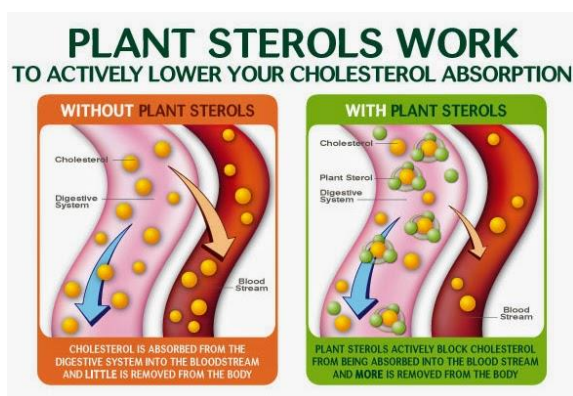
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9.3 Case Studies - market examples of preventative health food products

9.3.1 Case study 1. Margarine for lowering cholesterol

Scientific principle

Cholesterol-lowering spreads: These claims to contain natural plant sterols that lower cholesterol absorption – and the scientific evidence that plant sterols work is quite strong. They can lower the level of harmful LDL cholesterol in your blood by more than 10%. But you'd need to eat at least 25 g of the spread each day to get that level of benefit. Just smearing the occasional slice of toast with one of these spreads won't make much difference. Unfortunately, plant sterols also lower the absorption of beta-carotene, which forms vitamin A in the body. Therefore for consumers, in addition to these spreads, a daily serve of yellow or orange vegetables and fruits is recommended. These products are not meant to be a substitute for cholesterol-lowering medication.



How much do you need?

Most of us eat about 200 to 400 mg of plant sterols daily via plant-based foods including vegetable oils, nuts, seeds, legumes, bread and cereals. However, in order to have a significant cholesterol-lowering benefit, 2 to 3 g per day of plant sterols is recommended. Research suggests that eating 2 to 3 g of plant sterols daily can lower your LDL (bad) cholesterol levels by 10% on average. Eating more than this amount is unlikely to lower your cholesterol any further. Less than this amount will simply have a lesser effect.

Product description

Products like Flora pro-activ have been enriched with plant sterols (also known as phytosterols), which have a similar chemical structure to cholesterol. They tend to compete with and block the absorption of cholesterol from the intestine, ultimately reducing the amount of cholesterol that ends up in the blood.



Eating 2–3 g per day of plant sterols in the form of enriched spread, yoghurt, milk or a combination of these products can help lower cholesterol. The impact from consuming these products can be realised in a matter of weeks. However, as with the cholesterol-lowering medication, these products need to be consumed daily for the benefits to last.

Market niche

The launch of Flora pro-activ in 1999 was the first plant sterol spread to be launched in Australia. Flora pro-activ stimulated market growth by offering a clearly differentiated product with strong, deliverable functional and emotional consumer benefits which consumers were prepared to pay a significant price premium. Having established Flora pro-activ as the authority in cholesterol lowering spreads amongst consumers 55+ years, mainly via PR, the next challenge was to broaden appeal to a younger market. That is, males 40+ years who may have a history of heart disease, or suffer from elevated cholesterol.

Who can they benefit?

People at risk of heart disease and in particular those who have high blood cholesterol levels (total cholesterol of 5.5 mmol/L or more) can benefit from eating products enriched with plant sterols. Research shows that if you lower your blood cholesterol levels, you lower your risk of heart disease and stroke. Some research suggests that a reduction in LDL cholesterol levels by about 10% could reduce the risk of heart disease by 20–25% – especially in someone with risk factors (a family history of heart disease, high blood pressure, being overweight or a smoker, for example) as well as high blood cholesterol.

Market failure or success

According to Roy Morgan Research, in the 12 months ending in June 2016, 54.7% of Australian grocery buyers purchased butter at least once in an average four-week period. This is a substantial increase on the 47.2% who brought butter 4 years ago (June 2012).

By contrast, only 44.6% of people brought margarine at least once a month in the 12 months ending in June 2016. This is a 20% decrease on June 2012 figures.

Approximately 30% of Australians bought dairy spreads or butter blends at least once a month in the 12 months ending in June 2016, roughly the same amount who purchased the product in 2012.

FSANZ approval process

Although the specific approval process for pro-activ margarine does not appear to be publically available, the general FSANZ approval process for health claim can take up to 12-14 months. Preparation of the application may take approximately 6–8 weeks, and approval process can take up to 9-12 months.

9.3.2 Case study 2. Glucose control with Faulding® GlucoControl™

Scientific principle

Faulding® GlucoControl™ is a pre-meal drink that is used to assist in the management of type 2 diabetes. Taken 0-30 minutes before a high carbohydrate meal, it significantly reduces the blood glucose spike caused by that meal. In the long term, this helps reduce the blood sugar readings.

Product description

Faulding® GlucoControl™ is to be used as part of an overall management plan for people with pre-diabetes, early type 2 diabetes or those people with reasonably well controlled type 2 diabetes. Faulding® GlucoControl™ is a food product that has proven medical benefits for people with type 2 diabetes. It is not a 'medicine' and does not need to be prescribed by a doctor. It is comprised of food products that work to help people with type 2 diabetes manage their condition. It is available for purchase directly from the Pharmacy, and is recommended by your health care professional advising you on your diabetes management as part of your overall approach. Faulding® GlucoControl™ is for special medical purposes and is for use under the supervision of an appropriate health care professional, including your GP, nurse, pharmacist, dietitian, specialist or other health professional.

Faulding® GlucoControl™ is not recommended:

- For people with allergies to milk products or soy products.
- For people with high measures of blood glucose, or highly fluctuating measures of blood glucose.
- For people prescribed insulin by their doctor (without their direct advice).
- As a sole source of nutrition, or as a regular meal replacement product.

How long to take it

Faulding® GlucoControl™ is designed to be used as part of the routine management of type 2 diabetes. Studies show that for long term use the product is both safe and effective.

If you take too much (overdose)

The dosage recommendation is a single sachet consumed as a pre-meal drink before meals. As a food product, there is no potential for overdose, however the high levels of soluble fibre may lead to diarrhoea if consumed in large amounts.

Taking other medicines

Tell your health care professional if you are taking any other medicines, including any that you buy without a prescription from a pharmacy, supermarket or health food shop. This will help them decide if using Faulding® GlucoControl™ is appropriate for you.

Faulding® GlucoControl™ has been shown to be effective when used in conjunction with medicines designed to treat type 2 diabetes. As a food product, there is little chance of interaction. However, it is important to take oral medicines 15 minutes before the pre-meal drink so the absorption of the drug is not changed.

Manufacturing company: Omni Innovation Medical Nutrition

(<http://www.omniinnovation.com.au/consumer/glucocontrol>)

	<p><u>Ingredients</u></p> <p>Each Sachet contains:</p> <ul style="list-style-type: none"> – Whey protein (and other dairy proteins) – Guar (Soluble Fibre) – Flavouring and sweeteners (sucralose)
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Market niche

People with pre-diabetes, early type 2 diabetes or those people with reasonably well controlled type 2 diabetes. People with diabetes (1 million Australians – \$14 billion cost); ~90-95% are type 2 diabetes cases which represent the target market. Additional ~500,000 with pre-diabetes (impaired glucose tolerance) and/or undiagnosed type 2 diabetes. Total domestic target market ~1.5 million.

Market failure or success

Faulding® GlucoControl™ is currently in the Australian market.

9.3.3 Case study 3. BARLEYmax, a wholegrain developed by CSIRO with superior health benefits that can help combat cardiovascular disease, Type 2 diabetes and colorectal cancer

Scientific principle

BARLEYmax is a grain having higher fibre content and enhanced nutritional benefits compared with regular barley. A program of conventional plant breeding led to the development of BARLEYmax™, a high fibre wholegrain with high levels of resistant starch. An extensive program of experimental studies, including a number of human trials, showed that a range of foods produced with BARLEYmax™ as their key ingredient had a low glycemic index and also produced positive changes in a range of biomarkers of bowel health.

Product description

BARLEYmax is a high fibre wholegrain with high levels of resistant starch. This grain can be included in the formulation of a variety of food products such as breakfast cereals, food wraps, rice mixes and bread to deliver health benefits.

Manufacturing company: BARLEYmax™ is now licensed to a CSIRO spin-off company, The Healthy Grain (www.thehealthygrain.com/)



BARLEYmax is high in fibre, particularly resistant starch

(<https://www.csiro.au/en/Research/AF/Areas/Plant-Science/Wheat-barley/BARLEYmax>).

Market niche

Chronic diseases are a heavy burden on Australia's economy and well-being. Obesity, heart disease, stroke, type 2 diabetes and cancer are the leading causes of preventable death. Obesity alone cost Australian society and governments over \$58 billion in 2008. Australia needs practical, effective diet and lifestyle solutions that can help reduce the burden of these chronic diseases. Increased wholegrain intake has been shown to reduce the risk of certain cancers, heart disease, diabetes, stroke and even help with weight control.

Market failure or success

In a joint venture with Australian Capital Ventures Ltd, CSIRO bred the new BARLEYmax™ grain, then worked with food manufacturers to create products containing BARLEYmax™, including breakfast cereals, food wraps, rice mixes and bread. Consumers have been able to enjoy the benefits of foods containing BARLEYmax™ since August 2009.

The potential value of improved health outcomes for Australians from widespread, regular consumption of BARLEYmax™ is estimated to be worth approximately \$305 million per year due to its potential for lowering rates of Type 2 diabetes, cardiovascular disease and colorectal cancer. In addition, the total savings in health system costs from increased dietary fibre intake are forecast at up to \$17 million per year. BARLEYmax™ also benefits grain growers, through additional earnings from guaranteed prices for barley and diversification of farm business models.

9.4 Information sheet for survey participants

INFORMATION SHEET

Scoping opportunities for Red Meat in the preventative health trend

LOW RISK REVIEW PANEL NUMBER: LR14-2017

INTRODUCTION

Each year CSIRO performs a number of research projects involving human participants. We examine the effect of different foods, diet and lifestyle strategies on diseases, such as heart disease and bowel disease, which are leading causes of death in Australia. This project will assess the potential market of two “preventative health and wellness red meat opportunity spaces”. The two preventative health opportunities are:

- Controlling blood glucose with high protein red meat based ‘snacks’ and meals
- Lowering blood pressure with red meat solutions rich in anti-hypertensive peptides

Meat & Livestock Australia (MLA) wants to explore the potential role of red meat in the preventative health and wellness global mega-trend. The project team consists of scientists from the CSIRO Agriculture and Food and the CSIRO Health and Biosecurity divisions. This project will identify market opportunities for the promotion of red meat as a source of nutritional and functional compounds with beneficial physiological effects related to preventative health and wellness.

WHAT IS THE AIM OF THIS STUDY?

This project will assess the potential market of two “preventative health and wellness red meat opportunity spaces”. The two preventative health opportunities are:

- Controlling blood glucose with high protein red meat based ‘snacks’ and meals
- Lowering blood pressure with red meat solutions rich in anti-hypertensive peptides

HOW WILL THE STUDY BE CARRIED OUT?

The project will conduct a market study using two surveys which will be e-mailed to individuals from the CSIRO clinic database.

You will be eligible to complete one or both of the surveys if:

- 1) You are over 18 years of age and you have been diagnosed with or told that you have elevated blood-glucose levels or type 2 diabetes; or
- 2) You are over 18 years of age and have been diagnosed with or told that you have high blood pressure or hypertension.

You will be asked to complete the survey which corresponds to your health condition (elevated blood glucose or high blood pressure). If you have both elevated blood glucose and high blood pressure, you have the option of completing both surveys. There are two versions of the questionnaire

WHAT ARE THE BENEFITS OF PARTICIPATING IN THE STUDY?

You may not benefit directly from participation in this study, but you will be providing a valuable contribution to the scientific knowledge in this field. Participants not be notified directly of the findings and outcomes of the research, however the results may be published in scientific publications.

ARE THERE ANY RISKS INVOLVED?

There are no identified risks involved in completing the survey.

All human research undertaken by the CSIRO must comply with the values, principles, governance and review process specified in the NH&MRC National Statement on Ethical Conduct in Human Research (2007). A copy of the National Statement can be found at www.nhmrc.gov.au/guidelines/ethics/human_research/index.htm

HOW WILL MY PRIVACY BE PROTECTED?

CSIRO is governed under the Privacy Act 1988 (Cth). CSIRO is collecting your personal information for the purposes of conducting the study and related scientific research. CSIRO will only use and disclose your personal information in accordance with the Privacy Act 1988 and the NH&MRC National Statement on Ethical Conduct in Human Research (2007) as amended from time to time, and as otherwise required by law.

In relation to studies conducted by CSIRO, it is customary for all personal information to be identified by a code and stored at CSIRO under lock and key for a period of 7 years (or 15 years in the case of a drug study). Except where otherwise required by law or a government body, at the end of this period your records will be destroyed or permanently de-identified.

Where third parties are assisting CSIRO in relation to the conduct of this study (such as university staff, students and other health professionals), we may disclose your personal information to those third

parties for this purpose on a confidential basis. CSIRO will require such third parties to keep this information confidential and to only use your personal information for the purposes of the study and otherwise in accordance with the Privacy Act 1988.

CSIRO may publish study results and data in research publications and press releases, however, any personal information contained in the data and results will be permanently de-identified.

YOUR OBLIGATIONS AS A PARTICIPANT.

This survey is optional and you are not obliged to participate if you do not want to.

IF YOU HAVE FURTHER QUESTIONS

Please call the Project Leader on: +61 7 3214 2069 or via email: aarti.tobin@csiro.au

This study has been approved by the CSIRO Low Risk Review Panel. If you would like to speak with someone with respect to ethical matters or wish to register a formal complaint about the conduct of this research, please contact the Secretary of the Committee via email at chmhrec@csiro.au .

9.5 Questionnaire for Blood Glucose Survey

Red Meat for Preventive Health Survey - Blood Glucose

Preamble

Research has shown that the consumption of meat-based protein meals and related 'snacks' consumed between meals can provide blood-glucose lowering effects and could assist to better control blood-glucose post-meal and throughout the day, reducing the risk and developing diabetes-related complications. In this questionnaire, we would like to know your opinion and your level of interest in a high-protein, red meat-based snack/sauce/beverage/meal that has functional properties allowing for improved management of blood-glucose levels

1. Have you been diagnosed with or told that you have elevated blood-glucose levels or type 2 diabetes? If Yes, you can continue with the questionnaire.

- Yes
 No

2. Have you read the information sheet in the e-mail that describes the background and the purpose of the project and give your consent for your information being used in this research?

- Yes
 No

3. What is your age?

- 18-29
 30-49
 50-64
 65 years or older

4. What is your gender?

- Female
 Male

5. How often do you eat red meat (beef, lamb, veal, goat)?

- Never
 Once a week
 2-3 times per week
 4-5 times per week
 6+ times per week

6. If never, what are your reasons for not eating red meat?

7. How do you usually consume red meat? (select as many as appropriate)

- Steak
- Roast
- Burgers
- Mince
- Sausages
- Deli meats
- Meal

Other (please specify)

8. Do you have a desire to eat more red meat?

- Yes
- No

9. Do you consider pork healthy?

- Yes
- No

10. Do you consider chicken healthy?

- Yes
- No

11. Do you consider red meat healthy?

- Yes
- No

12. As a meal option, would you choose a red meat product over seafood or dairy, if given the choice?

- Yes
- No

13. Would you be interested in a food or beverage product to supplement your current diet?

Yes

No

14. Are you currently using any food or beverage products to manage your blood glucose levels?

Yes

No

15. If yes, what food or beverage products are you using?

16. What, if any, between-meal snacks do you usually eat?

17. How often would you usually consume a between-meals snack?

More than once a day

Once per week

Once a day

Never

2-3 times per week

18. Would you be interested in consuming a high-protein snack (incorporating red-meat protein) that could help to control the blood-glucose response, after a meal?

Yes

No

19. If yes, how often would you be willing to consume this product?

More than once a day

Once a day

2-3 times per week

Once a week

20. What would be your preferred format for this type of product? (select as many as appropriate)

- | | |
|--|-----------------------------------|
| <input type="checkbox"/> Meat 'chip' | <input type="checkbox"/> Sauce |
| <input type="checkbox"/> Jerky | <input type="checkbox"/> Dressing |
| <input type="checkbox"/> Snack bar | <input type="checkbox"/> Sausage |
| <input type="checkbox"/> Powder for beverage | <input type="checkbox"/> Steak |

Other (please specify)

21. How much would you pay for the above-described product (single serving)? For comparison, 50 g chocolate bar is ~\$1; 40g muesli bar is ~\$2; 100g pack of popcorn is ~\$3; 150g bag of chips is ~\$3.50; and 80g of protein balls are ~\$5

- | | |
|-------------------------------------|-------------------------------------|
| <input type="radio"/> \$1.00–\$1.99 | <input type="radio"/> \$4.00–\$4.99 |
| <input type="radio"/> \$2.00–\$2.99 | <input type="radio"/> \$5.00–\$5.99 |
| <input type="radio"/> \$3.00–\$3.99 | <input type="radio"/> \$6+ |

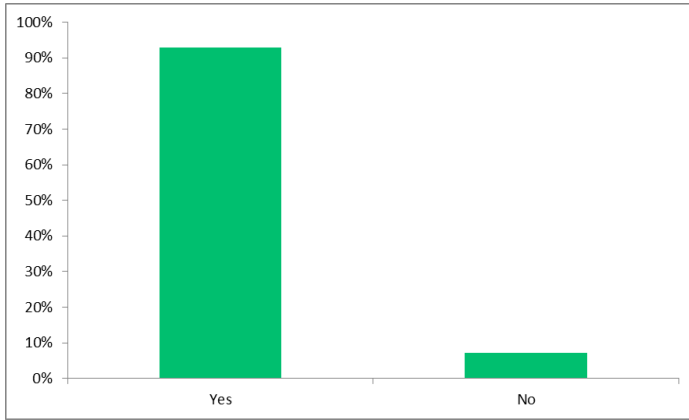
22. How do you currently monitor your blood-glucose levels?

23. Are you interested in continuous real-time monitoring of your blood glucose level?

- Yes
- No

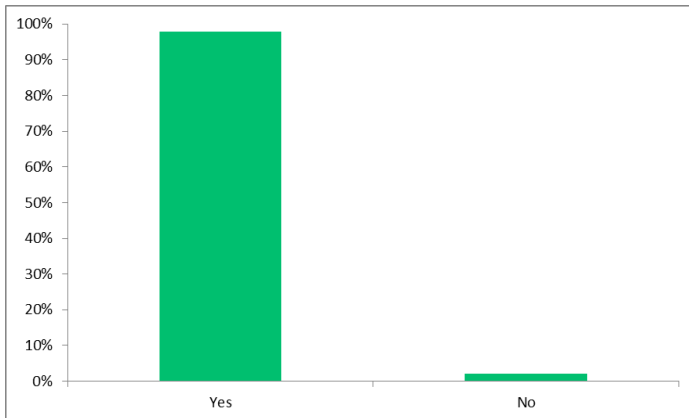
9.5.1 Results from Consumer Survey - Blood Glucose

Q1: Have you been diagnosed with or told that you have elevated blood-glucose levels or type 2 diabetes? If Yes, you can continue with the questionnaire.



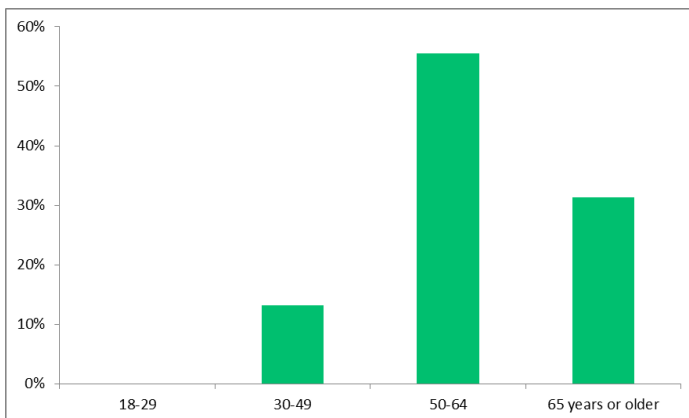
Answer Choices	Responses	
	Yes	92.93%
No	7.07%	7

Q2: Have you read the information sheet in the e-mail that describes the background and the purpose of the project and give your consent for your information being used in this research?



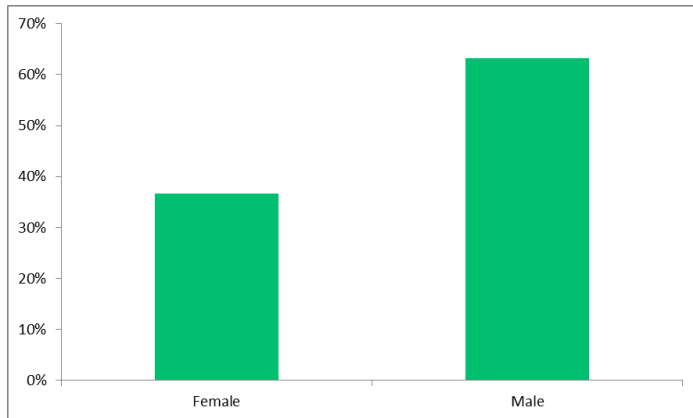
Answer Choices	Responses	
	Yes	97.96%
No	2.04%	2

Q3: What is your age?



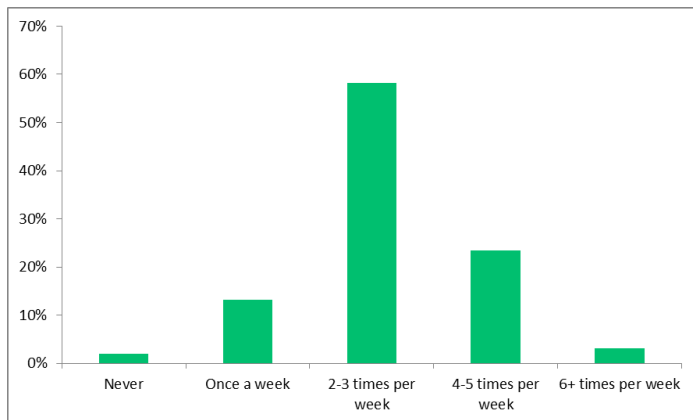
Answer Choices	Responses	
	18-29	0.00%
30-49	13.13%	13
50-64	55.56%	55
65 years or older	31.31%	31

Q4: What is your gender?



Answer Choices	Responses	
Female	36.73%	36
Male	63.27%	62

Q5: How often do you eat red meat (beef, lamb, veal, goat)?

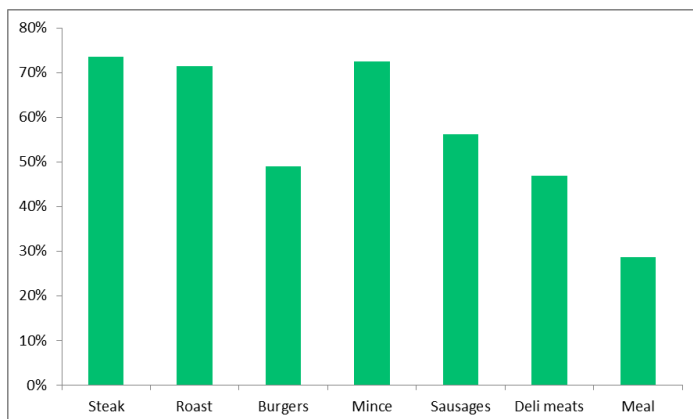


Answer Choices	Responses	
Never	2.04%	2
Once a week	13.27%	13
2-3 times per week	58.16%	57
4-5 times per week	23.47%	23
6+ times per week	3.06%	3

Q6: If never, what are your reason for not eating red meat?

- Cost is a limiting factor
- Chicken is cheaper

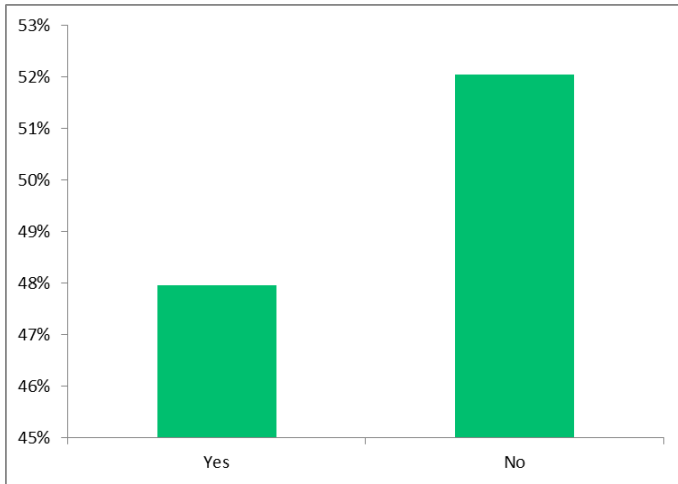
Q7: How do you usually consume red meat? (select as many as appropriate)



Answer Choices	Responses	
Steak	73.47%	72
Roast	71.43%	70
Burgers	48.98%	48
Mince	72.45%	71
Sausages	56.12%	55
Deli meats	46.94%	46
Meal	28.57%	28

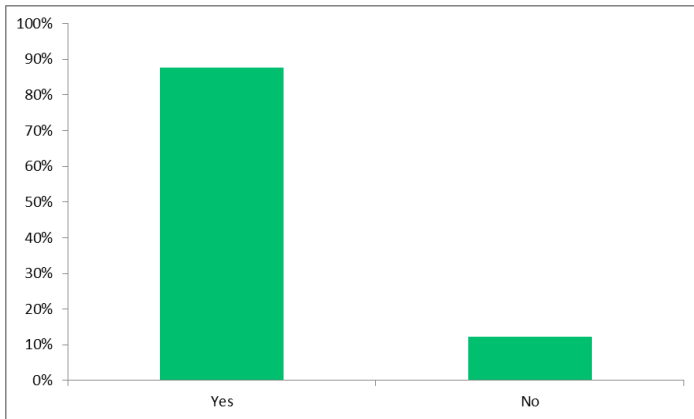
Other included – smoked snacks, fried, curry, stew, corned beef, BBQ, metwurst, casserole, pork and lamb

Q8: Do you have a desire to eat more red meat?



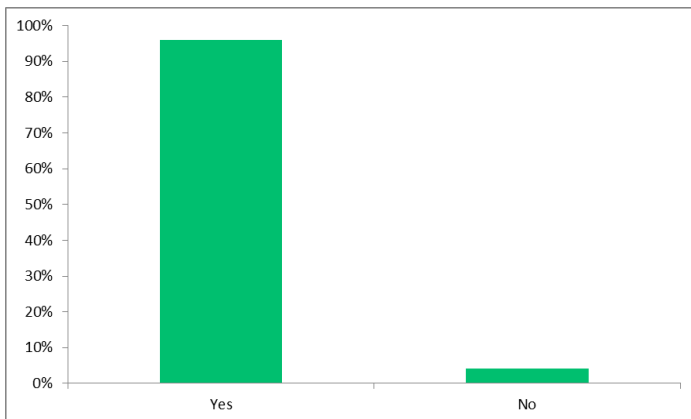
Answer Choices	Responses	
	Yes	47.96%
No	52.04%	51

Q9: Do you consider pork healthy?



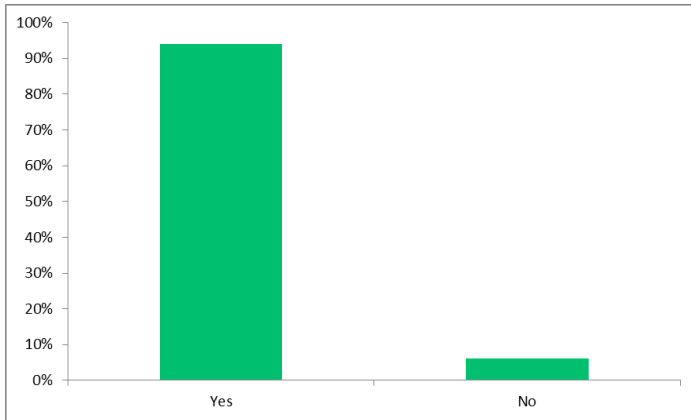
Answer Choices	Responses	
	Yes	87.76%
No	12.24%	12

Q10 Do you consider chicken healthy?



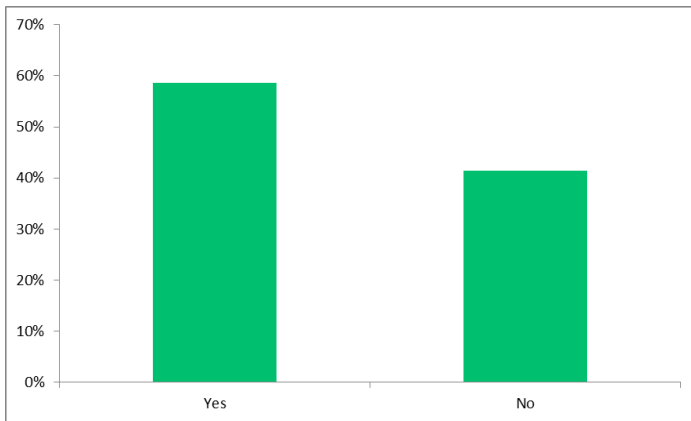
Answer Choices	Responses	
	Yes	95.92%
No	4.08%	4

Q11: Do you consider red meat healthy?



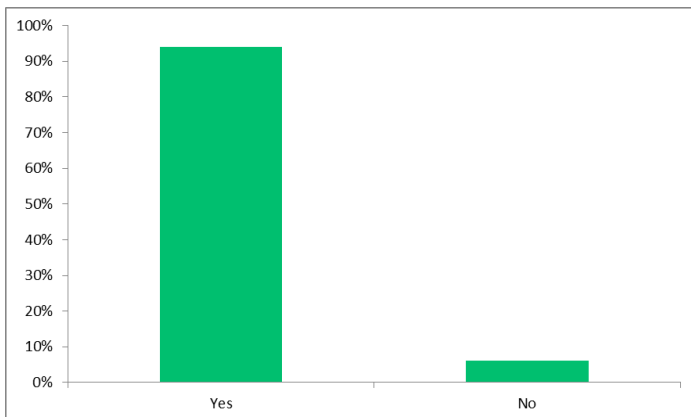
Answer Choices	Responses	
Yes	93.94%	93
No	6.06%	6

Q12: As a meal option, would you choose a red meat product over seafood or dairy, if given the choice?



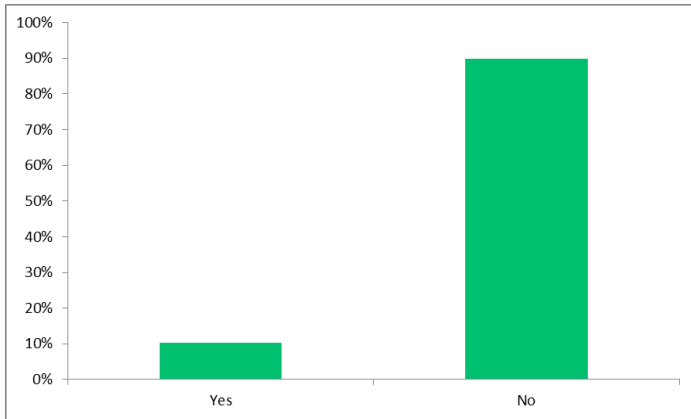
Answer Choices	Responses	
Yes	58.59%	58
No	41.41%	41

Q13: Would you be interested in a food or beverage product to supplement your current diet?



Answer Choices	Responses	
Yes	93.94%	93
No	6.06%	6

Q14: Are you currently using any food or beverage products to manage your blood glucose levels?



Answer Choices	Responses	
Yes	10.20%	10
No	89.80%	88

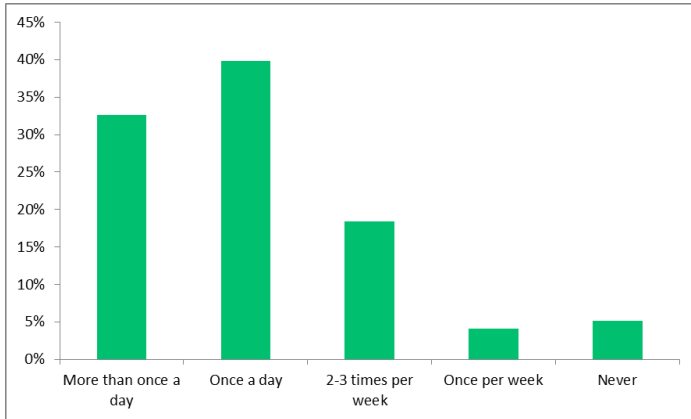
Q15: If yes, what food or beverage products are you using?

- Margarine with plant sterols
- Green leafy vegetables
- Diet coke rather than normal high sugar one
- Foods low on sugar
- Bevita biscuits
- Shakes
- Logicol
- Nuts, xylitol and protein supplementations

Q16: What, if any, between-meal snacks do you usually eat?

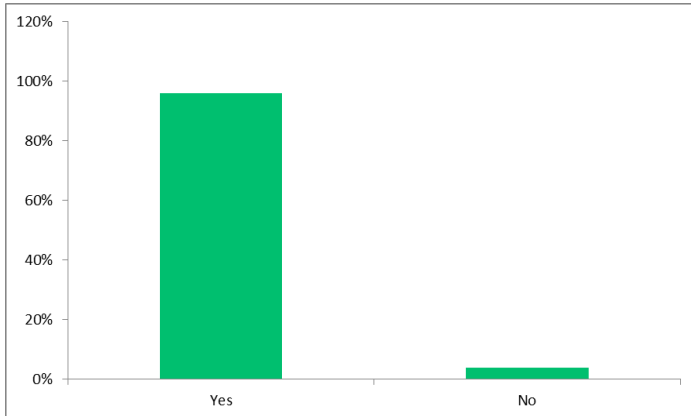
Food item	Frequency	Food item	Frequency
Fruits	35	Muesli Bar	2
Nuts	29	Pop Corn	2
Biscuits	23	Beef Jerky	1
Cheese	14	Salad	1
Chips	9	Cake	1
Yoghurt	7	Cereals	1
Bread	6	Metwurst	1
Vegetables	5	Jelly	1
Chocolate	4	Pickles	1
Tea/Coffee	2		

Q17: How often would you usually consume a between-meals snack?



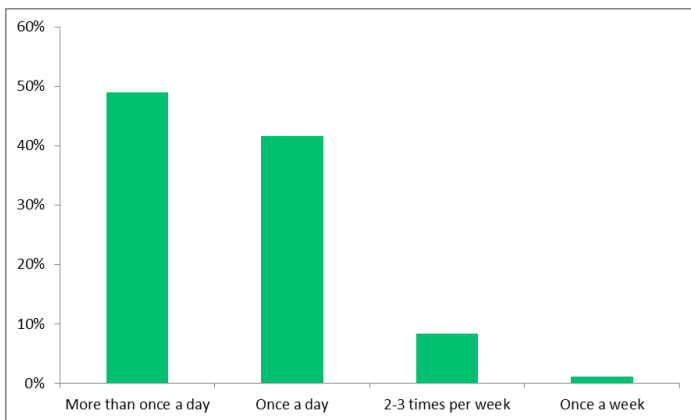
Answer Choices	Responses	
More than once a day	32.65%	32
Once a day	39.80%	39
2-3 times per week	18.37%	18
Once per week	4.08%	4
Never	5.10%	5

Q18: Would you be interested in consuming a high-protein snack (incorporating red-meat protein) that could help to control the blood-glucose response, after a meal?



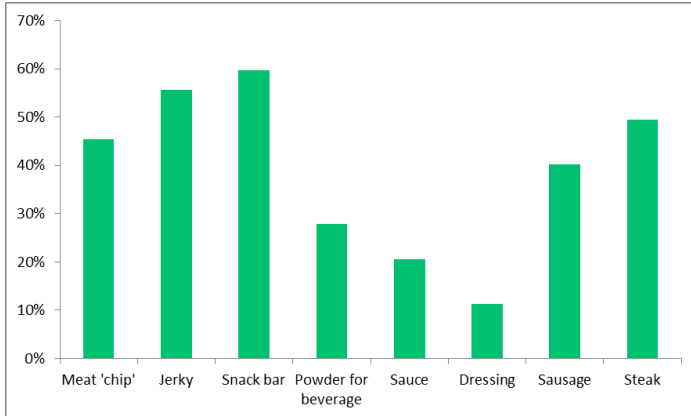
Answer Choices	Responses	
Yes	95.96%	95
No	4.04%	4

Q19: If yes, how often would you be willing to consume this product?



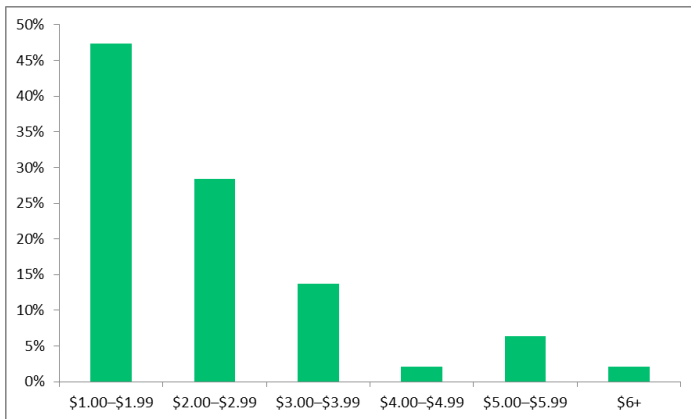
Answer Choices	Responses	
More than once a day	48.96%	47
Once a day	41.67%	40
2-3 times per week	8.33%	8
Once a week	1.04%	1

Q20: What would be your preferred format for this type of product? (select as many as appropriate)



Answer Choices	Responses	
Meat 'chip'	45.36%	44
Jerky	55.67%	54
Snack bar	59.79%	58
Powder for beverage	27.84%	27
Sauce	20.62%	20
Dressing	11.34%	11
Sausage	40.21%	39
Steak	49.48%	48
Other (please specify)		3

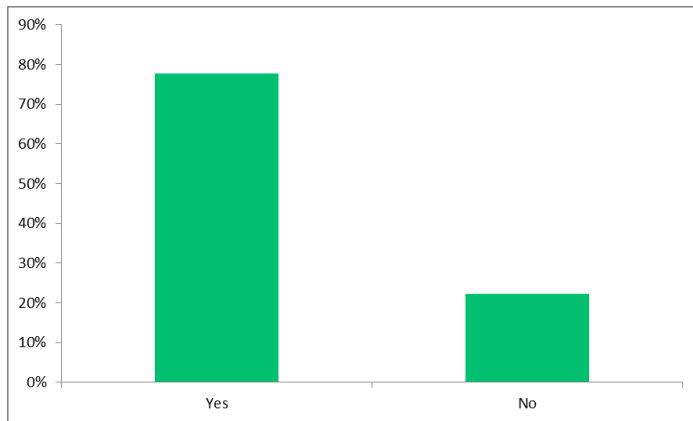
Q21: How much would you pay for the above-described product (single serving)? For comparison, 50 g chocolate bar is ~\$1; 40g muesli bar is ~\$2; 100g pack of popcorn is ~\$3; 150g bag of chips is ~\$3.50; and 80g of protein balls are ~\$5



Answer Choices	Responses	
\$1.00-\$1.99	47.37%	45
\$2.00-\$2.99	28.42%	27
\$3.00-\$3.99	13.68%	13
\$4.00-\$4.99	2.11%	2
\$5.00-\$5.99	6.32%	6
\$6+	2.11%	2

Q22: How do you currently monitor your blood-glucose levels?

Method	Frequency
Daily Finger prick	50
Regular Doctor visit	9
Six monthly check	6
Don't Check	6
Quarterly Check	5
Annual check-up	4
Weekly check	2

Q23: Are you interested in continuous real-time monitoring of your blood glucose level?

Answer Choices	Responses	
Yes	77.78%	77
No	22.22%	22

9.6 Questionnaire for High Blood Pressure Survey

Red Meat for Preventive Health Survey - High Blood Pressure

Preamble

Research has shown that there is potential to develop meat-based foods rich in anti-hypertensive peptides that can help people control their high blood pressure. In this questionnaire, we would like to know your opinion and your level of interest in a high-protein, red meat-based snack/sauce/beverage/meal that has functional properties allowing for improved management of high blood pressure

1. Have you been diagnosed with or told that you have high blood pressure or hypertension? If yes, you can continue with the questionnaire.

- Yes
 No

2. Have you read the information sheet in the e-mail that describes the background and the purpose of the project and give your consent for your information being used in this research?

- Yes
 No

3. What is your age?

- 18-29
 30-49
 50-64
 65 years or older

4. What is your gender?

- Female
 Male

5. How often do you eat red meat (beef, lamb, veal, goat)?

- Never
 2-3 times per week
 4-5 times per week
 6+ times per week
 Once a week

6. If never, what are your reasons for not eating red meat?

7. How do you usually consume red meat? (select as many as appropriate)

- Steak
- Roast
- Burgers
- Mince
- Sausages
- Deli meats
- Meal

Other (please specify)

8. Do you have a desire to eat more red meat?

- Yes
- No

9. Do you consider pork healthy?

- Yes
- No

10. Do you consider chicken healthy?

- Yes
- No

11. Do you consider red meat healthy?

- Yes
- No

12. As a meal option, would you choose a red meat product over seafood or dairy, if given the choice?

- Yes
- No

13. Would you be interested in a food or beverage to supplement your current diet?

Yes

No

14. Are you currently using any food or beverage to manage your high blood pressure?

Yes

No

15. If yes, what food or beverage products are you using?

16. What, if any, between-meal snacks do you usually eat?

17. How often would you usually consume a between-meals snack?

More than once a day

Once a week

Once a day

Never

2-3 times per week

18. Would you be interested in consuming a high-protein snack (incorporating red-meat protein) that could help to control high blood pressure?

Yes

No

19. If yes, how often would you be willing to consume this product?

More than once a day

Once a day

2-3 times per week

Once a week

20. What would be your preferred format for this type of product? (select as many as appropriate)

- | | |
|--|-----------------------------------|
| <input type="checkbox"/> Meat 'chip' | <input type="checkbox"/> Sauce |
| <input type="checkbox"/> Jerky | <input type="checkbox"/> Dressing |
| <input type="checkbox"/> Snack bar | <input type="checkbox"/> Sausage |
| <input type="checkbox"/> Powder for beverage | <input type="checkbox"/> Steak |

Other (please specify)

21. How much would you pay for the above-described product (single serving)? For comparison, 50 g chocolate bar is ~\$1; 40g muesli bar is ~\$2; 100g pack of popcorn is ~\$3; 150g bag of chips is ~\$3.50; and 80g of protein balls are ~\$5

- | | |
|-------------------------------------|-------------------------------------|
| <input type="radio"/> \$1.00–\$1.99 | <input type="radio"/> \$4.00–\$4.99 |
| <input type="radio"/> \$2.00–\$2.99 | <input type="radio"/> \$5.00–\$5.99 |
| <input type="radio"/> \$3.00–\$3.99 | <input type="radio"/> \$6+ |

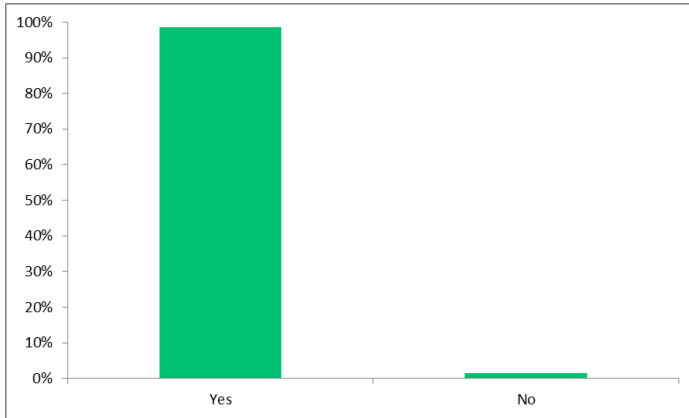
22. How do you currently monitor your high blood pressure?

23. Are you interested in continuous real-time monitoring of your blood pressure?

- Yes
- No

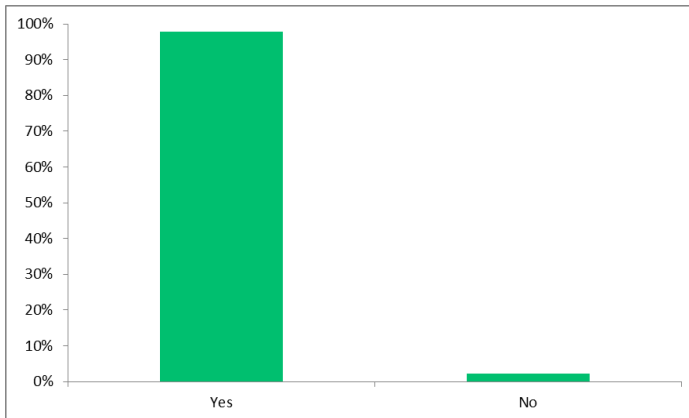
9.6.1 Results from Consumer Survey – High Blood Pressure

Q1: Have you been diagnosed with or told that you have high blood pressure or hypertension? If yes, you can continue with the questionnaire.



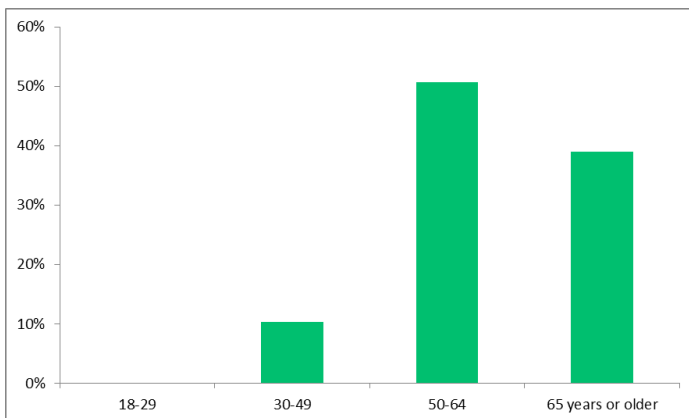
Answer Choices	Responses	
Yes	98.53%	134
No	1.47%	2

Q2: Have you read the information sheet in the e-mail that describes the background and the purpose of the project and give your consent for your information being used in this research?



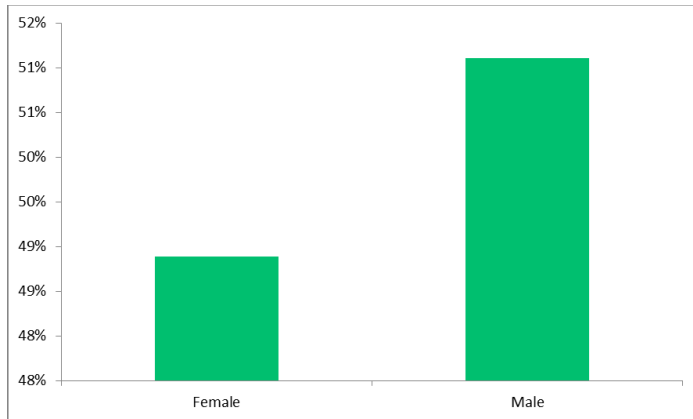
Answer Choices	Responses	
Yes	97.78%	132
No	2.22%	3

Q3: What is your age?



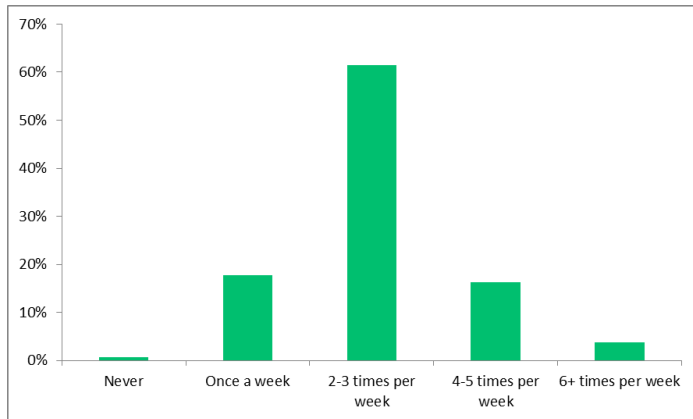
Answer Choices	Responses	
18-29	0.00%	0
30-49	10.29%	14
50-64	50.74%	69
65 years or older	38.97%	53

Q4: What is your gender?



Answer Choices	Responses	
Female	48.89%	66
Male	51.11%	69

Q5: How often do you eat red meat (beef, lamb, veal, goat)?

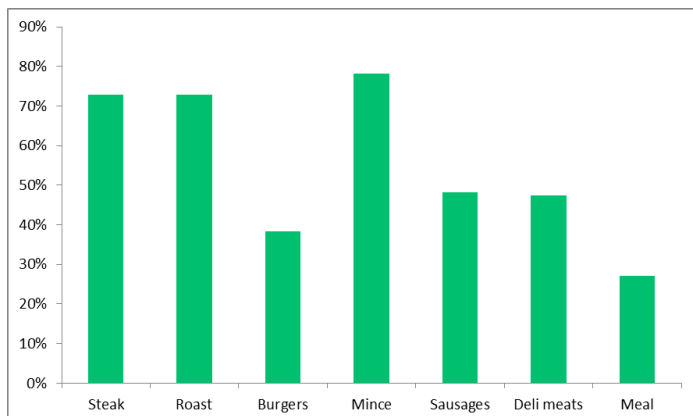


Answer Choices	Responses	
Never	0.74%	1
Once a week	17.78%	24
2-3 times per week	61.48%	83
4-5 times per week	16.30%	22
6+ times per week	3.70%	5

Q6: If never, what are your reason for not eating red meat?

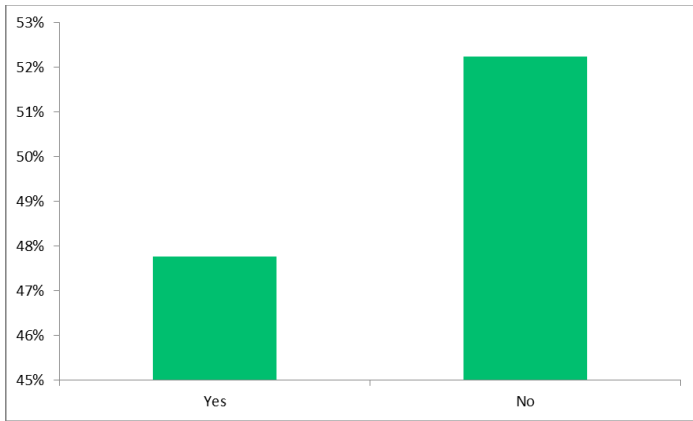
- Cost is a limiting factor

Q7: How do you usually consume red meat? (select as many as appropriate)



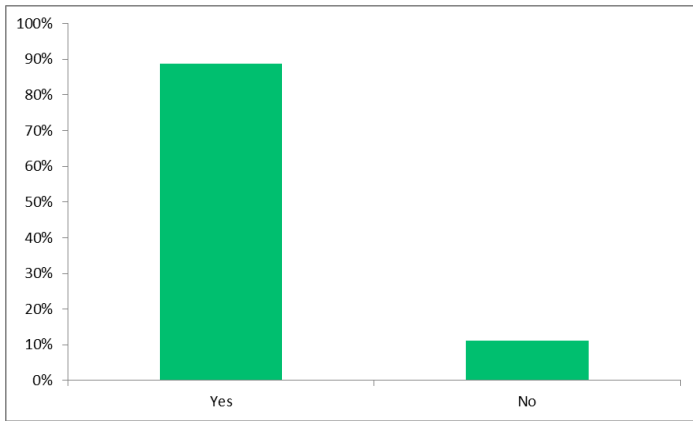
Answer Choices	Responses	
Steak	72.93%	97
Roast	72.93%	97
Burgers	38.35%	51
Mince	78.20%	104
Sausages	48.12%	64
Deli meats	47.37%	63
Meal	27.07%	36

Q8: Do you have a desire to eat more red meat?



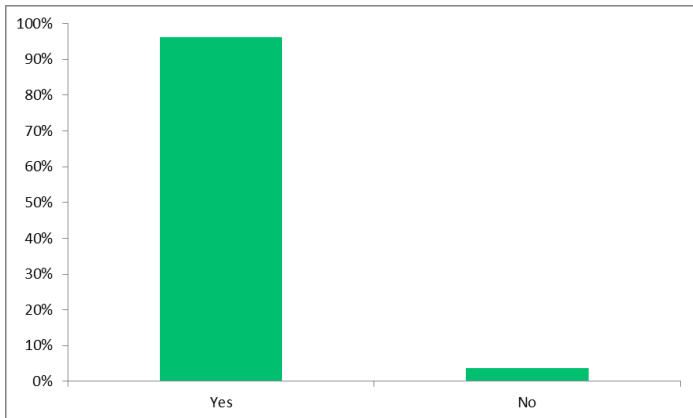
Answer Choices	Responses	
	Yes	47.76%
No	52.24%	70

Q9: Do you consider pork healthy?



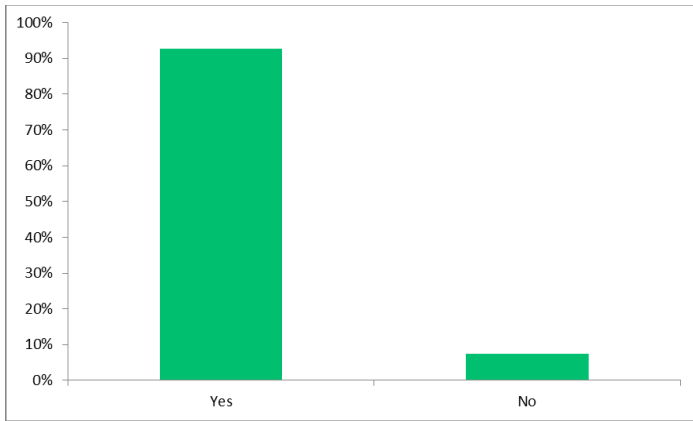
Answer Choices	Responses	
	Yes	88.81%
No	11.19%	15

Q10: Do you consider chicken healthy?



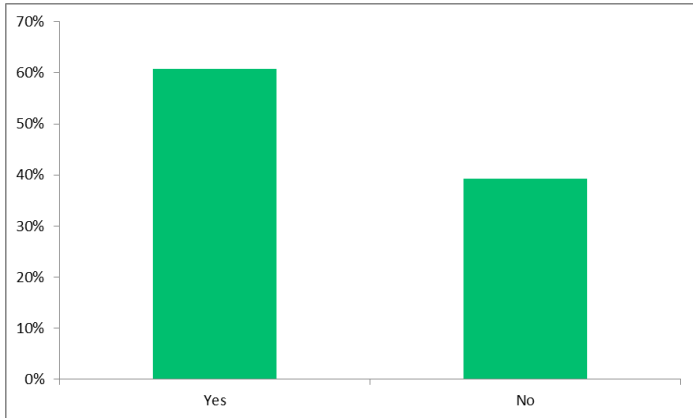
Answer Choices	Responses	
	Yes	96.27%
No	3.73%	5

Q11: Do you consider red meat healthy?



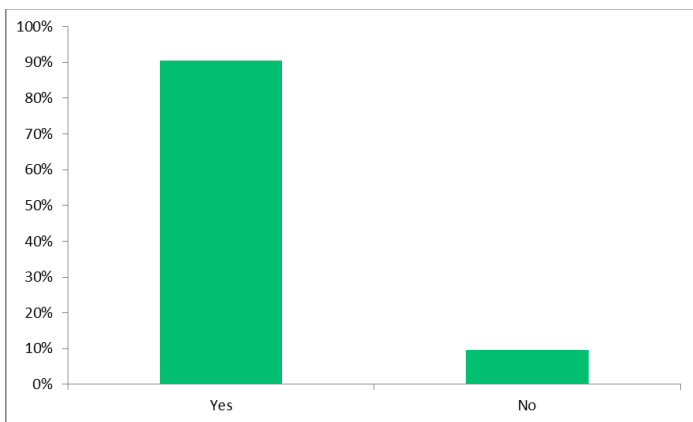
Answer Choices	Responses	
	Yes	92.59%
No	7.41%	10

Q12: As a meal option, would you choose a red meat product over seafood or dairy, if given the choice?



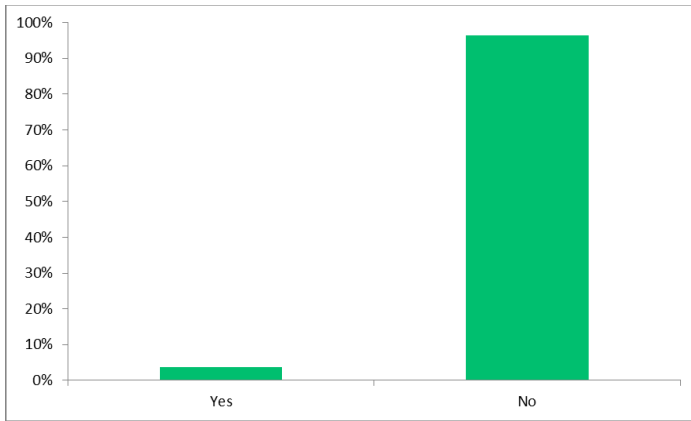
Answer Choices	Responses	
	Yes	60.74%
No	39.26%	53

Q13: Would you be interested in a food or beverage product to supplement your current diet?



Answer Choices	Responses	
	Yes	90.44%
No	9.56%	13

Q14: Are you currently using any food or beverage to manage your high blood pressure?



Answer Choices	Responses	
	Yes	3.68%
No	96.32%	131

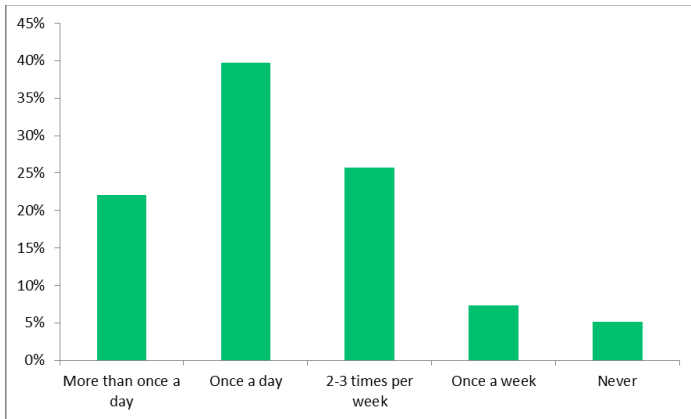
Q15: If yes, what food or beverage products are you using?

- Margarine with plant sterols
- Gelatine
- Medication
- Micardis (telmisartan) Keeps blood vessels from narrowing, which lowers blood pressure and improves blood flow.

Q16: What, if any, between-meal snacks do you usually eat?

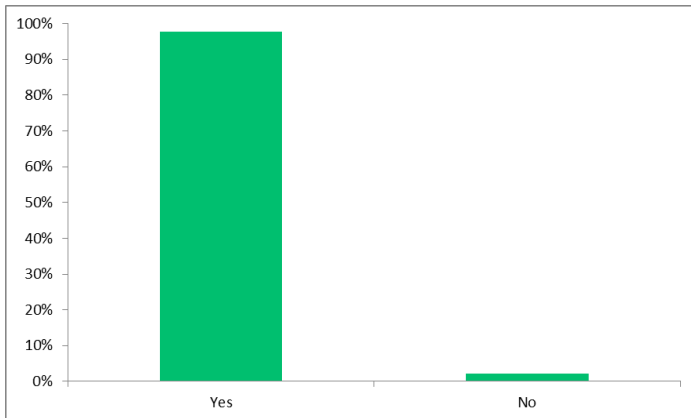
Food item	Frequency	Food item	Frequency
Fruits	53	Lollies	3
Biscuits	33	Pop Corn	2
Nuts	29	Deli Meat	2
Cheese	21	Pickles	1
Chips	14	Eggs	1
Crackers	13	Custard	1
Bread	9	Salmon	1
Yoghurt	8	Ice Cream	1
Chocolate	8	Protein Bar	1
Muesli Bar	7	Pretzal	1
Cake	7	Pies	1
Vegetables	5	Muffin	1
Tea/Coffee	3		

Q17: How often would you usually consume a between-meals snack?



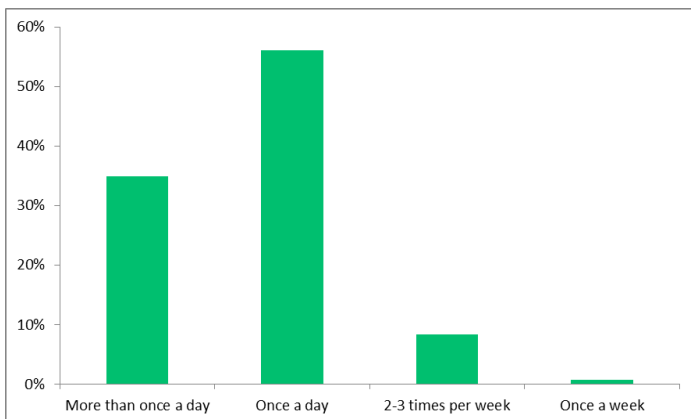
Answer Choices	Responses	
More than once a day	22.06%	30
Once a day	39.71%	54
2-3 times per week	25.74%	35
Once a week	7.35%	10
Never	5.15%	7

Q18: Would you be interested in consuming a high-protein snack (incorporating red-meat protein) that could help to control high blood pressure?



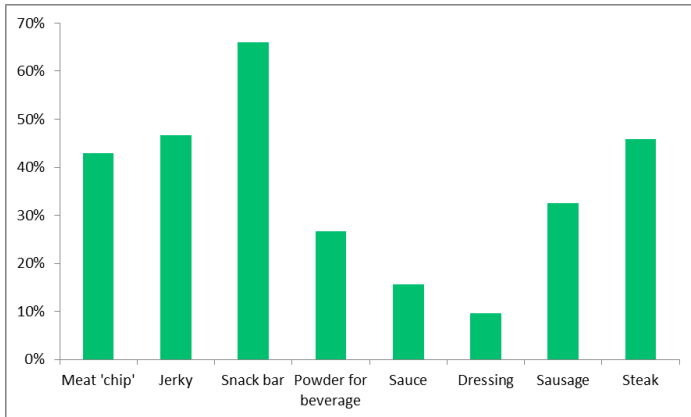
Answer Choices	Responses	
Yes	97.78%	132
No	2.22%	3

Q19: If yes, how often would you be willing to consume this product?



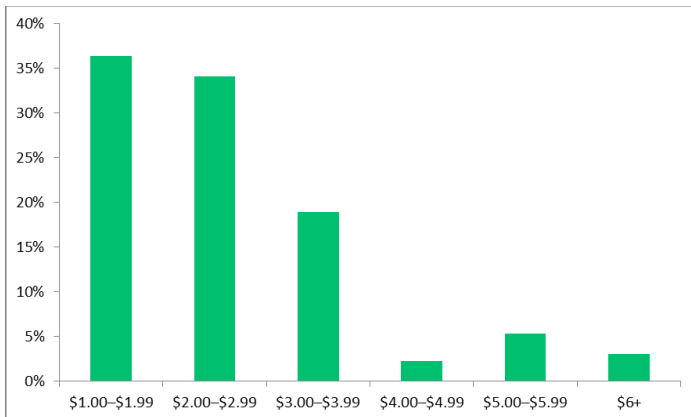
Answer Choices	Responses	
More than once a day	34.85%	46
Once a day	56.06%	74
2-3 times per week	8.33%	11
Once a week	0.76%	1

Q20: What would be your preferred format for this type of product? (select as many as appropriate)



Answer Choices	Responses	
Meat 'chip'	42.96%	58
Jerky	46.67%	63
Snack bar	65.93%	89
Powder for beverage	26.67%	36
Sauce	15.56%	21
Dressing	9.63%	13
Sausage	32.59%	44
Steak	45.93%	62

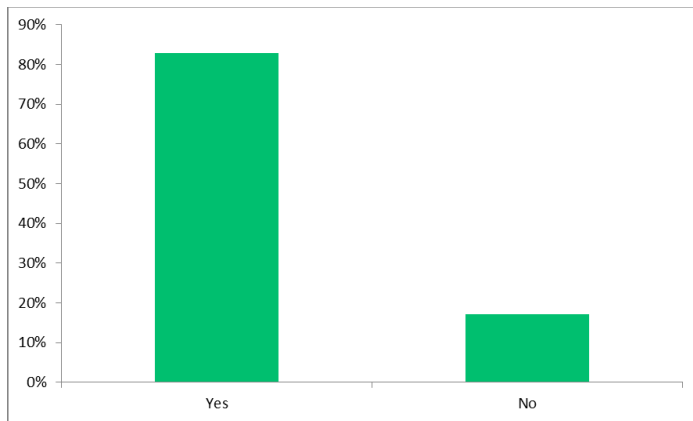
Q21: How much would you pay for the above-described product (single serving)? For comparison, 50 g chocolate bar is ~\$1; 40g muesli bar is ~\$2; 100g pack of popcorn is ~\$3; 150g bag of chips is ~\$3.50; and 80g of protein balls are ~\$5



Answer Choices	Responses	
\$1.00-\$1.99	36.36%	48
\$2.00-\$2.99	34.09%	45
\$3.00-\$3.99	18.94%	25
\$4.00-\$4.99	2.27%	3
\$5.00-\$5.99	5.30%	7
\$6+	3.03%	4

Q22: How do you currently monitor your blood pressure?

Method	Number
BP Monitor at home	45
Medication	32
Six monthly check	27
Monthly Check up	15
Quarterly Check	8
Don't Check	6
Weekly check	3

Q23: Are you interested in continuous real-time monitoring of your blood pressure?

Answer Choices	Responses	
Yes	82.84%	111
No	17.16%	23