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NT Shelf-stable Food Products – Market Opportunity Analysis

Part of the Charles Darwin University – Northern Australia Food Technology Innovation (NAFTI) Project

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Advisory

This report has been prepared by the CDU NAFTAI project marketing team and project coordinators, in conjunction with input from the official project advisory group members, as well as being informed by industry stakeholders and participants.

The report is intended for use by the CDU NAFTAI project stakeholders for the purposes outlined in the original project proposal. Stakeholder, participant and organisation acknowledgements in the report do not imply endorsement.

The consulting services undertaken by the project marketing team in preparing this report were limited to the project scope and limitations, as well as by the resources available. CDU therefore disclaims responsibility to any other person or organisation using the information presented in this report.

The research was conducted by the NAFTAI marketing project team in accordance with CDU ethical research standards – approval from CDU's Human Research Ethics Committee CDU -HREC, reference H22077. It has used information identified within the time and opportunity available and is based upon the team's reasonable judgement and evaluation. The report is therefore based on information captured at the date of preparation, within the project scope, resource constraints and limitations.

CDU has no responsibility or obligation to update this report to account for changing information or market circumstances. Conclusions and recommendations are based upon the project's finite research resources and considerable further research could be undertaken to further inform the findings (e.g., see section 'Limitations and proposed future research avenues').

Furthermore, the report findings have not been independently verified or checked beyond the agreed scope of work. CDU does not accept liability in connection with such unverified information, including errors and omissions in the report and information presented.

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Executive Summary

The NAFTI project and marketing study component

The Northern Australia Food Technology Innovation project (NAFTI) is investigating innovations in food processing and value-adding of agricultural produce in northern Australia. The project is dedicated to the regions of the Northern Territory and Northern Western Australia (north of 20°S latitude). Specifically, it is focussed on shelf-stable foods using novel food processing technologies. Shelf-stable foods are foods that can be safely stored at room temperature in a sealed container. This includes low-acid high moisture foods that would normally be stored refrigerated, but which have been processed (thermally treated or dried) so that they can be safely stored at room or ambient temperature for a usefully long shelf life. Ambient temperature stability enables these types of products to be stored and distributed without reliance on a cold chain thus reducing logistics costs and increasing the resilience of the supply chain. Products that are thermally treated to sterility are also able to by-pass most biosecurity barriers to interstate and international trade.

The marketing component of the NAFTI project is aimed at understanding the viability of an NT shelf-stable food processing facility and the market potential for shelf-stable foods produced using local NT produce, with a focus on red meat, tropical fruits and seafood. This market analysis also sought to inform the marketing strategies and approaches that will provide competitive advantage and the defendable long-term success for NT shelf stable foods. More specifically it identifies the types of shelf-stable food types using NT produce that offer most potential, as well as their critical unique selling points that will provide competitive advantage. It also informs key marketing aspects such as communication, pack size, pricing, and customer segments.

However, this marketing component in the NAFTI project is only the starting point and ongoing future market research will be necessary to providing greater insights to specific domestic and international markets, and the customer segment therein. Future concept testing of marketing mix elements will also be required to inform the tailoring of the shelf-stable food offerings to match these customer segment needs, as well as the standard continuous market research that monitors and informs ongoing marketing efforts.

RESEARCH BACKGROUND AND APPROACH

1. NAFTI marketing project background

The market opportunity analysis and marketing component of the NAFTI project evaluates the viability of an NT shelf-stable food processing facility, as well as the market potential for shelf-stable foods from local NT produce, with a focus on red meat, tropical fruits and seafood. This investigation also informs the marketing strategies and approaches that will provide a competitive advantage and defendable long-term success. More specifically, it identifies the market potential for shelf-stable food types using NT produce based on their unique selling points. It also informs other key marketing dimensions including product design, communications and promotion, pack size, and product pricing, as well as determining key target customer segments.

2. Research approach

This research comprised of a review of relevant industry reports and market data, as well as literature on marketing best practices, and innovative and localised manufacturing. It was also informed by interviews and workshops with agriculture and other food industry experts and stakeholders, located in the NT and elsewhere in Australia. Further competitive advantage and other marketing insights

were then generated via retail audit analysis of supermarket and other online retailers, as well as manufacturers in both Australia and the wider Asia-Pacific (APAC) region.

Specifically, this research sought to evaluate and inform:

1. The rationale for an NT shelf-stable food processing facility using new technologies, including advantages and disadvantages of the NT location and the new technologies.
2. Market opportunities presented by NT-produce-based shelf-stable foods (i.e. red meat, fruit and seafood) and associated products.
3. NT shelf-stable product marketing strategies, including competitive advantage/unique selling points, as well as insights into product formats, packaging, pricing, distribution and promotion.

3. FINDINGS AND DISCUSSION PART I – Scope, Context, Plant Rationale and Market Potential

Scope – market and food focus

It was determined as unfeasible for this study to provide in-depth analysis of all NT food types and all potential shelf-stable products and markets. This study therefore focused on NT red meat (beef and buffalo), tropical fruit (mango and Kakadu plum), and seafood (fish and maw/swim bladders), as well as a selection of corresponding shelf-stable food products. It considered the relevant customer markets for these products in the NT and Australia, as well as the wider APAC region and beyond.

While this study focused on selected foods and products, the market opportunity that was uncovered highlights that there is strong potential for other shelf-stable products made from a wider range of NT produce (e.g. vegetables from horticulture).

The study is premised on a staged development process with an initial small-scale pilot facility to undertake market and product testing, to deliver training and teaching, and provide entrepreneurship opportunity to regional business through access to the site.

Regional context

There is considerable opportunity to develop food production and processing capabilities in the NT, to leverage the market growth opportunities in many APAC countries where there is high population growth and where trade agreements with Australia have already been established. For example, Indonesia and Vietnam have established trade links for NT agricultural produce. These markets were therefore often prioritised within this study's market opportunity analysis, to illustrate the potential of the wider APAC region.

To effectively service these international markets, it will be important to capitalise on the *Australian agri-food business's international comparative advantages (e.g. high-quality reputation)*, while also *acknowledging and seeking ways to overcome its perceived disadvantages (e.g. higher costs)*.

New food processing technologies perspectives

The proposed NT food processing facility will use novel food processing technologies inclusive of microwave-based technologies to produce shelf-stable foods. Although both the benefits and challenges of these technologies need to first be considered through product testing to assure product uptake across various marketplaces. This will help to inform the viability of an NT-based shelf-stable food processing facility.

Benefits of using leading-edge food processing technologies in the food pasteurisation and/or sterilisation process, as identified by the industry experts in this study include:

- Production of shelf-stable foods with enhanced quality attributes in terms of nutrition, flavour, appearance, stability and convenience.
- Logistical and distribution benefits from lower storage, transport and handling costs. The lack of cold chain requirements is especially relevant to the NT based on its tropical climate, and its remote location and communities.
- Supporting the development of local producers to benefit the NT economy, where there has generally been a lack of growth opportunities.
- Supporting NT and Australian food security and supply chain resilience.
- In addition to social and economic benefits (e.g. jobs), there are other sustainability benefits based on a smaller environmental footprint, with a reduction in energy consumption via reduced transport and cold storage requirements.

The industry experts also identified a range of potential disadvantages of the new food processing technologies and corresponding shelf-stable foods. In particular, the perceived lack of knowledge about the new technologies could be a barrier to both the supply of fresh produce to the processing facility, as well as customer uptake of the new shelf-stable products.

Other potential production, supply and customer-related disadvantages are as follows:

Production

- The lack of commercial application of the new technology presents unknowns or risks.
- Production process limitations, such as flexibility in terms of scale, and ease of switching between produce and product types.
- The high costs of both setting up and running the processing facility.
- Technological complexity and high energy consumption involved in processing.

Supply

- Risks with inconsistency of supply of feedstocks for an NT facility.
- Agricultural/primary producer perceptions/inertia or unwillingness to supply the facility.

Customers

- Negative perceptions of shelf-stable food produced using the novel technologies, and acceptance of the promised nutrition and health benefits.
- Inability to satisfy manufacturer needs in terms of the volume quantities and pack sizes required.
- Customer inertia or brand loyalty that might see an unwillingness to try new products/brands.

Overcoming perceived disadvantages

Prior published research and literature on shelf-stable food consumption and perceptions of new food processing technologies can inform how to overcome barriers to uptake. Educating the market about the new food processing technology will be required, to minimise negative perceptions. Clear communication about the quality and healthier properties of the shelf-stable food produced via these new processing technologies will be important to reduce barriers and stimulate acceptance.

NT shelf-stable food processing facility rationale

Numerous location-specific factors, both positive and negative, inform the rationale and business case for an NT shelf-stable food processing facility. NT-produced shelf-stable foods must be able to capitalise on clear competitive advantages afforded by the NT provenance. The anticipated benefits need to clearly outweigh any potential challenges or barriers, as highlighted in this investigation and outlined below:

Benefits and rationale

Strategic national and jurisdictional significance

An NT food processing facility strongly supports both national and NT strategic priorities, such as:

- Enhancing food security via a more resilient national food supply chain, which may be increasingly important based on rising global geopolitical unrest and climatic perturbations.
- Enhancing Australia's sovereign food processing capabilities and securing the NT's food industry resilience.
- Promoting a self-sufficient NT economy that is better able to fulfil its strategic role in the APAC region, including Darwin's critical role as Australia's APAC defence hub.
- Without food processing value-add opportunities, NT agriculture risks losing out to international competition, and volatile commodity markets.
- Proving a pathway for sovereign Australian investment in shelf-stable food processing
- Improving local diets via healthier and safer shelf-stable foods, including overcoming cold chain challenges to benefit remote communities and other society members.

NT location

The NT's proximity to APAC countries means shorter distances/times to export destinations, lower transportation costs and a reduced carbon footprint. These aspects will become even more important if energy costs continue to escalate.

A Top End of the NT location is also logical in terms of available space for future scaling up of a processing facility and access to feedstock labour, accommodation and as well as the established road, rail, sea and airport transport infrastructure.

NT brand characteristics

Food grown and processed in the NT has inherited a range of unique brand values that provide distinct advantages over foods and products produced elsewhere in Australia. These are critical for informing competitive marketing advantages (see Table 11 of main report for details).

Barriers and challenges

While the rationale for the NT processing facility is strong, the perceived disadvantages and barriers still need to be considered and incorporated into planning to reduce their impact. These include:

Potential barriers internal to the NT

- Insufficient resources, including infrastructure, capital investment, and skillset available for the processing facility set-up and operations.
- Food producers' satisfaction with the current market situation, resistance to change, and a lack of familiarity with NT commercial food processing as well as new technologies.

Note, these issues are more fully addressed in the Supply-chains report under Activity 3 of the project.

Potential barriers external to the NT

- The Australian Government favouring investment in other states and territories, at the expense of economic development in the NT.
- Lack of market acceptance of, and lack of familiarity and experience with, new food processing technologies and corresponding products.
- Negative perceptions of the NT's commercial viability, given the failure of earlier NT food processing ventures.

- Other states and territories with more established food research and development (R&D) being favoured locations for new facilities.
- Perceptions of the NT's climate and physical environment as 'tougher' than other states and territories, with accompanying challenges.
- Comparatively weaker APAC trading networks and routes to market in the NT compared with other states and territories.
- Competition from large food product manufacturers and food processors in Australia, as well as internationally.

Potential shelf-stable product types

There is market opportunity for a wide range of shelf-stable food and non-food items made from NT produce. NT prawns, fish (e.g. barramundi) and dried fish maw offer strong potential. Beef and buffalo are the main meat product opportunities, while mango, watermelon and Aboriginal bushfoods (e.g. Kakadu plum) offer strong NT fruit-based product potential. Key product categories/types include:

- *Functional meal ingredients:* Ready-to-use, pre-prepared food ingredients for consumers, as well as for manufacturers and other food service organisations.
- *Bulk/high-volume waste produce value-add ingredients:* Strong opportunities for using out-of-specification or low-value produce (e.g. mango waste, low-value meat and fish offal, skin and bone), targeting business to business (B2B) market segments.
- *Snacks and convenience foods:* Numerous opportunities including fruit powder and ready-to-drink juices, as well as ready-to-eat snacks such as dried beef and fruit straps.
- *Pet food and snacks:* Opportunities from waste meat and fish produce, including human-grade premium pet food products for cats and dogs.
- *Health, wellbeing and beauty products:* Strong market potential for NT produce-based ingredients for cosmetics, protein powders (meat-based, but also jack fruit), and nutraceuticals that include plant/fruit powders and collagen powders (e.g. 'indigenous-ceuticals' from First Nations foods, such as Kakadu plum powder/puree).
- *Ready meals:* Strong market potential for general home and out-of-home use, such as by campers, defence forces, aid/relief agencies, as well as caterers and others in the food service industry. Also potential for supplying manufacturers of complete ready meals with key meal components (e.g. meat, gravy and vegetables).

Potential shelf-stable product customer segments

Most products have potential among both consumer (end-user) and B2B market segments (e.g. manufacturers, food service organisations). Exceptions relate to the bulk ingredients, which are most relevant for B2B customers.

Some of the many domestic and international customer segment opportunities for NT produce-based shelf-stable products and ingredients, in both food and non-food categories, include:

- *General consumers:* Grocery shoppers, pet owners, those with busy lives wanting convenience, and those wanting a back-up grocery store (e.g. for power outages).

- *Consumers with refrigeration and/or transport challenges:* Workers and school children (lunches), mothers requiring baby food, First Nations communities, campers and backpackers, and travellers and survivalists.
- *Organisations with refrigeration/cold chain challenges (field rations and catering):* Aid and development (e.g. disaster relief), Australian Defence Force, government seeking food store/reserve procurement, foreign aid supplies, the space industry, and also some international markets (e.g. Indonesia, Malaysia and Middle East).
- *Packaged food retailers:* Supermarkets, grocery and convenience stores, pharmacies and health food, pet food, and wholesalers.
- *Commercial food services (catering and hospitality):* Restaurants, cafes, hotels, bars, fast-food, as well as airlines, rail, ferries, service stations, aged care and hospitals, and recreational/sporting facilities.
- *Institutional food services:* Public sector/government organisations (e.g. Australian Defence Force), public schools, and colleges.
- *Manufacturers:* Packaged food, ready meals, convenience snack foods, pet food, pharmaceuticals, health and wellbeing, field ration/catering, and food service industry.

4. FINDINGS AND DISCUSSION PART II – Market opportunity analysis

Following description of general APAC shelf-stable product opportunities and demand, the market opportunity analysis is presented in the following sequence - seafood and aquaculture, tropical fruit and red meat.

The seafood section provides general insights to fish/seafood consumption trends, as well as marketing insights for a high value shelf-stable product primarily for sale in the international APAC market. The tropical fruit and red meat sections consider products for both domestic and international markets. The tropical fruit section presents some more detailed marketing mix considerations and NT unique selling points associated with NT fruit and in particular for NT Aboriginal bushfood. The red meat section presents more detailed marketing insights, including unique selling points that can be applied across complementary product lines.

Overall, the market opportunity analyses of selected shelf-stable product types identify key competitive advantage and marketing considerations that can inform the marketing for a much wider range of product types made from NT produce.

Shelf-stable product opportunities

NT produce and corresponding shelf-stable products with strong commercial opportunities in Australia and the APAC region are as follows:

Red meat – beef and buffalo: Processed traditional meat products, dried meat products (e.g. jerky), protein and collagen powder, wet and dry pet food.

Tropical fruit – mango, watermelon and First Nation bushfoods: Processed traditional fruit products, fruit pulp, dried fruit and straps, fruit powder and juice.

Seafood and aquaculture: Processed traditional fish products, dried fish products (including fish maw/swim bladder), wet and dry pet food.

Shelf-stable food product demand

Market demand is growing for NT's produce and corresponding shelf-stable products, in Australia and across the APAC region, as illustrated by the following:

- Escalating demand for healthier food options, which includes shelf-stable foods.
- Strong APAC growth forecasts, particularly from countries that are closer to Australia. For example:
 - Vietnam and Indonesia's expanding middle classes that use ecommerce are driving strong demand growth for packaged and shelf-stable foods (e.g. Halal beef products in Indonesia).
- FMCG value sales growth in Australia and many APAC markets since the COVID-19 pandemic:
 - packaged food, health supplements and pet food among the highest growth rates
 - also growth in ready meals and dried baby food, with significant growth in 'meal kits' from increasingly time-constrained consumers.
- Growing APAC demand for Australian-made goods due to their higher-quality associations.
- Rising domestic and international interest in food provenance and product sourcing information.
- Established free trade agreements that support Australian exporters.

Seafood and aquaculture

- Global fish and seafood consumption is predicted to increase over the next 10 years (by 14% to 20%), driven by population growth and awareness of health benefits.
- Australia's fish and seafood market will expand, with a 3% annual growth rate forecasted.
- Processed fish and seafood sales will also experience strong growth.

NT opportunities

- Darwin is ideally situated to meet APAC demand for high-quality fish and seafood products.
- Most NT fish and seafood are wild-catch and therefore in high demand.
- Local species with the most potential are barramundi, mackerel, goldband snapper, prawns, trepang, black jewfish, pearl meat, and shark.
- Seafood and fish offal including skin and bones also offer significant commercial opportunity in terms of pet food, utilising what would otherwise be wasted.

Dried fish and seafood

- Dried shelf-stable NT fish and seafood products represent significant market opportunity.
- Intensifying APAC demand for dried fish and seafood products means that prices are rising as demand outstrips supply.

Fish maw

Dried fish maw has been focused on to illustrate its market potential, providing marketing insights for NT shelf-stable maw as well as other products stemming from NT's unique fish and seafood species. Some of the key insights include:

- Fish maw (dried swim or air bladder) is a delicacy in China and South-East Asia.
- Quality and prices vary according to fish species, age and gender, as well as fish maw colour and size.
- From NT waters, black jewfish and barramundi offer the greatest opportunity, with up to \$500-\$900/kg for NT black jewfish maw reported.

- The high price of fish maw has led to overfishing and illicit trade in some countries (up to \$8,000/kg has been reported for the most prized fish maw species). Establishing a formal sales channel in Darwin will therefore help to legitimise the local trade and regulate captures in NT waters.

Marketing insights

- Fish maw is commonly sold in 250g, 400g, 500g and 1kg pack-sizes.
- Packaging is comprised of plastic pockets or sachets, which clearly display the maw inside.
- Fish maw prices range from between \$500/kg and \$1,280/kg on Australian websites, with a Malaysian site charging \$1,500/kg for black jewfish maw.
- Different fish maw quality grades also relate to size, with larger pieces carrying higher prices.
- In addition to species, other marketing information associated with fish maw's premium pricing includes country of origin (e.g. Australian or New Zealand waters), wild-caught, and sustainable fishing practices.

Tropical fruit

As with other foods, global demand for fruit is growing, and NT is Australia's largest producer of mangoes and one of its largest producers of watermelon. Bushfoods are also common in the NT, which attract premium prices despite the small-volume production. As fruit perishes quickly in the NT and there is a lack of processing options, the need for cold chain storage is costly and there are also high waste volumes.

NT opportunities

- High potential shelf-stable tropical fruit products are juice, puree or pulp, wet or dry whole fruit or fruit pieces, straps or leathers, as well as dried flakes, crisps, chips and powders.
- To ensure success, such products need to offer distinct advantages over fresh/frozen fruit, which includes reflecting the growing demand for convenient, healthy and 'clean' (free from additives) fruit products.
- The most viable consumer segments are those requiring ready-to-eat or ready-to-use food, snacks and ingredients.
- Among B2B customer segments, the most viable are functional bulk ingredients (e.g. imparting high vitamin C content, and desirable flavour and fragrance properties).

Vitamins and supplements

- Vitamins and supplements comprise health, sport and fitness, and weight management products.
- NT tropical fruits can serve as functional ingredients for a wide range of vitamins and supplements.
- NT red meat can also service the demand for protein and collagen powders, which are a key ingredient in many sports and weight management products.
- 54.6% of Australian produced vitamin and supplement sales are from international markets.
- APAC consumers pay premium prices for Australian vitamins and supplements, which are considered higher quality.
- APAC demand is forecasted to drive Australia's annual sales revenue growth of 3.4%.

Beauty and personal care

- The beauty and personal care category comprises cosmetics, hair and skin care, soaps, and bath and shower products.
- Opportunities for NT produce include mango, Kakadu plum and other tropical-fruit-based functional ingredients that impart desired properties (as well as collagen powders from red meat).

- It is predicted that APAC's booming demand for beauty and personal care products will drive annual sales growth of 9.2%.
- Australia's estimated annual sales growth is 4.8% and is highest for baby- and child-specific products.

Mangoes

Market overview and opportunities

- The high volume of NT mango waste, in conjunction with a reputation for best quality and flavour, means strong potential for shelf-stable processing.
- Potential shelf-stable mango products include general-fruit-based foods, powder for flavoured food and drinks, as well as ingredients for nutraceuticals, beauty and personal care.
- Yet despite such opportunities, NT (and Australian) mango producers face a range of challenges that include:
 - growing international competition where cheaper mangoes are produced (e.g. Thailand, Vietnam and Philippines)
 - seasonal availability and difficulty in acquiring mango pickers
 - health trends and consumers moving away from fruit because of high sugar content
 - transportation and cold chain issues (e.g. mangoes are picked green and may deteriorate during storage)
 - potential for the bulk-waste mango processing at the NT facility to be unrealistic for some products due to cost and production limitations.
- Such challenges have meant that Australian mango production has stagnated in recent years:
 - Although 2.1% annual growth is predicted in coming years, due to innovative processing technology boosting the export of shelf-stable mango products.
- Growth opportunities and the longer-term viability of the NT mango industry is therefore dependent on local shelf-stable processing capabilities.

Marketing insights

- Shelf-stable mango product types are highly differentiated by price. For example, wet fruit pieces are priced around \$20/kg, straps are \$42/kg, dried pieces are \$80/kg, powder is \$123/kg, and crisps are \$213/kg.
- NT mangoes offer premium pricing potential based on source and reputation.
- Other premium price selling points are organic and natural, non-GMO, and 'clean' (i.e. no artificial colours, flavours, preservatives, fillers).

Kakadu plum (bushfood)

- Many NT bushfoods offer shelf-stable product potential, but Kakadu plums probably offer the most.
- Kakadu plum is the world's richest natural source of vitamin C and has been used by Australia's First Nations people for thousands of years.
- Growing recognition of its health benefits has driven market demand both domestically and internationally, especially among manufacturers.
- Such demand has often outstripped supply, which has led to fake Kakadu plum products.
- NT's Kakadu plum production is mostly via wild harvest by First Nations organisations. Although there is a plantation under non-Indigenous ownership.
- Annual NT output varies depending on weather and availability of pickers.
- Harvest and storage costs are high, and the plums require freezing as they deteriorate rapidly.
- While the plums are mostly processed into powder products, the premium price of fruit pulp or puree offers wider opportunities among cosmetics manufacturers.

- Product quality relates to whether the seed is included – seed-free plum products attract a premium.
- New food processing technologies that preserve produce quality and remove cold chain requirements present significant cost saving and convenience potential, especially for plum puree.

Marketing insights

- Kakadu plums are used in a range of product categories, including many processed grocery food and drink items, health and beauty products, and even premium pet food.
- Plum powder is widely available via online purchasing, from Aboriginal social enterprises, as well as Australian wholefood and skin care companies.
- Bulk-pack plum powder is available in 20kg packs, with a wide range of smaller consumer options available (e.g. 10g through to 1kg). Pouches or bags are the most common pack format, with jars also available for some smaller sizes (e.g. 25g).
- Powders are differentiated in terms of price (e.g. small packs at \$1,400/kg, and 1kg packs at \$400 to \$500).
- Common marketing message themes for Kakadu plum powders include:
 - wild harvested
 - support of Aboriginal communities and traditional owner harvested
 - sustainable and ethical supply, including biodegradable packaging
 - product characteristics (e.g. bush superfood, certified organic, pure and natural, nature's vitamin C – some also specify made with or without the seed).
- Social enterprises involved in the Kakadu plum harvest also emphasise:
 - Aboriginal product provenance, authenticity, and traceability back to specific communities
 - connection to country, including Aboriginal nurturing of the environments where the plums grow
 - empowerment of Aboriginal enterprises and families, and communities and their wellbeing.
- NB: Marketing of Kakadu plums will need to address any potential negative perceptions about foods processed via the new technologies, in terms of maintaining their health properties.

Red meat

- Red meat demand is weakening in developed markets (including Australia), with a shift to white meat and meat-free alternatives in many due to perceptions around animal welfare and public health, and the perceived health benefits of a non-meat diet.
- Population growth across emerging markets will drive an overall increase in red meat consumption of around 15% the next 10 years.
- While beef and veal represent only around 20% of the global total meat produced, it dominates in terms of value and by 2031 will account for more than half of the total meat trade value.

NT beef opportunities

- Significant potential for NT-processed shelf-stable red meat products (e.g. beef jerky/biltong, protein powders and collagen, and pet food) based on:
 - established NT cattle industry and infrastructure including abattoirs and export connections
 - significant and growing international demand (e.g. Halal beef in Indonesia influenced by rising population)
 - rising consumer interest in understanding meat provenance, including demand for local, sustainable and ethically produced meat products.
- Value-adding to NT beef via new processing capability is key to the industry's future to overcome:

- growing competition from international beef producers
 - weakening domestic red meat (fresh and processed) demand (and from developed countries like USA) based on a trend for healthier alternatives
 - other Australian states and territories targeting markets that the NT has traditionally served.
- However, high beef prices into certain markets mean that NT pastoralists may be unwilling to switch to supplying a new processing facility, preferring to stay with their current sales channel. Therefore the approach would be best positioned at targeting the low-value red meat stream i.e., those volumes going into the manufacturing meat trade.

Buffalo opportunity

- Global demand is increasing at a rate of almost 3% annually.
- It is one of the healthiest of red meats, which also makes buffalo an ideal protein powder source.
- Compared with APAC rivals, NT has a quality-assured product, based on robust industry standards.

Beef marketing insights

- Opportunity to produce a wide range of traditional beef products (e.g. shelf-stable premium beef cuts, ground beef, offal/organs, cooked, cured and dried), as well as functional beef ingredients used in numerous grocery products.
- The new food processing technology's ability to maintain meat quality in terms of nutrition, flavour, texture and appearance and long shelf-life are key selling points. For example:
 - existing shelf-stable beef ready meals using the new technologies promote convenience as a selling point in terms of being easy to prepare, transport and store (no refrigeration needed).
- Value-add propositions that promote conventional fresh ground beef in Australian supermarkets provide further insights to selling points and marketing of shelf-stable beef products. For example:
 - meat quality in terms of fat content that determines placement in economy, mid-priced and premium price bands, with lean and extra lean having higher prices
 - Australian provenance, which state/territory it comes from and even down to specific farm source
 - mode of production (e.g. grass/pasture-fed, free range, no added hormones, organic)
 - method of slaughter (e.g. halal, kosher).
- Similar value propositions are found across beef-related product categories including ready meals, soups and baby foods.
- Unlike other states and territories, most NT beef is free-range and can therefore take advantage of related premium value propositions.
- NT's large volume beef exports to Muslim markets like Indonesia also means it is well situated to provide Halal beef products, via abattoir Halal certification. Northern abattoirs have Halal certification.

Pet food

- Pet food is driven by dog and cat food sales, with many red meat or fish and seafood-based products.
- APAC demand for wet and dry pet food, and pet snacks has grown substantially.
- Strong annual APAC sales growth of above 5% is predicted for dog food, and 15% for cat food.
- This growth is driven by demand for premium higher-quality pet food products.

- APAC ecommerce pet food sales have escalated, with online now accounting for almost half of all cat food sales.

Marketing insights

- As with beef for human consumption, pet food (treats, wet and dry) has similar economy, mid-priced and premium price bands.
- Similar value propositions are also evident for premium pet food, presenting an opportunity to serve both human and pet food customer segments via the same beef product lines.

Price and pack size

- Raw ground beef is a common premium wet food for both cats and dogs.
- Pack sizes and portions are relatively consistent for cats, but vary for dogs based on breed and/or dog size (e.g. from small 50g patties up to 2kg sausage packs).
- Premium wet beef pet food is priced similar to low- and mid-priced ground beef for human consumption (e.g. dog \$12.50/kg to \$17.00/kg, cat \$20/kg).
- Dry beef treats have higher prices (e.g. \$100-\$200/kg).

Product information

- Premium beef pet foods present value propositions based on product quality meeting the pet's nutritional needs, including being low-carb, grain- and soy-free, and horse-meat-free, and human-grade (i.e. same quality and production standards).
- They also present the same premium propositions as human ground beef (e.g. sustainable and no factory-farmed meat, Australian-made ingredients, locally made, organic and grass/pasture-fed).
- Another premium segment is Halal pet food, which presents another viable and lucrative opportunity for exporting to APAC Muslim markets (e.g. Halal beef, and fish/seafood pet food to Indonesia).

Collagen and protein powder

- Collagen and protein powders apply similar marketing strategies to other beef-derived products.
- For example, low-, mid- and high-price bands are evident for collagen powders.
- These products also use similar value propositions to differentiate brands (e.g. grass-fed and pasture-raised, as well as country of origin).

5. Strategic marketing considerations for NT shelf-stable products

This study's market opportunity analysis has demonstrated strong potential for a variety of NT manufactured food and non-food shelf-stable food products. However, the success of these products, and therefore the success of the proposed NT food processing facility, is dependent on effective marketing strategy.

Acceptance of the new food processing technologies and shelf-stable foods

To overcome any potential negative perceptions and stimulate acceptance, it is essential for initial marketing efforts to educate customers and suppliers about the new food processing technologies and their value propositions. To facilitate acceptance of the new products, marketing communications should emphasise the improved food quality relating to healthiness, fewer preservatives, sensory properties (appearance, texture, taste, aroma) and extended shelf life.

Competitive advantage and unique selling points

The new shelf-stable NT products must offer clear competitive advantages that are defensible against competition. Competitors include Australia's major supermarkets and multinational food manufacturers that enjoy high volume sales and lower production costs derived from economies of

scale and/or production in emerging markets. Setting up regional New food processing, likely from a greenfields position, comes with a capital expenditure outlay, so the new products must support premium prices based on the technology benefits, and the unique selling points of NT produce and localised production.

This study identified numerous unique selling points for shelf-stable products made locally from NT produce, with social, political, economic and sustainable production (environmental) sustainability dimensions (see Table 11 in the main report). These selling points must inform marketing mixes to provide the necessary competitive advantage in the marketplace. They also inform the rationale for locating the processing facility in the NT. The relevance of specific unique selling points will vary by product type and target customer segment. Maintaining competitive advantage will also require monitoring competition to understand how they respond to the new shelf-stable product marketing.

Diversification strategy

A diversification strategy is recommended to maximise long term market opportunities and to avoid risky over-reliance on a small number of products and markets. Diverse product portfolios also ameliorate the seasonality of NT produce supply and afford some protection against market demand fluctuations. Diversification is also particularly relevant for an initial pilot processing facility, to provide the flexibility for testing out product ranges and markets. Such diversification is achieved by:

- producing a range of shelf-stable foods from each produce type
- processing NT produce via wet and dry manufacturing lines
- using different produce grades for products with high, medium and economy price options
 - these are still differentiated by the unique selling point, e.g. a lower grade NT beef product can still be legitimately marketed as pasture fed/free range to secure a premium within the economy price band.
- servicing a range of markets / countries and customer segments therein.

Complementary product lines should target both B2B and consumer segments, e.g. bulk protein powder for supplement manufacturers, and protein powders for sale to end users in health/wellness shops. Complementary product lines also support effective market entry strategy, e.g. initially target B2B to generate sales / production volumes, before exploiting consumer segments.

Test marketing

In addition to enabling experimentation with shelf-stable food manufacturing lines, an initial pilot food processing facility enables product testing and the refinement of other marketing elements such as packaging, communications, and pricing. Such test marketing includes via collaboration with key stakeholders including consumers in the NT, Australia and specific countries in the APAC region, as well as produce suppliers, distributors, retailers, and manufacturers.

Future research

On the production side, future research is required to inform product line efficiencies, product profitability, as well as overcoming challenges of applying new processing technologies and raw feedstock supply.

On the customer side, this study's market opportunity analysis is only a starting point. Further market research is essential to for deeper insights into specific domestic and international markets and customer segments. Future concept testing of marketing mix elements is also required, to tailor the shelf-stable food offerings to match the target customer needs. More research is also required to accurately gauge market demand for different products and markets, as well as barriers to uptake.

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1. Introduction

1.1. NAFTI project and the market opportunity analysis

In 2021, Charles Darwin University (CDU) received an Australian Government award to investigate developing the manufacturing capability of the agricultural and food (agri-food) industries in Northern Australia.

Food processing is essential for adding value to agricultural produce, which are highly vulnerable to commodity market volatility and competition from international producers. Currently there is only small-scale shelf-stable food processing in Northern Australia, and commercial-scale processing is urgently required to facilitate value-adding and to improve the resilience of the Northern Territory (NT) food sector.

The Northern Australia Food Technology Innovation (NAFTI) project is a feasibility study for the establishment of food processing facilities in the Northern Territory, to process local beef, horticulture and seafood into shelf-stable products using new food processing technologies.

Shelf-stable products include the full complement of processed fresh foods such as meat, fruit, fish and vegetables that would normally require refrigeration. Shelf-stable foods are usually preserved via heating or drying, and are packaged in durable, airtight packaging to ensure a long shelf life.

Any proposed NT shelf-stable food manufacturing facility would take advantage of new food processing technology to produce new ranges of shelf-stable food products, offering significant benefits over food processed via conventional methods. This new technology (some of which could include microwave-assisted) offers the potential for foods that are tastier, healthier, look better and have a reduced carbon footprint compared with other shelf-stable foods produced using other methods.

Overall, the NAFTI project should lead to the implementation of an NT-based food manufacturing facility (initially a pilot facility is recommended), which would provide benefits for NT residents in the form of jobs and economic development, as well as supporting national priorities like increased food security for the NT and Australia, as well as improved sustainability outcomes.

The NAFTI project consists of several components to inform key dimensions, such as the potential manufacturing pilot facility design, as well as distribution and logistical considerations. This report concerns the marketing component, which evaluates market opportunity and informs marketing, including the future potential product ranges that match NT capabilities.

This marketing NAFTI project component is therefore a scoping market opportunity analysis. It involved strategic consideration of potential shelf-stable food markets in Australia and the wider Asia Pacific (APAC) region. This market potential was examined in relation to the NT's capabilities to serve these markets via a localised manufacturing facility. More specifically, this study investigated:

1. The rationale and viability of a localised NT shelf-stable food processing facility using novel processing technologies
 - a. benefits of and barriers to the new technologies and new shelf-stable food products
 - b. challenges and opportunities for NT shelf-stable food production and products.
2. Market opportunities represented by the broad types of NT produce (key focus red meat, tropical fruit and seafood) in domestic and international markets
 - a. market opportunities for specific types of shelf-stable products made from NT produce.

3. Market analysis to inform NT shelf-stable food product marketing strategy, including product formats, packaging, pack size, price, distribution, and likely target market/customer segments.

The outcomes of this market opportunity analysis inform the other components of the wider NAFTI project, including the identification of competitive advantages of NT-produced shelf-stable foods, and the guidance of food technologists in determining the types of shelf-stable food products that offer most potential and should be tested in any future proposed shelf-stable food pilot facility.

The market opportunity analysis was informed by capturing input from various agri-food industry stakeholders and experts, as well as desktop research including analysis of market research data, and retail audit of products and associated marketing strategy. This report initially discusses the research approach that was used, before presenting the findings and discussion.

The findings presented in this report offer an informed opinion on the most viable shelf-stable foods for the NT manufacturing facility to produce, generated within the project resources. The analysis cannot predict market dynamics, nor does it guarantee future market success of the recommendations provided. As with such feasibility studies, it also raises many more questions for further investigation in the future.

2. Research approach and method

The NAFTI marketing project and market opportunity analysis was driven by desktop research and analysis of secondary data sourced from relevant industry market research reports and information resources. The types of information collected in this investigation were informed by recognised strategic marketing best practices (e.g. Reed, 2015) as well as current thinking relating to assessing the feasibility of distributed localised manufacturing in the food sector (e.g. Gimenez-Escalante et al., 2020).

The desktop research and interpretation of data were also informed by primary research involving conversations with agriculture and food industry experts and stakeholders. Ethical approval for the primary data collection was granted by CDU's Human Research Ethics Committee (CDU-HREC, reference H22077). Further detail on the research components applied in this study are discussed below.

2.1. Industry expert conversations

Conversations with a convenience sample of industry experts from the meat, fruit, seafood and aquaculture, as well as horticulture and food technology and manufacturing were used to guide the desktop research, and to inform interpretation of the secondary data analysis, as well as to make recommendations for shelf-stable food products and markets.

Project stakeholder and industry expert conversations were conducted via individual face-to-face, or telephone/Teams/Zoom interviews, as well as several face-to-face group meetings and workshops where idea generation was desirable.

The stakeholder and industry expert conversations were between March and November 2022. These involved the official project advisory group member organisations, as well as other external stakeholders.

Data collection from the conversations was in the form of note-taking for individual meetings, while group meetings were recorded to assist with the write-ups. For reporting purposes and to meet

ethical research standards that ensure the anonymity of responses, no comments/quotes that are reported are ascribed to any individual or organisation.

All participants were given the opportunity to be included, or not, in the report acknowledgements – see opening section Acknowledgements of contributors and participants. Participants also had the opportunity to vet and provide additional input to the interim report prior to finalisation and publication.

2.1.1. Phase 1

The initial stakeholder conversations informed the desktop study focused on the identification of relevant information resources. These were used to understand benefits and barriers of the new shelf-stable foods produced with the new microwave-assisted technology, viability of the local NT manufacturing facility, and potential shelf-stable food opportunities, including the potential customer and product opportunities.

These initial conversations were open and flexible, rather than following a rigid structured interview schedule, and included the following questioning themes:

- Where is the competitive advantage for NT-produced shelf-stable food using the new technology? (What are the key benefits? What are the key shortcomings?)
- Who/where are the biggest potential competitors for an NT-based facility?
- What information sources can inform the marketing of shelf-stable foods in Australia and APAC?
- Which types of shelf-stable products using NT produce offer most opportunity? (What are the key benefits? What are the key shortcomings?)
- Which do you think are the top three high potential markets/customer segments for NT-produced shelf-stable foods?
- In the APAC region, which countries do you think offer most opportunity? (What are the key benefits? What are the key shortcomings?)

2.1.2. Phase 2

Industry expert conversations in phase 2 involved discussing the findings from the ongoing desktop research, to identify further avenues to explore and to gain feedback on the potential shelf-stable foods identified for specific agri-product types.

As in phase 1, group sessions in conjunction with individual interviews were employed. The phase 2 interviews helped to further refine the desktop market investigation, and to identify shelf-stable food types offering the most potential for production by an NT manufacturing facility. These conversations also provided associated marketing input, as well as insights into manufacturer requirements relating to raw materials and ingredients.

2.2. Research using secondary sources and the retail audits

These study components comprised of a desktop review of relevant literature, market and industry information, and a retail audit of food products that offer the most potential for NT-produced shelf-stable foods.

2.2.1. Desktop literature and industry information review

The desktop research phase relied on a systematic review of secondary data sources identified between April and September 2022, within the project scope and research resources that were available. These sources included public reports and trade figures (e.g. UN FAO and government

reports), commercial market research industry reports (e.g. Euromonitor, IBIS World), as well as relevant academic journal articles identified using CDU's library search capability. The CDU library has access to key reputable academic papers (e.g. EBSCOhost, JSTOR, ProQuest, Scopus, Web of Science). The library search was supplemented by a more general search conducted using the Google search engine, as well as information resources identified during the industry expert conversations.

Following literature review and secondary research best practice (e.g. Pickering & Byrne, 2014), the search utilised carefully selected keywords to initially identify potential information resources. This was followed by initial screening to ascertain the relevance, or otherwise, of identified sources. The more relevant papers were then reviewed in greater detail to identify key themes and trends.

Searches were conducted for the three main food types covered in this report (meat, fruit and seafood). As illustration of the search process that was applied, for meat for human consumption the search keywords and combinations thereof included:

- broad food category (e.g. meat, beef, buffalo)
- food product type (e.g. biltong, burgers, cured meat, deli meat, dried meat, ground beef, jerky, minced beef, pate, ready meal rib, sausages, sliced meat, smack, steak)
- preservation type/process (e.g. canned, dried, frozen, microwave-assisted, pasteurised, ready-to-eat, shelf-stable)
- market and customer segment (e.g. consumer, restaurant, food manufacturer, backpacker/camping, defence ration pack)
- location (e.g. Australia vs other APAC markets)

Where search terms generated excessive record numbers or hits, more keyword combinations were used, and the search output was restricted to more recent resources (e.g. within the last 2 to 5 years).

2.2.2. Retail audits

Retail audits were used in this study to supplement the desktop research findings and to provide more detailed insights into specific shelf-stable products and their associated marketing strategies.

Retail audits are commonly used to investigate the marketing strategies of fast-moving consumer goods (FMCG) manufacturers (Laforet, 2015). Retail audits capture stockkeeping unit (SKU) details such as price, pack size, pack type and packaging information, which helps to understand the marketing and positioning strategies used in specific product categories (Greenland et al., 2016). Such understanding is useful for informing appropriate marketing and positioning strategies for any future NT-produced shelf-stable products.

The retail audits in this study mainly relied on online shopping websites, which were supplemented with a convenience sample of in-store visits. The online point-of-sale SKU information was captured via webpage screenshots, and via photographs for the in-store visits. These audits also captured SKU information from selected manufacturer websites. While the audits captured some information from other APAC countries, they mostly focused on Australia and its two largest supermarkets.

Australian supermarkets dominate grocery sales and are therefore the logical focus for food research (Grigsby-Duffy et al., 2020). Consistent with some other Australian FMCG marketing studies (e.g. Riesenbergs et al., 2019), this study's retail audits focused on Australia's largest supermarket retailers Coles and Woolworths, which dominate national grocery sales. As illustration, in 2021 Woolworths earned 32.4% of grocery retail sales value in Australia (Euromonitor International,

2022a). The Australia supermarket sample was supplemented with audits of some other online food retailers, as well as manufacturer websites in Australia and the APAC region.

NB: It was not possible to present all the relevant data from the desktop research and secondary data collection phases of this research in this report. For example, data from commercial market research industry reports are copyrighted which means only summary insights can be presented. Likewise, the product images captured from retailer and manufacturer websites during the retail audit phases cannot be presented for the same copyright reasons. Analysis of product details instead enabled identification of the relevant range of positioning strategies and marketing dimensions.

3. Findings and discussion – scope, context and potential

The research comprised of various components and stages (desktop research, retail audits, and stakeholders and agriculture/food industry expert interviews). Rather than presenting the findings from each component separately, the findings and discussion provides an overview of the relevant key considerations. These are presented in the following sequence:

- project scope – geographic (market) and food focus
- regional context
- the novel shelf-stable food processing technologies
- NT shelf-stable food manufacturing facility viability
- potential shelf-stable product types
- potential shelf-stable product customer segments

(NB. Any prices or values presented are AU\$, unless specified otherwise)

3.1. Research scope – geography (market) and food focus

Resource limitations prevented in-depth analysis of all potential food types, products, markets and customer segments. However, the potential afforded by selected shelf-stable food products, customer segments and related targeted marketing is indicative of the broader market potential and informative for marketing strategies overall.

In terms of geography, the market opportunity analysis first focused on the NT and Australia, followed by consideration of wider APAC and global perspectives.

In terms of food sources, industry expert conversations were used to brainstorm the types of shelf-stable foods that the NT processing facility should focus on. This idea generation with industry experts continued at various research stages, and was further informed by broader market opportunity analysis.

Despite the market potential for horticulture-based shelf-stable foods, due to resource limitations the market opportunity analysis focused on the following food types, with the approximate allocation of associated research effort indicated in brackets:

- meat – specifically red meat, beef and buffalo (main – @50%)
- fruit – specifically tropical fruit such as mango and watermelon, as well as First Nations bushfoods native to the NT such as Kakadu plum (secondary – @30%)
- seafood and aquaculture – specifically dried fish and maw/swim bladders (secondary – @20%).

3.2. Regional context

Further contextual information is provided in the accompanying report: Supply Chains for Shelf-stable Food Manufacturing in Northern Australia. This provides additional detail on NT geography, as well as data on the territory's beef and buffalo, tropical fruit, seafood and aquaculture industries, and associated production volume outputs including supply to local and export markets.

3.2.1. NT and agri-food business GSP

The NT covers 1,347,791 square kilometres (Geoscience Australia, 2022), and in March 2022 its population was reported to be 233,000 (Australian Bureau of Statistics, 2022). The NT's location is strategically important in terms of the wider APAC region, and it consequently has a substantial defence presence (army, navy and air force) to help maintain economic and regional stability.

The NT economy is heavily dependent on government and community service industries, as well as mining and manufacturing. In the last 10 years, there has been notable growth in onshore and offshore petroleum and natural gas production. The contributions to gross state product (GSP) and employment among the main industries is summarised in the table below.

Table 1: NT industry contributions to GSP and employment, 2020–2021

Sector	Value \$M	Value share %	Employee number	Employee share %
Government and community services	6,539	26.4	57,333	43.7
Public administration and safety	3,125	12.5	22,194	16.9
Health care and social assistance	2,124	8.7	22,700	17.3
Education and training	1,290	5.2	12,439	9.5
Service industries	5,069	20.6	41,708	31.8
Accommodation and food services	610	2.4	8,164	6.2
Transport, postal and warehousing	798	3.4	5,154	3.9
Information and media telecommunications	119	0.5	1,165	0.9
Financial and insurance services	615	2.5	1,155	0.9
Rental, hiring and real estate services	346	1.4	1,940	1.5
Professional, scientific and technical services	866	3.5	7,375	5.6
Administrative and support services	425	1.8	5,080	3.9
Electricity, gas, water and waste services	465	1.8	1,943	1.5
Arts and recreational services	321	1.3	3,137	2.4
Other services	504	2	6,594	5
Mining and manufacturing	7,439	24.1	6,431	4.9
Mining	6,446	19.9	3,058	2.3
Manufacturing	993	4.2	3,374	2.6
Defence	2,244	8.8	5,433	4.5
Retail and wholesale trade	1,578	6.5	12,996	9.9
Retail	741	3	11,258	8.6
Wholesale trade	837	3.5	1,738	1.3
Construction	1,464	6	10,375	7.9

Sector	Value \$M	Value share %	Employee number	Employee share %
Tourism	852	3.3	7,300	5.5
Agriculture, forestry and fishing	924	3.6	2,406	1.8

Source: Adapted from Northern Territory Government, 2022

The GSP from the NT's agriculture, forestry and fishing is small in comparison with other industries. This means that at a national output/export reporting level, NT agriculture and fishing are often too small to appear in the national statistics for specific food types. This is despite agriculture, forestry and fishing providing employment for over 2,400.

Given the size of the NT and its low level of agricultural output compared with other states and territories, there is considerable opportunity for further development of food production in the NT.

3.2.2. APAC opportunity

At the global scale, Australia's population is relatively small (26M), with an annual growth rate of <1% (Australian Bureau of Statistics, 2022), which means domestic market growth opportunities are limited. In contrast, the wider APAC region offers significant potential for food export. This includes China and India (with the world's biggest populations), as well as several other countries with populations of 100 million or more, including Indonesia (275M), Philippines (110M) and Vietnam (100M) (World Bank, 2019). The APAC region's many developing countries have some of the world's fastest population growth rates, offering the greatest opportunities in terms of sustained market growth.

Australia has favourable trading agreements with many APAC countries, as per the ASEAN-Australia-New Zealand Free Trade Area (AANZFTA) agreement between ASEAN member states (Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam), Australia and New Zealand. This agreement provides tariff reduction as well as reassurance for suppliers and investors (Department of Foreign Affairs and Trade, 2022a).

While it is not the intent of this report to provide market overviews for all APAC countries, it is appropriate to consider the significant potential of some. This includes neighbouring Indonesia and Vietnam, given the established trade networks for NT exports, including agricultural products (e.g. beef and mangoes). The focus has therefore been on these countries in the APAC market opportunity analysis.

3.2.3. Advantages and challenges for Australian agri-food businesses

The commercial opportunities for the NT's agri-food businesses in the APAC region are well recognised (e.g. Fortune Agribusiness, 2022; KPMG, 2020). To capitalise on such opportunities, it is important to understand Australia's international comparative advantages and challenges (see Table 2).

Table 2. Summary of Australia's agri-food business – international comparative advantages and challenges

Theme	Strengths	Weaknesses
Reputation 'Clean and green'	<ul style="list-style-type: none"> • Strong reputation • Low prevalence of food-borne illness • High safety standards 	<ul style="list-style-type: none"> • Lacks uniqueness • Disparity between perception and performance • Extensive list of accreditation schemes
Location 'Unique geography'	<ul style="list-style-type: none"> • Close to growing APAC markets • Diverse range of agri-ecological zones • Counter-seasonality to Northern Hemisphere 	<ul style="list-style-type: none"> • High transport costs • Small and geographically dispersed domestic market • Disconnect between producers and processors
Technology 'World-class research'	<ul style="list-style-type: none"> • Strong R&D sector, especially in agricultural science 	<ul style="list-style-type: none"> • Poor conversion / commercialisation • Relatively low business expenditure on R&D
Trade 'Global mindset'	<ul style="list-style-type: none"> • Globally focussed industries • Free trade agreements 	<ul style="list-style-type: none"> • Exposure to global fluctuations • Complex regulatory arrangements
Industry 'Established sector with high proportion of SMEs'	<ul style="list-style-type: none"> • Strong knowledge, skills and infrastructure base • Fast, agile and high innovation potential 	<ul style="list-style-type: none"> • Difficult to generate scale • Most Australian small and medium enterprises (SMEs) are micro

Source: Adapted from CISRO (2017, Figure 3)

Some but not all of the above-listed agri-food business strengths apply to the NT. For example, Darwin's trade links are not as established as other larger Australian jurisdictions and trading centres. Similarly, food technology and agribusiness industry infrastructure are much weaker in the NT compared with other states and territories. Workforce availability (skilled and general) has also been a challenge across Northern Australia since the start of the COVID-19 pandemic in 2020 (Sangha et al., 2022). The NT's advantages and unique selling points are discussed in more detail throughout this report.

3.3. New shelf-stable food processing technologies

A proposed NT food processing facility would apply novel technologies to produce shelf-stable foods from NT produce. These technologies could include the likes of advanced retort technologies in a 'wet-line' i.e., pouch-packaged overpressure processed products, and/or drying systems such as microwave-assisted vacuum drying. Yet while these new technologies could bring many benefits in terms of sensory and nutritional outcomes and energy economies, they also pose challenges that need to be considered. One of the key challenges is understanding any potential negative market perceptions of these technologies, which could have unexpected detrimental impacts on the feasibility of the proposed NT food processing facility in terms of the sales of the shelf-stable foods it produces. Customer unfamiliarity with products or the way in which they are packaged could also affect market acceptance.

It is therefore essential to appreciate the advantages as well as any disadvantages and perceived barriers to market acceptance, associated with any new food processing technologies planned. Such understanding must inform the shelf-stable food marketing strategy to capitalise on the benefits, while minimising the impact of potential barriers and disadvantages.

3.3.1. Acceptance and adoption

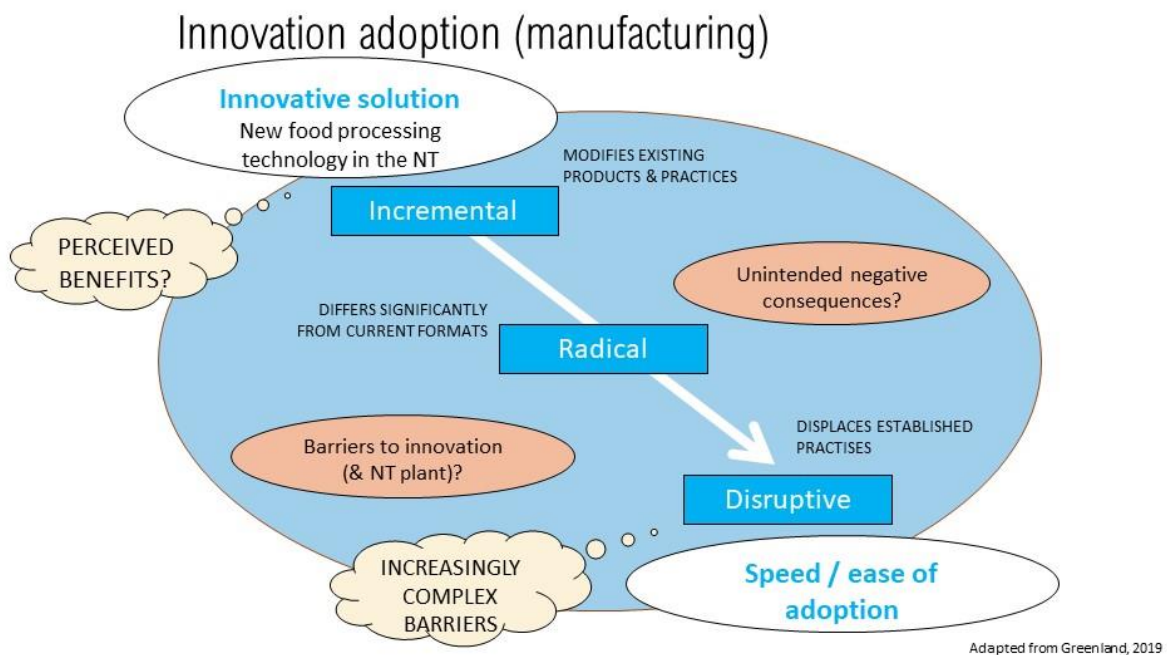
The ease of acceptance and rate of adoption of any new technology, including food manufacturing innovations, is a key consideration that can determine market success or failure. Adoption and

acceptance of new processes and products are faster and smoother in situations where the perceived benefits clearly outweigh any perceived disadvantages (Greenland et al., 2019). In the context of microwave-assisted shelf-stable food processing technology, it is critical that the key stakeholders, including growers/suppliers of food products, government investors, and customers (e.g. food manufacturers, retailers and end-users/consumers) appreciate the benefits, to overcome and minimise potential adoption barriers.

Innovation acceptance and adoption is faster when the new technology represents only minor incremental improvement or modification of existing products and practices (Christensen et al., 2015). This is in comparison with more radical, significantly different adaptations that can disrupt current practices, including in supply chains, and raise a more complex array of adoption barriers (Reed, 2015). While the delineation between incremental, radical and disruptive innovation can be blurred (Harmancioglu et al., 2009), generally the more radical the innovation is the longer it takes for the new technology to be accepted (Christensen et al., 2015).

Figure 1 below depicts how the type of innovation can affect the speed of adoption. As it illustrates, the more radical and disruptive an innovation is, the greater the range and complexity of the barriers that can arise. It also shows how innovation can foster unintended consequences that present additional barriers that affect the rate of acceptance and adoption of the new process and corresponding products. For example, in the context of shelf-stable foods that do not require cold chain transport and storage, a potential unintended consequence could be negative reaction from cold storage transport companies, who perceive the new products as a threat to their own business.

Figure 1. How new food processing technological innovation can affect speed of adoption



3.3.2. Benefits of new food processing technologies

The food preservation technologies under consideration in the project are leading-edge technologies involving sterilisation via microwaves (e.g. Tang et al., 2018), high-pressure systems, or drying. Some of these new technologies have the potential to replace canned or frozen foods, and are beginning to impact food product formats and distribution, based on the provision of alternative higher-quality shelf-stable food offerings.

The initial stages of this research, particularly the industry expert conversations, sought to establish the key benefits of the new food processing technologies. A wide range of benefits were identified that are applicable to a range of shelf-stable foods, as well as non-food products such as nutraceuticals and cosmetics.

The key advantages of shelf-stable foods produced by the new technologies include corresponding food product attributes such as greater convenience, as well as logistics and distribution, which could also lead to better sustainability outcomes. These advantages are further discussed below, supported by verbatim comments from agri-food industry experts (in *italics*). While most of these advantages could be applied to any location, some are more specific to the NT.

Leading-edge technology and associated product attributes

“Flavour is a key attribute because for things like the juices you actually maintain flavour, compared to traditional canning”

“Even par cooked, the technology allows it to maintain its flavour. It maintains its tenderness if it’s meat, and maintains the flavour if it’s a juice.”

“High nutritional value, easily consumable, good flavour and texture – satisfying the range of anticipated consumer attributes.”

“Food safety the number one driver – in terms of not getting sick, not giving everyone dysentery.”

Compared with other shelf-stable foods, positive product attributes produced by the new technologies relate to the themes of innovation, nutrition, flavour, stability/safety, and convenience/timesaving:

Innovation

- Latest innovations in food processing technology
- Improved consumer experiences and outcomes

Nutrition

- Higher nutritional value compared with other food processing methods
- Preservative free/reduced (especially with advanced retort technologies)
- Reduced sugars (preservative-related)

Flavour

- Better flavour compared with other shelf-stable food processes
- Even par cooked, the technology maintains food flavour and texture

Stability and safety

- Unrefrigerated – does not require refrigerated storage
- Longevity of product – extended use-by date
- Processing and packaging means reduced perishability/loss of quality
- Packaging/individual meal-pouch cooking prevents cross-contamination of foods

Convenience and timesaving

- Ready-to-use ingredients
- Pre-prepared saves on prep time (e.g. stir-fry-ready beef)

- Par cooked saves on cooking time
- Ready-to-eat (pre-cooked/pre-prepared)
- Heat in bag – plastic heat-resistant packaging

Logistics and distribution

“Excellent shelf stability.”

“Doesn’t require refrigeration. If you eliminate the cold chain, you eliminate forty to fifty percent of the cost.”

“There’s just so many places where cold chain is just non-existent and unreliable, and they need to preserve proteins because they’re really dangerous going off in tropical conditions.”

“We [the NT] are a net exporter of fresh air [sic]. Most of our stuff comes up containerised. Most containers go back empty.”

Most of the logistical and distribution benefits relate to lower storage, transport and handling costs:

- processed at source – cheaper than transporting raw goods for processing elsewhere
- less packaging/storage volume – more SKUs per pallet/shipment
- lightweight/dried products easier to handle
- unrefrigerated – eliminates cold chain need and approximately 50% of the distribution cost
- greater supply chain resilience – not affected by transport delays, etc.
- less perishable, can be stored for longer
- improved supply chain efficiency – utilising empty containers that leave the NT (NT is a net importer)
- easier to export – processed foods have less stringent export rules than fresh/live produce.

Supporting sustainable development and supply chain resilience

“Supports the sustainability goals of industries (e.g. beef) to be carbon neutral by 2030.”

“The resilience of the supply chain. When the Stuart Highway is cut off by flooding, the food is not going to go off waiting three weeks to get through.”

“For regional remote communities that can’t access fresh vegetables. Means those without cold chain can get nutritious meat and vegetables that they couldn’t otherwise.”

The benefits of the new shelf-stable products in terms of their contribution to sustainable development in Australia include supporting political/governance objectives, social contributions including diet and health, as well as economic and environmental contributions:

Political/government

- Improved Australian food security
- Enhanced Australian sovereign food processing capability
- Improved Australian food supply chain resilience
- Produces long-life food that can go into a durable regional food reserve

Social

- Provides healthier dietary options
- Regional and remote community health benefits – improving diet via the supply of nutritious food to First Nation communities
- Creates jobs that will keep people in the NT/stop them leaving to work in other states and territories
- Reduces need for live cattle transport

Economic

- Creating major industry opportunity in Northern Australia
- Driving expansion of the NT primary production sector
- Providing regional employment opportunities
- Stimulating wider industry and employment growth
- Effective use of waste products, by capturing more value from raw materials
- Processed foods have simpler legislation regarding export barriers

Environmental

- Improved efficiency and lower greenhouse-gas emissions
- Food processed at/near source (less transportation)
- Reduced need to import food (less transportation)
- Elimination of cold chain storage, which means reduced infrastructure/running costs (takes up less space)
- Less cooking time/energy for par cooked products
- Reduced waste in the food chain and associated pollution (for shelf-stable foods made from waste product ingredients)
- Sustainable packaging – even if it is not biodegradable, it can be made from recycled items (regulatory requirement)

3.3.3. Barriers to new food processing technology and shelf-stable food

A key disadvantage to some of the potential new food processing technologies could be could be entrenched customer-related views:

“Consumers might not see it [shelf-stable food] as being healthy and nutritious ... It’s full of nitrates ... It’s full of sodium.”

“Changing consumer perception – this is the major challenge even if it’s not true. Shelf-stable foods are generally considered to be less nutritious”

There are also practical production issues with various processing technologies:

“...it’s expensive to set up, but this is related to throughput and cost per unit – minimum scale and utilisation are major issues.”

Each technology has limitations , i.e., they may be “...inflexible in terms of ability to handle different food types. You can’t do dried beef and dried mango at the same facility.”

“If you went below 100 grams, you are wasting the package. But the maximum size is the real issue, because this is microwave and has limited penetration capabilities, even though we are trying to push those limits out – but you can’t do 10 kilos yet.”

Production process issues

Given that the new microwave-assisted processing technology is largely untested in commercial-scale shelf-stable food manufacturing, there are numerous potential barriers and unknowns:

Potential production process limitations

- Maximum size limit of 2kg (for microwave and over-pressure reort technologies)– potentially too small for bulk product/ingredient supply
- Production has to be continuous – no downtime (24-hour production requirement)
- Inflexible – you cannot scale down volume (minimum 1 tonne per hour)
- Flexibility – ability to switch between different food types (e.g. meat and fruit)
- Flexibility – ability to switch between different cooking/processing types (e.g. raw to dried, par cooked, fully cooked/ready-to-eat)
- Flexibility – ability to switch between processing single ingredient vs. full-ready-meal type products
- Packaging – shelf-stable food packaging has to be imported (currently unavailable in Australia)

Facility set-up costs

- High capital expenditure to build facility and start up production

Running costs

- Production is energy-intensive
- Expense relates to minimum throughput (e.g. 1 tonne of product per hour to be viable)

Technological complexity

- Access to a sufficiently skilled workforce – skills gap
- Technology maintenance and support for processing facility breakdown

Sustainable development issues

- Currently there is no sovereign capability for the microwave-compatible packaging in Australia, and limited suppliers of retort over-pressure processing packaging.
- Disruptive negative impact on some businesses (e.g. those involved in cold chain distribution)
- Energy-intensive – GHG emissions

Supply-side issues

There are some potential limitations relating to the supply of produce to the proposed NT shelf-stable food production facility:

Consistent and high-volume raw feedstock supplies

- Consistent feedstock supply is critical for food manufacturing operations
- Feedstock t supply can be impacted by bio-physical events (i.e. cyclones, flooding, drought, pests and disease)
- Limited ability to find alternative feedstock supplies when produce is 'out of season' i.e., particularly relevant to horticultural produce

Agricultural/primary producer perceptions

- Producers may not want to sell to/supply the shelf-stable food manufacturing facility due to the perceived risk of switching to supply the new facility and letting go longstanding sales channels
- Preference to continue selling into the fresh produce market (e.g. fresh meat market is booming)
- Supplier inertia and unwillingness by industry to invest the time required to build new relationships and set up new channels for production and sales

Customer-related issues

Customer and end-user concerns relate to negative perceptions of the new shelf-stable food and anticipated market uptake:

Customer perceptions

- Acceptance of food produced from new food processing technologies– customers may view it negatively
- Disbelief of the nutrition, health, long-life storage claims

Shelf-stable food market viability

- Unproven shelf-stable food markets – unknown uptake of the new products produced via the new technology
- Business-to-business (B2B) customers may be wary of shelf-stable foods that have unknown consumer demand/acceptance

Ability to satisfy end-user needs

- B2B market segments may need larger shelf-stable food SKUs than the facility produces (>2kg)
- B2B customers may require a greater range of products than can be provided (e.g. Australian Defence Force requires a range of meals)

Customer inertia

- Consumer inertia – unwillingness to try new products
- B2B inertia – unwilling to invest the time in building new supplier relationships

3.3.4. *Market perceptions about new food processing technology*

Existing research on shelf-stable food consumption and new food processing technology, including investigations of customer perceptions, can help to overcome potential barriers and encourage acceptance.

Former research shows that acceptance of the new microwave-assisted food processing technology and adoption of the new shelf-stable foods that it produces are mostly driven by growing consumer demand for both convenience and food quality, as well as by food industry demand for greater efficiencies and quality controls (Stanley & Petersen, 2016). Although as acceptance and speed of adoption are dependent on educating the market, it will be important to ensure that marketing communications about this new technology impart the most appropriate messages. Such communication should emphasise the key benefits of the new technology and ameliorate any perceived disadvantages and barriers.

The anticipated extended shelf-life afforded by this new food processing technology will be particularly appealing, but only if the new technology is understandable (Grebitus et al., 2013). The

healthier properties of the shelf-stable food produced via the new microwave-assisted processing method, compared with conventional approaches, will also be a significant factor that will most likely stimulate acceptance (Grant et al., 2021).

3.4. Viability of NT shelf-stable food processing facility

This section considers the viability of an NT shelf-stable food processing facility and demonstrates why the NT, as opposed to other Australian locations, is most suitable.

All the advantages and barriers of the new food processing technology discussed in the previous section are relevant for evaluating the viability of any shelf-stable food manufacturing facility, as they will influence the likely uptake of the corresponding products. While most of these factors are not location-specific, so could demonstrate the rationale for processing facilities anywhere in Australia, several are more relevant to the NT. For example, those challenges relating to a lack of established infrastructure and food processing capability, as well as the limited variety of produce available, are particularly relevant to the NT. Some of the benefits such as the provision of healthier shelf-stable food products for regional or remote communities, the expansion of primary production and value-add opportunities in the agricultural sector, as well as waste product utilisation, and less need for cold chain storage given the tropical climate, are especially pertinent to the NT.

In addition to the benefits and barriers relating to the new microwave-assisted technology and new shelf-stable products, there are some other factors to consider in evaluating the viability of a processing facility located in the NT, relating specifically to the territory. Overall, the anticipated benefits of an NT location need to outweigh the challenges and barriers. This requires in-depth understanding of the NT's unique attributes in order to identify and leverage the competitive advantages it presents.

3.4.1. Establishing facility viability and identifying competitive advantage

For long-term viability, a clear competitive advantage needs to be identified for establishing the food production facility in the NT. Previously failed food processing facilities demonstrate potential challenges, such as the \$100 million¹, 1,000 head per day Livingstone abattoir plant south of Darwin, which opened in October 2014 and was mothballed only four years later (Nason, 2019). Also see the accompanying report (Supply Chains for Shelf-stable Food Manufacturing in Northern Australia) for further insights into past ventures.

To establish food processing facility viability, many other feasibility studies have examined the range of perceived advantages and challenges, and attempted to predict financial viability on the basis of economics, including demand predictions of capital and operational expenditure, as well as return on investment (e.g. GDH, 2016). Other studies have applied standard SWOT (strengths, weaknesses, opportunities, threats) analyses of supply, production and logistics, along with associated risk evaluation in an effort to inform production-focused decisions (e.g. KPMG, 2020). While these approaches all have their merits, this marketing component of the NAFTI project relies on evaluation of the advantages and challenges of a local NT shelf-stable food facility based on marketing and competitive advantage perspectives. Such competitive advantage, including being able to effectively differentiate product offerings from others in the marketplace, is the key to long-term success (e.g. Reed, 2015).

NT-produced shelf-stable foods must capitalise on clearly demonstrable competitive advantages afforded by the NT location. Broadly demonstrating the market potential for shelf-stable food does not justify the NT processing facility location, since it does not inform the critical market positioning

¹ Unless specified otherwise, all dollar amounts in this report are citing Australian currency

strategy that will make NT-processed products defensible against competition. Thus, this section's evaluation of the viability of the proposed food processing facility has involved the identification and demonstration of the clear rationale and advantage, or otherwise, of the NT over other locations in Australia.

The next sections discuss the barriers and challenges, as well as the benefits and advantages of the NT location, including the overall rationale for the food processing facility.

3.4.2. Barriers and challenges

Barriers to the NT shelf-stable food processing facility need to be considered in the context of accompanying barriers to the novel shelf-stable food processing technologies and corresponding shelf-stable food adoption, as discussed in the previous section.

Capability required to operate such a facility and other barriers will be discussed more fully in the Supply-chains study under Activity 3, and The Capability Analysis - Activity 5 of the project. Also discussed in these studies will be maintaining the required high-volume feedstock supply for a food processing facility. Some elements of the NT primary sector do have reservations around the supply narrative, these in part could be derived from positions of being ill-informed or misunderstanding of where feedstock could likely be drawn from. The following comments from local primary industry reflect this.

"We all like mangoes. One of the biggest problems, of course, is it's seasonal."

"We are talking about a relatively small industry [NT mangoes]. We produce thirty-one thousand tonnes of mangoes. . It's still only thirty-thousand tonnes [which may not be enough for a mango processing facility]." [Note, this constitutes of first grade fruit, but does not account for out-of-specification produce which is considerable and of low or no value].

"Producers may not want to sell to the plant. Quite happy to continue selling into the fresh produce market. Beef prices currently are sitting at \$5.50 a kilo live weight Buffalo is at \$2.50." [Note: these are live export prices – not manufacturing market prices which are considerably lower. Feedstock supply to a plant is likely to come out of the stock entering the manufacturing meat stream] .

NT producers' lack of familiarity with NT commercial food processing, as well as the new technology, could be inhibiting factors that could impede the supply of raw materials to a proposed food processing facility, due to an unwillingness to change from their proven sales channels. Hence, local industry needs to be fully engaged and informed of key aspects around feedstock supply possibilities in order to gain acceptance of a proposal for food manufacturing.

Common external barriers that could risk investment in an NT food processing facility relate to the Australia Government favouring investment in other states and territories, and appearing unsympathetic in terms of supporting economic development in the NT. Wider market acceptance of foods produced from the new food processing technology could also be barriers, as well as legislation in terms of a lack of shelf-stable food product certifications in some international markets could also serve as impediments. There may also be negative perceptions of the commercial viability of projects in the NT given the failure of earlier food processing plants (typically abattoirs, which is covered in the Supply-Chains study).

The NT's climate and physical environment could also be perceived as 'tougher' than other states and territories. Furthermore, supply chain management in the NT could be a viability barrier, along with the perceptions of comparatively weaker trading networks and routes to market in the NT compared with many other states and territories.

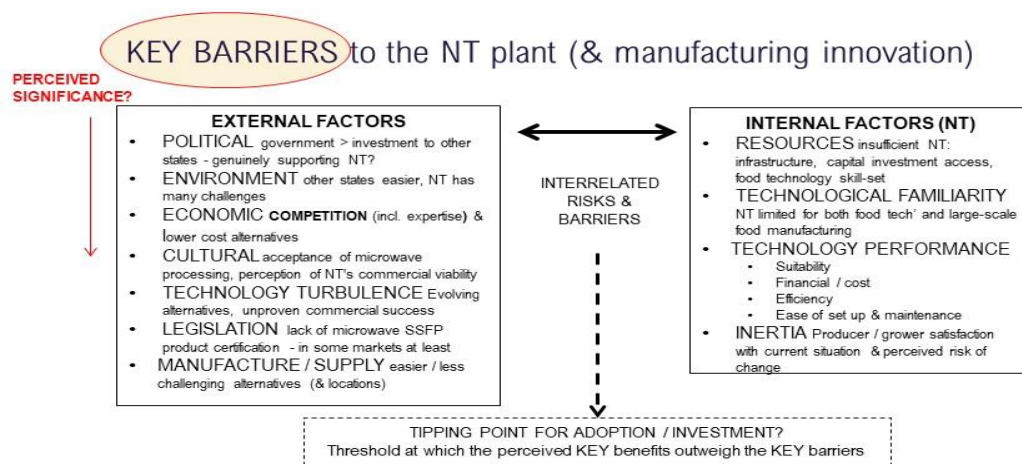
Competition is also likely to be a significant barrier to long-term viability. Key competitors mentioned by this study's industry experts include:

- frozen, processed and packaged food manufacturers (domestic and international)
- Australia's largest supermarket retailers, which are also significant players in food manufacturing
- fresh food producers/growers interested in value-adding to produce
- interstate abattoirs/meat processors
- low-cost importers – if they can bring the same in cheaper
- alternative products (e.g. meat free substitutes).

Given this scale of competition and the fact that the NT is a smaller player in Australian agriculture, seafood and aquaculture, and food manufacturing, it is unlikely to be able to compete effectively on price and economies of scale. Identifying other avenues for competitive advantage is therefore essential, as further discussed in the 'Strategic marketing considerations for NT' section.

Key internal and external barriers to the NT shelf-stable food manufacturing facility are summarised in Figure 2 below.

Figure 2 Key barriers to the NT shelf-stable food manufacturing facility



Source: Stakeholder workshop and literature reviews. Figure adapted from Greenland, Levin, Dalrymple and O'Mahony 2019

3.4.3. Benefits and rationale

To overcome the above-discussed barriers, a deeper understanding of the NT's unique attributes is required, to enable a competitive advantage for shelf-stable food products produced in the NT. The following sections discuss how the benefits of the NT location can outweigh such barriers (see Figure 2), establishing the viability and rationale for NT manufacturing operations, as well as distribution from Darwin.

Strategic national and territory significance

Perhaps the strongest argument for the new NT food processing facility development relates to Australian national and NT jurisdictional strategic priorities. Enhancing Australia's sovereign food processing capability is a key national priority, as is securing the NT's food industry resilience and long-term economic development, while also creating positive sustainability outcomes (e.g. Australian Security Leaders Climate Group, 2022). Enhancing food security via a more resilient national food supply chain will only become more important based on the rising global geopolitical unrest that includes the Russia–Ukraine conflict, as well as increasingly frequent climatic events (Aminetzah et al., 2022).

Australia also needs a healthier, more self-sufficient NT economy if Darwin is to fulfil its important strategic role in the APAC region (e.g. Northern Territory Government, 2022). Without investment and the provision of food processing value-add opportunity, NT agriculture could arguably be vulnerable to numerous market centred perturbations without additional value-adding. Note; this is covered more fully in the NAFTI Supply-chains report. In line with this, the CSIRO (2017, p. iv) reported: “The food and agribusiness (F&A) sector is a vital contributor to the Australian economy and presents a key source of growth for the nation over the coming decades. This growth cannot be sustained through productivity improvements alone.”

The industry experts in this study highlighted that NT food producers have long been crying out for value-add opportunities to grow their businesses, as evidenced in other recent NT food processing facility feasibility studies. For example, KPMG (2020) was commissioned by the NT Government and NT seafood industry to conduct a feasibility study for NT aquaculture and fisheries. The Northern Australia Aboriginal Kakadu Plum Alliance (NAAKPA), a consortium of nine Aboriginal corporations, also recently submitted a feasibility study seeking funding for a bushfood processing facility (revealed during expert interviews conducted for this research).

While the NT has well established beef, fruit, seafood and horticulture production industries, there are limited food processing capabilities. Food producers in the NT therefore lack growth and value-adding opportunities, and are especially vulnerable to the highly volatile commodity markets, including price and currency fluctuations. For example, the NT’s livestock, primary processed meat and horticulture industries rely heavily on export and interstate markets respectively. Both are susceptible to market shocks and international competition.

In addition, NT food producers often have an over-reliance on a small number of international markets (Dalglish et al., 2018). The cattle industry is particularly exposed with a large proportion of the herd going to the live export market (Meat & Livestock Australia, 2021). Media coverage, as well as parliamentary debate, has highlighted animal welfare failures in Australia’s live export trade, and whether this should continue or be replaced with exports of Australian-processed lamb and beef (e.g. Coombs & Gobbett, n.d.) is uncertain in the longer term. Media coverage and political discussion about Australia’s complex relationships and issues with APAC neighbours, including Indonesia (e.g. Tan 2022), complicates this space. Building capability that will provide additional options should access to certain markets falter is critical.

Another political concern relates to the Australian Government not leveraging economic opportunities in the NT. This is despite international investors seeking growth opportunities based on their recognition of the territory’s potential and significance. Yet while such investment is often positively perceived by the NT Government, the strategic significance of the NT in both Australia and the APAC region has raised broader national concerns about the potential conflicts associated with foreign investment and national security priorities. For example, the leasing of the Port of Darwin to a Chinese company for 99 years has come under increasing media attention since the issue was first publicised (e.g. Garrick, 2018a). Such investment has subsequently been linked to China’s Belt and Road Initiative, aligned with its longer-term strategy to gain influence over foreign governments (e.g. Garrick, 2018b).

Local Australian investment in initiatives that enables increased agricultural sector resilience through market and product diversity must be considered in the north of Australia. Creating a more sustainable agri-food industry is also a national priority in Australia, with a reduction in food wastage at the produce source reported as the most significant priority for improving sustainability in food production (Vågsholm et al., 2020). This study’s industry expert interviews confirmed that an NT

food processing facility would provide opportunities for significant food waste reduction across the tropical fruit, seafood and beef industries.

NT location

A Top End NTs location is clearly a unique benefit that differentiates it from other states and territories. Its proximity to other APAC countries means shorter distances to export destinations and therefore more sustainable transportation costs. Such factors will only become more important as global transport and energy costs continue to escalate.

The following travel durations reflect direct travel times from Darwin, which are significantly lower than travel times from Sydney and Melbourne:

From Darwin by air:

- Shenzhen, China – 5h 40m
- Singapore – 4h 30m

From Darwin by sea:

- Singapore – 5 days 6 hours
- Hong Kong – 6 days 13 hours
- Kuala Lumpur, Malaysia – 5 days 19 hours
- Shanghai, China – 7 days 16 hours
- Seoul, South Korea – 8 days 13 hours
- Tokyo, Japan – 8 days 10 hours

Source: KPMG (2020)

A Top End facility location is also likely to be perceived positively in terms of:

- ample available space for future expansion
- established road, rail, sea and airport transport infrastructure
- Darwin's critical role as Australia's APAC defence hub.

Other benefits

Other commonly expressed views from this study's industry experts, in terms of the benefits of an NT facility location, are summarised below:

"The NT has cheap land, or access to high amounts of water; access to large amounts of renewable energy; existing infrastructure; access to Asia."

- Technology innovation and infrastructure development for NT agriculture and manufacturing sectors will fuel further NT investment.
- Value-adding to NT agricultural output at the source will also help to reduce the considerable volumes of waste product, which is currently just discarded.
- There will be greater control, opportunities and rewards for NT producers and businesses.
- There will be opportunities to develop the NT's domestic and international reputation – promoting Darwin as an agricultural and manufacturing hub.
- 'Organic' growth driven from within the NT is essential for sustained economic and employment development.

- The sustainability benefits of NT-produced shelf-stable foods (economic, social and environmental) will lower Australia's carbon footprint (e.g. reduced food miles and no need for cold chain/storage).
- Locally produced healthier long-life foods will also provide benefits for NT residents in the form of jobs and economic development, as well as remote and regional communities in relation to nutritious food accessibility.

NT food brand characteristics

Additional validations for a processing facility located in the NT relate to the range of inherent and unique food brand values and attributes that the territory location impart. These are unique to the NT and therefore could provide distinct provenance advantage over production located elsewhere in Australia, by appealing to customers social, political, economic and environmental values.

These attributes are critical for establishing and informing competitive advantage in terms of marketing, and are further discussed in the subsequent market opportunity report sections relating to specific product types (seafood, tropical fruit and red meat). (Also see Table 11 – Summary of unique NT selling points and key marketing message themes in the last section).

3.5. Potential shelf-stable product types

A wide range of potential products emerged from the industry expert discussions and subsequent data collection phases, in terms of NT-produced shelf-stable food and non-food items. Similar to the identification of broader APAC market potential based on examination of specific countries, investigation into the market opportunity of one food type has been determined as indicative of market potential for a wider variety of shelf-stable food products.

While prawns, barramundi and dried fish maw are NT shelf-stable seafood opportunities, shelf-stable products relating to red meat and tropical fruit are also prevalent. Beef and buffalo are the main red meat product opportunities. Mango, watermelon and Aboriginal bushfoods are the NT fruits that offer the most opportunity.

The main shelf-stable product categories/types are summarised below, with more detailed analysis provided in the subsequent seafood and aquaculture, tropical fruit, and red meat market opportunity sections.

3.5.1. Functional meal ingredients

Ready-to-use, pre-prepared meal ingredients made from NT produce offer strong potential in terms of shelf-stable food.

Functional bulk/high-volume food product ingredients

Functional bulk shelf-stable ingredient products present strong market potential for sales to manufacturers and other organisations involved in both food and non-food production. Common ingredients include:

- Dried mango or meat products.
- processed functional ingredients (e.g. bioactive ingredients/essential nutrients, such as cattle hides turned into collagen powders – hydrolysed collagens for cosmeceuticals).

Bulk/high-volume waste produce ingredients

A value-add product opportunity is addressing the wasted produce, which would predominantly be targeted at the B2B market segment rather than consumers. Such waste product ingredients are:

- mango and fruit juice and pulp
- low-value meat cuts (including trim, bone and offal)
- low-value fish and seafood cuts (including skin, heads, tails and bones)
- vegetable waste unsuitable for sale.

While most opportunity relates to human consumption, there is some bulk waste product opportunity in terms of animal/fish feed and pet food.

3.5.2. Snack and convenience foods

Relevant convenience consumer foods are:

- drinks – small ready-to-drink fruit juices
- snacks – small ready-to-eat snacks.

The range of potential snack food products echoes existing snack ranges available in supermarkets and grocery outlets. There is also potential for mango drinks in terms of NT produce, along with dried beef and fruit straps.

3.5.3. Pet food

Shelf-stable pet food offers potential in terms of lower-quality cuts, offcuts, trims, skins and offal from both meat and seafood. Although the premium segment in this product category means that higher quality cuts should not be excluded (e.g. dry cat and dog treats such as jerky, dehydrated beef liver, and buffalo and chicken jerky) – i.e. premium pet foods for pets considered as family members.

3.5.4. Health, wellbeing and beauty products

A range of health and wellbeing dry powder products, as well as ingredients for cosmetics, offer strong consumer market potential, including:

- protein powder (meat-based)
- nutraceuticals – capsulised plant powders or collagen powders from cattle/buffalo skins
- vitamin C powder
- fruit powders (e.g. mango and Kakadu plum)
- 'indigenous-ceuticals' from First Nations traditional foods – i.e. premium bushfoods such as Kakadu plum that has the highest vitamin C content of any fruit
- ingredients for cosmetics and beauty products (e.g. collagen and Kakadu plum powders).

3.5.5. Ready meals

Ready meals also offer strong market potential, although the type and format varies somewhat based on SKU, size and meal type, as well as the relevant target market. For example, ready meal types vary based on general home use versus consumption out-of-home such as by campers, and use by defence forces and aid/relief agencies versus use by caterers and the food service industry.

Ready meal shelf-stable product variations include whether they are complete ready meals or a key component of a ready meal such as the meat and gravy. Ready meals also differ in terms of whether they are ready to eat or require heating or actual cooking, and whether they are hydrated or rehydrated (i.e. require water to be added) and the reheating or cooking involved, including conventional oven, microwave, stovetop and boil in the bag. The following is a summary of the main ready meal types:

- complete ready meal (ready to eat, ready to heat, ready to cook)
- core component of a ready meal (ready to eat, ready to heat, ready to cook)
- complete rehydratable ready meal (add water and heat or cook, or just add boiling water)
- core component of a rehydratable ready meal (add water and heat or cook, or just add boiling water).

3.6. Potential shelf-stable product customer segments

A wide range of potential customer segments for shelf-stable products were identified from the industry expert conversations and the secondary sources, representing both domestic and international market opportunities, in both food and non-food categories.

Most of the identified product types have potential among both consumer (end-user) and B2B market segments (e.g. manufacturers, food service organisations). Exceptions mainly relate to the bulk ingredients, which are most relevant for B2B customers. The potential customer segments are summarised below:

3.6.1. Consumer market segments

General consumers

- Grocery shoppers (specifically supermarket shoppers)
- Those with busy lives that need convenience food
- Pet owners (mostly dogs and cats)

Consumers with refrigeration and/or transport challenges

- Workers/school children (lunch)
- Mothers requiring baby food
- First Nations communities
- Campers and backpackers
- Travellers
- Survivalists
- Home emergency supplies (e.g. for power outages/cyclones/flooding etc)

3.6.2. B2B market segments

Packaged food retailers

- Supermarkets, grocery and convenience stores
- Pharmacies
- Wholesalers

Commercial food services (catering and hospitality)

- Restaurants, cafes, hotels, bars, fast-food
- Airlines, rail, ferries
- Service stations
- Recreational/sporting facilities

Institutional food services

- Public sector/government organisations (e.g. Australian Defence Force)
- Public schools and colleges

B2Bs with refrigeration/cold chain challenges (including field rations and catering)

- Aid and development organisations (e.g. disaster relief agencies)
- Emergency hospital reserves
- Aged care facilities
- Australian Defence Force
- Government – food store/reserve procurement
- Space industry
- International markets (e.g. Indonesia, Malaysia, Middle East)

Manufacturers

- Packaged food manufacturers
- Ready meal manufacturers
- Convenience snack food manufacturers
- Pet food manufacturers
- Pharmaceutical companies
- Health and wellbeing companies
- Field ration/catering suppliers and manufacturers
- Food service industry suppliers and manufacturers

In the following report sections the market opportunities for the broad food categories (seafood, tropical fruit and red meat), as well as the market potential for specific types of shelf-stable products are examined.

4. Findings and discussion – market opportunity analysis

The second part of this study's findings and discussion provides details of the market opportunities for NT produced shelf-stable products, which are presented in the following sequence:

- APAC opportunity analysis
- seafood and aquaculture market opportunity analysis
- tropical fruit market opportunity analysis
- red meat market opportunity analysis
- strategic marketing considerations for NT shelf-stable products

4.1. APAC opportunity analysis

This section considers the broad market potential for shelf-stable food products in Australia and the APAC region.

4.1.1. Shelf-stable product opportunities

The food types and relevant shelf-stable products that the industry experts believed present most commercial opportunity in terms of NT produce are:

Red meat – beef and buffalo

Meat products (traditional)

Dried meat products (including beef jerky / biltong)

Protein powder and collagen (including nutraceuticals and cosmetics)

Wet and dry pet food (dogs and cats)

Tropical fruit – mainly mango, watermelon and First Nation bush superfoods

Fruit products (traditional)

Fruit pulp
Dried fruit and fruit strips (ingredient and snack items)
Fruit powder (including nutraceuticals and cosmetics)
Fruit juice

Seafood and aquaculture

Fish products (traditional widely available fish and seafood products)
Dried fish products (including fish maw / swim bladder)
Wet and dry pet food (dogs and cats)

FMCG and packaged food

Shelf-stable food made from a variety of ingredients from the above food types, including snacks

Ready meals

Ready-to-eat meals
Dehydrated ready meals
Baby food (wet and dry)

4.1.2. Growth in Shelf-stable NT food products

Demand for food and shelf-stable products associated with NT produce is discussed further in the subsequent food-specific market opportunity sections, while in this section general consumption trends are discussed, in relation to packaged foods.

In both domestic and international markets, there will likely be rising demand across the broad agricultural food types outlined above, as well as for associated shelf-stable products (e.g. FAO IBIS Euromonitor).

While there is variation in market projection figures across the different market research and industry sources, many have highlighted a trend in rising market demand for food and packaged shelf-stable food products across the APAC region including Australia. This is particularly evident across agri-food industry reports from commercial companies such as Euromonitor, IBISWorld, Nielsen and Roy Morgan, as well as from international organisations such as the Organisation for Economic Co-operation and Development (OECD), and the Food and Agriculture Organization of the United Nations (FAO).

This predicted escalation in food and particularly healthy shelf-stable food demand reflects global population growth, predominantly in developing countries, and APAC in particular (e.g. OECD–FAO, 2022), as well as market recovery from COVID-19. Although such projections were largely influenced by consumption trends observed before the Ukraine/Russia conflict and its associated economic fallout.

As illustration of demand growth, FMCG value sales have generally risen in APAC markets since the COVID-19 pandemic (see Table 3).

Table 3. FMCG value sales % change between 2019 and 2021, APAC

Country	FMCG value sales – % change 2019 vs 2021
Singapore	14.0
India	13.8
Australia	13.3
New Zealand	11.1
Taiwan	7.3
Indonesia	6.7
China	6.4
South Korea	2.4
Malaysia	2.1
Philippines	- 5.0
Vietnam	- 6.0
Thailand	-11.7
Hong Kong	-22.6
Myanmar	-35.4

Source: Adapted from Nielsen (2022)

The poorer FMCG sales performance in some APAC countries, such as Vietnam, has been attributed to later COVID-19 waves that delayed economic recovery. Although there are still growth forecasts for these countries, with market research and industry reports highlighting the strong market potential of Australia's neighbouring countries. This was echoed by the industry experts in this study, who highlighted future commercial opportunities in Indonesia and Vietnam in particular.

Vietnam has been flagged by the Australian Government as offering significant future growth potential for Australian businesses based on its burgeoning middle class and ecommerce (Australian Trade and Investment Commission, 2022). Vietnam also demonstrates strong projected demand growth for packaged and shelf-stable food where "convenient meal solutions such as ready meals and products with a health slant ... will benefit from growth in the coming years" (Euromonitor International, 2021a, p. 13).

According to the Department of Foreign Affairs and Trade (2022b), by 2050 Indonesian per capita consumption of food commodities like beef is predicted to be greater than China. In line with this, key considerations and opportunities for Australian food exporters include:

- The Indonesian Government's food security priority in their economic development plans, including stabilising prices for consumers and producers.
- The IA-CEPA agreement (Department of Foreign Affairs & Trade, n.d.) means that 99% of Australian agricultural products can now enter Indonesia duty free and/or under improved trade terms.
- A better understanding of Indonesian regulatory requirements in relation to food imports can be obtained by partnering with a local distributor/importer.
- Provision of quality, premium, healthy and safe food products, for which Australia is well known for, targeted at the rising Indonesian middle class.
- While traditional markets and small grocers dominate Indonesian food retail, modern retail channels are emerging, including supermarkets and ecommerce.
- Indonesian consumer trends include a growing demand for convenience and packaged goods, which include shelf-stable products.
- Halal food is a key marketing consideration, as almost 90% of the Indonesian population is Muslim.

In the broader APAC region, an escalation in FMCG demand (of which shelf-stable products are part of) has been predicted for Australian-made goods due to their higher-quality associations. This will be

facilitated by the Regional Comprehensive Economic Partnership (RCEP) that complements existing free trade agreements with 14 Indo-Pacific countries, and is expected to support Australian exporters (e.g. OECD–FAO, 2022).

Among the APAC FMCG categories, packaged food and other food/agricultural-produce-derived goods were reported by the global market research agency Nielsen (2022) to have experienced some of the highest sales growth rates (see Table 4).

Table 4. Value sales % change between 2019 and 2021 for NT produce-related FMCG categories, APAC

NT produce-related FMCG categories	APAC value sales growth rates – % change 2019 vs 2021
Packaged food	14.6
OTC & health supplements	18.5
Petfood & care	27.6

Source: Adapted from Nielsen (2022)

The steady growth in packaged food sales in the APAC region includes shelf-stable products such as ready meals and dried baby food. There has also been significant growth in demand for packaged cooking ingredients, such as ‘meal kit’ items (Euromonitor International, 2021a, p. 34), reflecting “the increased demand for convenient meal solutions by time-constrained consumers” in the APAC region (Euromonitor International, 2021a, p. 5). Eilert’s (2005) prediction of growing global demand for more convenient shelf-stable food has therefore been realised, fuelled by an aging population, the lower-level cooking skills of the average consumer, and the increasingly busy lives of these consumers, which has reduced their time available for meal preparation.

Global shelf-stable food consumption has also increased since the COVID-19 pandemic, with supermarkets experiencing a boost in shelf-stable grocery sales across all food types (Hamstra 2020; Kazarian, 2020). Industry reports have highlighted that this growth in shelf-stable food consumption primarily relates to the prioritisation of those products considered healthier, including those claimed to boost immunity (Euromonitor International, 2020). There has been a shift towards consumers demanding healthier shelf-stable foods and particularly those that are produced in a more sustainable manner.

Although price considerations should also be factored into any APAC marketing strategies of shelf-stable foods, based on the following assumption: “Products claimed to boost immunity will gain appeal. Yet as consumers trade down (in times of economic hardship), value for money will matter more; even within new health-oriented propositions” (Euromonitor International, 2020, p. 43).

In terms the marketing of NT shelf-stable processed meat, fruit and seafood products, there has been a rise in Australian consumer interest in food provenance, based on growing demand for product sourcing information. Australian consumers are increasingly supportive of local businesses that prioritise local production and local sourcing of ingredients. Such consumer demand can also be leveraged by NT-produced shelf-stable-foods.

Further detail of the opportunities for shelf-stable products made from the NT’s fish and seafood, tropical fruit and red meat produce, based on growing APAC market demand, is provided in the subsequent sections.

4.2. Seafood and aquaculture market opportunity analysis

4.2.1. Market overview

According to OECD–FAO (2022), demand-driven global fish and seafood production volumes (both capture and aquaculture) will increase by 14% between 2020 and 2031, an annual growth rate of 1.2%. Other market research and industry reports also predict market growth for the global fish and seafood market. For example, Million Insights (2022) has predicted a compound annual growth rate (CAGR) of 3.3% from 2021 to 2028. This has been attributed to rising consumption of fish and seafood in both developed and developing countries, based on population growth and increasing consumer awareness of the associated health benefits.

In Australia, fish and seafood market growth has been forecasted as 3% volume CAGR from 2021 to 2026 (Euromonitor International, 2022b).

Based on growing consumer demand for fish and seafood, the importance of aquaculture is increasing globally, and is expected to overtake captured fish and seafood production in 2023. This is despite consumers still having a stronger preference for wild-catch fish and seafood. It is anticipated that by 2031, aquaculture will account for well over half of total seafood production. In terms of seafood species, strongest production growth globally is expected for prawns and shrimp (+31%) and tilapia (+25%), with carp remaining the most widely produced fish.

Processed fish and seafood

Processed fish and seafood sales are growing across the APAC region. For example, Euromonitor International (2022c) has forecasted that shelf-stable seafood sales values will rise across APAC markets between 2022 and 2027 at a CAGR of 4.4%. In Australia, shelf-stable seafood sales values are also expected to rise between 2021 and 2026, at a CAGR of 2% (Euromonitor International 2021b). The opportunity for the north of Australia could lie with sustainable use of species presently not being utilised in the current fisheries business, as well as waste products from primary stage processing (e.g. tails, heads, frames etc). This is more fully discussed in the Activity 3 Supply-chains report.

4.2.2. NT opportunities

In terms of potential profitable market opportunities for NT fisheries, a scoping study of a Darwin seafood processing facility was previously conducted by KPMG (2020). This highlighted Darwin's ideal location to meet growing APAC market demand for high-quality fish and seafood products. It also confirmed the unique offerings of Darwin and the NT in terms of fish and seafood species, based on consumer perceptions of the benefits of wild-catch fisheries, which make up most of the NT's seafood production. In particular, strong market opportunities were confirmed in relation to domestic and/or international market demand for the following local fish and seafood species:

- barramundi
- mackerel
- goldband snapper
- prawns
- terpeng
- black jewfish
- pearl meat
- shark.

In Darwin and the NT, the market potential and intensifying demand for high-value dried fish maw, or swim bladder, was also reported by KPMG as a strong opportunity.

The interviews conducted with key informants in the NT's fisheries sector confirmed the KPMG findings, highlighting the need for a local processing facility to enable the local fish and seafood industry to develop. They also confirmed the significant market opportunity presented by fish maw, as well as the need for a more regulated approach to manage the 'shady' trade of this lucrative product. These industry experts identified a variety of potential shelf-stable foods in terms of NT fish and seafood, including snacks and ready meals. Seafood and fish offal including skins was also recognised as offering significant commercial opportunity in terms of pet food (see 'Red meat market opportunity analysis' section for further discussion on pet food opportunities). The following sections provide further insights into the potential of high-value dried fish and seafood products, particularly fish maw.

4.2.3. Dried fish and seafood

Howieson et al. (2013) provided a comprehensive evaluation of the APAC market potential for dried fish and seafood. While only modest amounts of dried fish and seafood are produced in Australia, there is significant consumer demand in the wider APAC region, with many markets outstripping supply. Furthermore, as many dried seafood products are considered delicacies, this is a lucrative opportunity for premium pricing.

The drying of undervalued and/or underutilised local NT fish and seafood, to produce highly valued shelf-stable products, presents significant market opportunity. The following section examines the most lucrative dried fish product, fish maw, which implies further potential market opportunity for shelf-stable food using a wider range of unique dried NT fish and seafood.

Fish maw

A luxury food item in China and South-East Asia, fish maw is the internal gas-filled swim or air bladder found in most fish (Sinthusamran et al., 2013). While cooked fish maw has a bland taste, it is considered to have therapeutic health benefits, including medicinal and as an aphrodisiac.

Dried fish maw attracts premium prices as a delicacy, and its production has continued to escalate based on growing demand from Hong Kong and China in particular. This has influenced the depletion of global marine resources through overfishing, particularly in regions where fishing regulations are not as strong, such as in Africa and South America (e.g. Hui & Reed, 2022; Sadovy de Mitcheson et al., 2019).

A recent study investigated maw US\$/kg prices across various fish species and global locations. While the mean price was US\$72/kg, there was significant variation in pricing, with the most sought after totoaba and black-spotted croaker fetching prices up to US\$8,000/kg and US\$2,299/kg respectively (Ben-Hasan et al., 2021).

Choo et al. (2016a, 2016b) defined fish maw quality and price parameters as follows:

- Species – A large range of fish are used as fish maw, including varieties of croaker, carp, snapper, cod, ling, seabass/barramundi, sturgeon and tuna (e.g. Kaewdang et al., 2014; Sinthusamran et al., 2013).
- Colour – good fish maw has to be yellow, and the richer the colour the higher the price.
- Age – older fish are considered to provide maw that is less oily and fishy in taste.
- Size – larger (size and thickness) fish maw are highly prized, based on fish species as well as gender (i.e. male fish tend to be bigger).

Species is the key determinant of price, with the NT's black jewfish and barramundi considered to offer the greatest fish maw opportunity. While KPMG (2020) reported prices of US\$500-900/kg for black jewfish maw, the NT fisheries experts in this research suggested prices in the thousands of dollars for the highest quality dried black jewfish maw, particularly in the lucrative Hong Kong market.

Marketing insights

The online retail audits of prices and characteristics of dried fish maw sold from Australia and New Zealand, and other APAC markets, provided insights into the marketing of fish maw. A convenience sample of retail websites selling dried fish maw revealed that it is most commonly sold in 250g, 400g, 500g and 1kg pack-size options. The packaging is generally plastic pockets or sachets, which are either clear or at least have a clear window that enables the inside product to be viewed (e.g. New Zealand Coastal Seafoods, n.d.).

There was a range of prices observed across the Australian and New Zealand retail websites, from around \$500/kg to \$1,280/kg (see Table 5). Different grades or quality of fish maw relate to the product size. For example, HealthyNest Australia (Limited) had three grades of fish maw based on size, with the New Zealand pink ling 500g pack options including:

- extra-large: 4-5 pieces \$490.00
- large: 5-6 pieces \$438.00
- medium: 7-11 pieces \$390.00.

Higher prices were also observed for some premium species, such as on a Malaysian site where black jewfish maw was sold for around \$1,500/kg (chaihuathin, n.d.).

Table 5. Dried fish maw – pack size and pricing indicators

Price band	\$/kg	Pack size	Price* \$	Type/grade**	Manufacturer/retailer website
Mid	750	250g	187.50	Fish maw	Tas Live Abalone (https://tasliveabalone.com.au/product/fish-maw/)
Mid	780-980	500g	338.00 to 459.00	New Zealand pink ling (medium, large, extra-large)	HealthyNest Bird's Nest (https://www.healthynest.com.au/shop/new-zealand-ling-fish-maw-500g/)
High	1,280	1kg	1280.00	Fish maw / fish tripe – A grade	Chinese Herbs Online (https://www.chineseherbsonline.com.au/)

*Web prices change regularly in line with currency fluctuation

**Some retailers specify fish species, country of origin and/or grade, others do not

Source: Convenience sample from online retail audits (Sept/Oct 2022)

Other marketing information captured during the retail audits emphasise the importance of fish maw quality. In some instances, the fish species was specified as the quality parameter, and in others the country of origin (source) was specified. In line with this, Matchless Food (n.d.) described its ling maw as follows:

“New Zealand is regarded as one of the purest environments on earth. A place of abundance; of untouched beauty and precious natural resources. From this pristine setting we source freshest, wild-caught ling fish – using innovative techniques and sustainable methods to create premium dried ling maw.”

New Zealand Coastal Seafoods (n.d.) also emphasised sustainability as a quality parameter in its ling maw description:

“Sustainably-sourced: New Zealand has an industry-leading quota management system to support sustainable fishing, which means only a small number of ling fish are able to be caught each year.”

Despite such claims, Ben-Hasan et al. (2021) highlighted that a comprehensive understanding of the global fish maw market and its value is lacking. Sadovy de Mitcheson et al. (2019, p. 818) similarly described the global fish maw trade as “secretive and not well understood”, and suggested better regulation was required to resolve issues, such as illegal trade and overfishing. The same concerns, including the criminalisation of the industry, were echoed by Hui and Reed (2022) who focused on Brazil’s booming fish maw trade.

The Darwin fisheries’ industry sources expressed similar opinions, with respect to Darwin’s lucrative grey-market fish maw trade, which if left to its own devices is at risk of “criminal take-over”. A Darwin fish and seafood processing facility that bought the local fresh fish maw would help to counter such issues including illegal fishing in NT coastal waters, and create a more legitimate fish maw trade with Hong Kong and China.

To better inform the marketing of Darwin fish maw shelf-stable products, additional research should be conducted to further understand Darwin’s (and Australia’s) fish maw trade, market opportunities and corresponding product marketing in Hong Kong and China via further retail audits and interviews.

4.3. Tropical fruit market opportunity analysis

In 2020/21, the NT produced 54% of Australia’s mangoes (27,627 tonnes) and 25% of its watermelons (28,744 tonnes) (Hort Innovation, 2022). The NT also has a significant bushfood industry, which includes NT-native tropical fruits such as Kakadu plum that attract a premium price (Northern Australia Aboriginal Kakadu Plum Alliance, 2022). While the tropical fruit market opportunities discussed in this section primarily relate to mangoes, watermelons and NT bushfoods such as Kakadu plum are also considered.

There is currently only limited processing of tropical fruit in Darwin and the NT, such as small-scale drying facilities, and the more basic cutting and wrapping of watermelon slices in preparation for fruit salad products and juices (e.g. Plant Health Australia, 2022).

The value-add potential from turning NT tropical fruit, mangoes in particular, into shelf-stable products is particularly appealing. The high perishability of some NT tropical fruits means that there is a large volume of wasted produce. Bushfoods like Kakadu plum are as perishable as mangoes, which means there are limited future growth opportunities without a local food processing facility. This is why the NAAKPA recently conducted a feasibility study to obtain funding for a bushfood processing facility involving more conventional technologies (as discovered during the interviews with industry experts).

4.3.1. Tropical fruit processing opportunities

There are a range of shelf-stable NT tropical fruit formats that offer strong market potential, including juice, puree or pulp, wet or dry whole fruit or fruit pieces, rolled fruit straps or leathers, as well as dried flakes, crisps, chips and powders.

Shelf-stable fruit products are viable for both consumers in the form of ready-to-eat or ready-to-use food, snacks and ingredient items, and for manufacturers in the form of functional bulk ingredients. For example, mango and Kakadu plum offer important food manufacturing applications based on their properties such as high vitamin C level, flavour and fragrance. These products can therefore serve the demands of manufacturers and consumers in the context of a wide range of foods, as well as health and wellbeing, and beauty and personal care products.

Although the industry experts in this study highlighted that any NT-produced shelf-stable tropic fruit products will need to provide a clear advantage over fresh fruit and other fruit products that are already available:

“The issue with mangoes and many other fruits is not to try and replicate fresh. The processing technologies you want to have products which are not trying to compete directly with fresh. With something like mango, you need to get it into a one fruit health serve format that people will want. And it might be sugar-free gelato; or it might be a low sugar, ready-to-use breakfast food.”

It is particularly important to establish a sustainable competitive advantage for the new shelf-stable fruit products, given the declining sales of processed fruit and vegetable in Australia. Oo (2021) recently reported that Australian processed fruit and vegetable sales have been flat, with a -2.1% annual sales revenue decline predicted for 2012–2026. This reflects intensifying import competition, as well as growing health-consciousness and demand for ‘clean’ foods free from sodium, artificial colouring and preservatives.

NT shelf-stable tropical fruit products can take advantage of these healthier consumption and lifestyle trends, which also include the growing demand for vitamins and supplements, and products for the beauty and personal care categories.

Vitamins and supplements

In an overview of Australia’s vitamins and supplements category, Richardson (2022) reported the following segment sales breakdown:

- health and wellbeing 65.5%
- sports and active nutrition 25.5%
- weight management 9%

More than half (54.6%) of Australia’s total value of vitamins and supplements category sales values are derived from exports. An annual sales revenue growth rate of 3.4% is predicted between 2022 and 2027. This is primarily driven by strong demand among APAC consumers, willing to pay premium prices for Australian vitamins and supplements that are considered to be higher-quality compared with those produced in many other countries.

Protein-powder-based products make up a substantial part of the sports and active nutrition and weight management segments. For example, gym-goers often use protein powders for muscle growth and recovery, while protein bars and shakes help consumers manage their weight. NT red meat could help to fill this growing demand for protein powder products, with NT tropical fruits potentially providing additional flavourings and health benefits.

Bushfoods and other tropical fruits also offer a range of opportunities for use as functional ingredients in a wide range of health and wellbeing products, such as vitamins.

Beauty and personal care

The growing beauty and personal care category also provides potential opportunities for NT produce. This includes collagen powders from red meat, as well as mango, Kakadu plum and other tropical-fruit-based functional ingredients that impart desired properties to a range of products such as:

- cosmetics
- hair care
- skin care
- soaps, bath and shower.

The beauty and personal care category is booming in the APAC region, with Euromonitor International (2022 – Beauty and Personal Care in Asia) predicting year-on-year retail sales growth of 9.2% between 2021 and 2026. APAC players with the highest market shares include L'Oréal, Procter & Gamble, Estée Lauder and the Unilever Group. Australia's year-on-year retail sales growth in the beauty and personal care category has been estimated at 4.8%, and is even higher for sales of baby- and child-specific products. While L'Oréal Australia is the biggest provider of beauty and personal care products, a significant proportion of market sales are driven by a large number of Australian SMEs.

4.3.2. Mangoes

Market overview and opportunities

The escalation of mango production by growers in Thailand, Vietnam and the Philippines, which are closer to most APAC markets, has meant that Australian producers are facing tougher competition. Yet even though Australia's annual growth of mango production has consequently stagnated between 2016 and 2021 (-1.1% annual growth), 2.1% annual growth has been predicted between 2021 and 2026 (Baikie, 2021), due to the innovative processing technology for diversifying mango products. This has the potential to boost profit margins and export of shelf-stable products over the next five years.

Despite such market challenges, most of the industry experts in this study considered mangoes to offer strong potential for shelf-stable products because of:

- the established NT mango industry with a lot of waste
- the reputation of NT mangoes in terms of best quality and flavour
- strong domestic market demand
- their ability to serve both consumer and manufacturer segments.

“We are talking about a relatively small industry. We produce around thirty-thousand tonnes of mangoes, and there might be nearly that much of waste mangoes too.”

The shelf-stable food processing of mangoes has been determined as essential if mango exports are to expand in APAC and beyond, by helping Australian producers to compete on the basis of their value-added mango products (e.g. Akbar et al., 2020).

“You could be making dry products that could be added to your breakfast cereal, and you could have an ingredient that you can be transported to any food manufacturer. You can go to your breakfast companies, and the like.”

Potential shelf-stable mango products include:

- fruit ice-cream, gelato, sorbet, yoghurt
- smoothies and shakes
- dried fruit pieces (as an ingredient, but also ready-to-eat)
- juice
- dry fruit straps (snack)
- powder for drinks, but also as ingredients for nutraceuticals, beauty and personal care, and other products.

Although some of the potential challenges associated with producing shelf-stable mango products include:

- highly seasonal availability of mango produce
- difficulty in acquiring mango pickers for harvesting
- limited international export market and strong APAC competition that produces cheaper mangoes
- current health trend away from fruit and juice because of high sugar content
- transportation issues – mangoes have to be picked green and flavours can deteriorate during transport and while in storage
- waste mango bulk ingredient processing being unrealistic due to production costs and maximum 2kg pack size for the new microwave-assisted processing technology.

“With mangoes here, we have tens of thousands of tonnes of mango, but it comes all at once and then it stops.”

“Vietnam, Philippines – they produce huge amounts of bulk mango, so you’ve got to be able to differentiate it.”

“The key things around juices is at the moment are they are high in sugar, and you know the movement away from having juice because of the sugar.”

Marketing insights

APAC competition highlights the need to add value and to differentiate Australian mango products. For example, dried mango and powder products offer premium pricing potential.

The retail audit showed that compared with frozen mango pieces, dried shelf-stable mango products can attract much higher prices. For example:

- organic frozen mango pieces \$20/kg (e.g. Woolworths Macro brand)
- organic fruit strap \$42.00/kg (e.g. Fruit Wise Apple, Mango and Passionfruit 14g)
- organic dried mango pieces \$80/kg (e.g. Just About Foods Organic Dried Mango Diced Lunch Packs 28g)
- mango fruit powder \$123.34/kg (e.g. Indus Farms Superfoods Mango Fruit Powder 227g)
- dried mango crisps \$213.33 /kg (e.g. Frisp Mango Crisps 15g).

Typical packaging and website marketing messages include:

- 100% natural
- 100% fruit
- 100% Australian
- non-GMO

- no artificial colours, flavours, preservatives, fillers
- allergen free
- organic.

Previous research into consumer preferences for dried tropical fruit and mangoes could also assist in the production and marketing of NT shelf-stable mango products (e.g. Sabbe et al., 2009; Sulistyawati et al., 2020).

4.3.3. Kakadu plum (bushfood)

While Kakadu plum offers the most potential, according to the industry experts in this study, there are many other native NT bushfoods that could also offer potential, including green plum, red bush apples, lemon myrtle and native wattle. Another is the beauty leaf tree that is common in the NT, which could be an ingredient for cosmetics and skin care products.

Market overview and opportunities

Sharing the name of the NT's most famous national park (Kakadu), the Kakadu plum is a native fruit that is one of the world's richest natural sources of vitamin C. Australia's First Nations people have been using it for tens of thousands of years for both medicine and as a food source (Lim, 2019).

Market demand for Kakadu plum has intensified both domestically and internationally. As illustration, on the Australian manufacturer G&M Cosmetics website (<https://gandmcosmetics.com.au/>) that sells a Kakadu plum range of skincare products, the strong and rising demand for these products in Asia, including China and Vietnam, has been highlighted. However, this demand has often outstripped supply, especially now that beauty and personal care manufacturers recognise the benefits of Kakadu plum products (Lim, 2019). This has also corresponded with a rise in fake Kakadu plum products appearing in the market.

NT Kakadu plum production is often conducted via wild harvest by First Nation community organisations, including the NAAKPA. These social enterprises incorporate their traditional Aboriginal cultural values and sensitivities into the production process (IP Australia, n.d.). With the exception of a plantation created at Wildman River (Wild Harvest NT), there are no significant plantations of Kakadu plum under non-Indigenous ownership in the NT (Gorman et al., 2020). The local Indigenous social enterprises are therefore now competing with Wild Harvest NT.

NT Kakadu plum production estimates vary, with overall annual output estimated at somewhere between 40 and 70 tonnes. It often varies from year to year. For example, one NAAKPA consortium corporation member can produce up to 10 tonnes annually, but their output is weather dependent. Recent production output has also been negatively affected by community unrest that disrupted harvesting (e.g. ABC, 2022).

The costs of wild harvest production are also high in terms of labour and storage. Kakadu plums can deteriorate within 24 hours, so they have to be frozen within this short time period, which is costly. One industry expert interviewed in this research estimated the freezing cost at approximately \$2/kg of fruit, and indicated that they had been experimenting with a natural spray-on preserve that can extend product life by two weeks.

To address such storage and supply chain issues, Kakadu plums are often processed into powder products, with one industry expert citing a sale price of between \$310 and \$490/kg. Although Kakadu plum pulp or fruit puree is a more premium format, based on its wider applications such as on the basis of vitamin content. For example, while frozen Kakadu plums attract a wholesale price of

around \$30/kg, the price can be up to \$200/kg for seed-free plum puree required by cosmetics manufacturers, which is prepared using a no-heat treatment to preserve the high vitamin C content.

In terms of production, it is estimated that around 10kg of Kakadu plum produces the equivalent of 7kg pulp or puree, or around 1kg of powder (seed free). There is a higher return if you pulp or powder whole fruit, but this also produces woodier and therefore poorer quality puree.

The new microwave-assisted food processing capability to produce shelf-stable Kakadu plum products presents significant potential in terms of cost savings and convenience, especially for pulp/puree formats by removing the need for cold chain storage. Although it would first need to be considered whether the new technology could negatively affect the product's health properties.

Marketing insights

Concerns raised by one industry expert about whether the new processing technologies would impair the health benefits of corresponding shelf-stable products (e.g., using microwave assisted processing), is clearly an important market perception issue that requires further attention to dispel misconceptions.

The retail audits can also inform Kakadu plum marketing in terms of product types and specifications, pricing packaging and pack size, as well as marketing communications. These identified that Kakadu plums are already in a wide range of product categories, including:

- processed grocery food items (e.g. Native Oz Bushfood's Kakadu Plum Mango Passionfruit Dessert Sauce, Blue Frog's Kakadu Plum Granola, Kettle's Kakadu Plum & Australian Aged Cheddar Chips, Nestlé Nescafé Nativ Nascara Kakadu Plum Infused Drink)
- pet food (e.g. Talentail Adult Dog Chicken & Brown Rice with Kakadu Plum Dog Food)
- health and beauty products (e.g. Melbourne Bushfood Kakadu Plum Capsules, Bliss Essentials Kakadu Plum Liquid Extract for cosmetics, skin & hair care).

The retail audits also revealed that Kakadu plum powder is widely available via online purchasing, from Aboriginal social enterprises, as well as Australian wholefood and skin care companies.

- Bulk-pack Kakadu plum options, presumably targeting businesses, are available, such as 20kg Kakadu plum powder packs (\$24,750) from New Directions Australia, and 100kg+ orders at \$700/kg from Mayi Harvests. Mayi Harvest also sold frozen whole Kakadu plums at 3kg (\$150) and 5kg (\$250). A wider variety of smaller Kakadu plum product and pack size options, presumably targeting consumers, are also available, such as NAAKPA's selling whole freeze-dried plums at 50g (\$30) and 300g (\$120).
- Smaller Kakadu plum powder pack sizes range from less than 10g up to 1kg. While most powders are packaged in bags, jars are also used for some of the smaller sizes, such as Mercedes Cove's Wild Gubinge Powder 25g jar (\$32). Smaller pack sizes carry a price premium. For example, Roogenic Kakadu Plum powder 7g pack price is equivalent to \$1,421.428/kg. Larger pack sizes provide better value with 1kg packs retailing for around \$400 to \$500/kg.

The following Kakadu plum pack sizes and prices from selected Australian social enterprises and specialist retailer websites provide further insights:

Table 6. Examples of Kakadu plum powder pack size and price options

NAAKPA	Australian Superfood Co.	Kakadu Plum Co.	Kaiyu Superfoods	Mayi Harvests	Roogenic Australia
30g \$20.95 100g \$60.00 500g \$257.00 1kg \$412.00	30g \$25.00 80g \$55.00 250g \$160.00 500g \$310.00 1kg \$495	45g \$25.95 250g \$160.00 500g \$310.00 1kg \$495	10g \$10.99 30g \$31.99	50g \$50 100g \$100	7g \$9.95 30g \$44.00

Common themes used for marketing Kakadu plum powders on retail websites and product packaging include:

- 100% wild harvested
- sustainable and ethical supply
- supports Aboriginal communities
- traditional owner harvested
- native Australian bush superfood
- certified organic
- 100% pure and natural
- nature's vitamin C
- biodegradable packaging.

Social enterprises involved in the Kakadu plum harvest emphasise the authentic Aboriginal provenance of this product, including traceability back to the specific community source. These organisations also stress the connection to country and that includes the Aboriginal nurturing and management of the environments where Kakadu plums and other native foods grow, and that associated sales empower Aboriginal enterprises and families, and contribute to the overall wellbeing of communities. Such Aboriginal connectivity, genuine provenance and traceability have also been highlighted by other researchers as key marketing elements (e.g. Restom, 2021).

Some existing products also specify what part of the Kakadu plum the powder is made from. For example, those made from the whole fruit (seeds and flesh) versus the fruit without the seed. An industry expert in this study indicated that Kakadu plum powder (and pulp) made from the fruit only is higher grade and therefore has the potential to attract higher market value.

4.4. Red meat market opportunity analysis

The red meat market opportunities discussed in this section primarily relate to beef. While this is the main meat produced in the NT, there is also some consideration of buffalo. In the context of shelf-stable meat products, the primary focus is on traditional processed meat products such as beef jerky/biltong, protein powders and collagen (nutraceuticals), and wet and dry pet food wet (for dogs and cats).

4.4.1. NT opportunities

This study's industry experts believed that beef offers the most potential among NT produce as a feedstock source for the NT processing facility because:

- NT has a long-established cattle industry that offers a sufficient supply of raw product throughout the year.
- There is existing meat processing infrastructure – abattoirs at Batchelor and Livingstone.

- There is significant red meat demand, especially internationally, including strong and growing demand for protein powder and premium pet food, which provide opportunity to develop a diverse range of high-demand shelf-stable products from NT beef.

“Sixty-five percent of the world are lactose intolerant, and for all of those whey proteins aren’t suitable. You take meat powder on the other hand, and you create a product there that could be soluble and go into anything – you’ve just got to get around some of the issues with solubility, and flavour, and so-forth. But you do that, and you capture an incredible market opportunity because there are virtually no allergies to meat, and it has the perfect nutritional profile. If you look at the demographics you want to hit, it’s your athletes ... to the elderly who have muscle loss ... and you can start to create all sorts of products from these (beef products).”

Although the high beef prices based on a booming market could mean that pastoralists may not be interested in moving away from their current lucrative channels to market (i.e. to supply the food processing facility).

4.4.2. Market overview

According to OECD–FAO (2022), red meat demand is weakening in high-income countries, with a shift to white meat and meat-free alternatives in many developed markets (including Australia) due to perceptions around animal welfare and public health, and the perceived health benefits of a non-meat diet. Although it is estimated that population growth across emerging markets of around 10% over the next 10 years will drive 15% growth in global meat consumption by 2031 (OECD–FAO, 2022).

Table 7. Global production and demand by main meat types

Meat	2021 weight (1,000 kt cwe)	%	2031 weight (1,000 kt cwe)	%	% weight increase 2021– 2031
Beef and veal	70.6	21.44	76.4	20.25	8.22
Pig meat	110.6	33.59	128.9	34.16	-
Poultry	132.5	40.24	153.9	40.79	-
Sheep	15.6	4.74	18.1	4.80	-
Total	329.3	100	377.3	100	14.58

Source: Adapted from OECD–FAO (2022 – ANNEX C Table C.4)

As shown in the above table, the global meat trade is dominated by poultry in terms of volume (40.24%), compared with beef and veal (21.44%). While the proportion of beef and veal of total production is predicted to decline slightly to 20.25% by 2031, this still represents an increase of 8.22%, given the anticipated overall growth in meat production from 70.6 to 76.4 million tonnes.

Other commercial industry reports predict even higher market demand growth rates for meat. For example, Euromonitor International (2022d) has predicted 3.6% year-on-year growth in total meat sales volumes up to 2026, with year-on-year growth of over 2% predicted for beef and veal.

While beef and veal represent only around 20% of the global total meat produced and consumed, it dominates in terms of value. For example, it has been estimated that by 2031, beef and veal will account for more than half of the total meat trade value, with the largest growth in import demands coming from China, Indonesia and Korea (OECD–FAO, 2022). As one of the leading beef exporters, FAO (2020) has estimated that Australia’s output accounts for 10.2% of global bovine exports, behind the largest exporters that are Brazil, the USA and India.

Australia's top three beef export destinations (in volume terms) have been Japan (26% of total exports), USA (20% of total exports) and China (19% of total exports) (Meat & Livestock Australia, 2021). As beef production is expected to expand in other countries such as the USA, India, China, Canada, Uruguay, Pakistan and Paraguay (FAO, 2020), Australian beef producers will face more competitive pressure. This may mean that beef producers in other Australian states and territories ramp up their efforts in targeting markets that the NT beef sector currently focuses on, such as Indonesia. A key opportunity for competing in the increasingly competitive market and to increase revenues over the next five years is by value-adding to beef via new processing technology (Wheeler, 2022a).

Buffalo opportunity

In terms of other NT red meats, some of this study's industry experts highlighted that buffalo presents an opportunity (camel was also mentioned).

While global buffalo meat production is only around 4-5 million tonnes per year, with most produced in Asia, it has grown by 24% since 2000 (Di Stasio & Brugiapaglia, 2021). Globally, buffalo meat has gained in popularity due to perceived beneficial properties – it is perceived as one of the healthiest of red meats, due to reduced fat and cholesterol content (Kandeean et al., 2013). As an Australian producer, the NT is well placed to serve this customer segment given its ability to offer a quality-assured product, produced under robust industry standards compared with many of its APAC rivals (Foulkes et al., 2015).

Globally, while many consumers are not familiar with buffalo meat and some view it unfavourably due to its perceived toughness, consumer testing research has found positive acceptance of buffalo meat in terms of flavour, colour, succulence and tenderness (Marques et al., 2016). Its health properties may also make it an ideal source for protein powder.

There is considerable opportunity to utilise buffalo as a manufacturing meat feedstock for production of a wide range of human or petfood related products.

4.4.3. Processed meat

Processed meat sales are growing across the APAC region. Euromonitor International (2022c) has estimated that APAC shelf-stable meat sales will rise at a CAGR of 2.9% between 2022 and 2027. Although in Australia, based on the shift to meat-free alternatives, shelf-stable meat sales are expected to drop slightly by a CAGR of -0.7% between 2021 and 2026 (Euromonitor International, 2021b). Wheeler (2022a) also highlighted that Australian processed red meat sales are gradually declining, as consumers have grown more health-conscious about their food choices and are seeking alternatives to red meat.

Nevertheless, many Australians continue to be regular meat eaters, and there has been rising market interest in understanding more about meat provenance that enables consumers to make ethically informed choices in terms of the impact on the environment and society. Australians have become increasingly supportive of local businesses, local production, as well as production methods that are sustainable and ethical. Such local consumer trends can prove beneficial for the NT shelf-stable meat products.

Additionally an opportunity exists to produce superior shelf-stable red meat products than what Australians and particularly northern Australians can currently access. Australia though a recognised leader in red meat production, does not have a strong repertoire in producing shelf-stable meat products.

Marketing insights

The retail audit of beef has identified a wide range of traditional beef products that offer potential for shelf-stable products using the new microwave-assisted food processing technology. These include all traditional fresh beef products as well as many existing shelf-stable beef offerings – see Figure 3 below.

Figure 3. Beef: Shelf-stable opportunity across the range of traditional products

Beef: Shelf-stable opportunity across the range of traditional products

Human consumption from economy to premium ranges (as well as animal/pet related products)

Fresh cuts and pieces

Steak - ribeye, rump, fillet, porterhouse, sirloin, T-bone, chuck, shank, etc.

Marrow bone, soup bones

Tail

Ribs

Brisket

Diced beef

Ready to cook - beef schnitzel, kebab, stir-fry

Minced/ground beef and related items

Rissoles

Meat balls

Kebabs

Burgers

Sausages

Offal/organs

Liver, kidney, tripe, etc.

Cooked / cured / smoked beef

Joints and sliced – corned beef, roast silverside, roast topside, etc.

Numerous country sliced varieties e.g., pastrami, and numerous beef and pork combinations

Pulled beef

Spreads and pate

Sausage, hot dogs, franks, pepperoni, salami, kranski, etc.

Dried beef

Sliced, chipped, jerky or biltong (wet and dry)

Functional ingredient core for numerous shelf stable products

Pies

Pie filling

Canned - corned beef, mince, sausage mince, steak, etc.

Stock – powder, cube, liquid

Ready meals / key meal component

Meatloaf, meat balls, soups, cottage pie, lasagne, braised steak and mash, bolognaise, stroganoff, sauces, chilli con carne, fajitas, curries, noodles, etc.

Some of these novel food processing technologies' ability to maintain meat quality in terms of nutrition, flavour, texture and appearance has led to premium shelf-stable meat cuts entering the global market, such as shelf-stable uncooked steak and chops manufactured by Hong Kong-based IXON Food Technology (<https://www.ixon.com.hk/>). These prime meat cuts look similar to fresh meat cuts, presented in vacuum-packed clear plastic, and reported to last for up to two years at room temperature.

Shelf-stable ready meals using microwave-assisted technology have appeared in the global market, such as Tata's Q ready meal range (<https://www.tata.com/newsroom/business/tata-q-ready-to-eat-meals>). Another is KJ Poultry's (<https://kjpoultry.com/>) Beef Rib Steak Ready Meal, which is promoted as follows:

- **READY-TO-EAT:** Prepared meals, fully cooked. Warm in microwave for approximately 2 minutes.
- **ON-THE-GO:** Compact size packaging for an easy travel experience. Ideal for camping and hiking dinner meal.
- **SHELF-STABLE:** No refrigeration needed, may be stored in a dry, refrigerated or frozen area. Packed and sealed in a microwavable tray.
- **FINEST INGREDIENTS:** Our dishes are prepared with the finest ingredients – then sterilised to preserve freshness, flavour and texture. No preservatives or TBHQ added. No MSG added.
- **GLATT KOSHER:** Certified by the Orthodox Union (OU) and Rabbi Getzel Berkowitz of Kiryas Joel. (<https://kjpoultry.com/product/beef-rib-steak-12-oz/>)

Additional ranges of red meat shelf-stable products will appear as international manufacturers explore opportunities presented by new food processing technologies, influenced by evolving consumer demands. The retail audits in this research have captured prices and characteristics of red meat products mainly sold in Australia, to provide insights into shelf-stable beef product marketing.

There are common pricing determinants and value propositions that relate to Australian provenance in terms of beef products – e.g. most packages clearly specify Australian grown or 100% Australian beef. Meat quality (fat content), mode of production (grass/pasture fed or organic), and the method of slaughter are key points of differentiation. Table 8 below provides a summary of fresh beef mince product prices and packaging details, sold by both Coles and Woolworths.

In terms of the impact of fat content, prices are higher for beef mince with lower fat content (i.e. lean and extra lean). The three fat-content-based price bands are clear in Woolworths' beef mince pricing. While Coles has the same price bands, it also applies a 3-, 4- and 5-star rating system determined by the meat fat content. Grass fed and organic products carry higher pricing, with packaging that indicates further information such as 'free to roam', 'pasture fed', 'no added hormones'. Halal and Kosher products also attract higher prices.

Table 8. Summary of prices and packaging specifications on fresh beef mince products – Coles and Woolworths Source: Online retail audits (Sept/Oct 2022)

Price band	\$ /kg	Slaughter	Production	Fat content	Pack size	Price \$	Brand (retailer)
High	37.00	Kosher		6%	500g	18.50	Continental Kosher Butchers Beef Mince Extra Premium (Woolworths)
	34.00	Kosher		10%	500g	17.00	Continental Kosher Butchers Beef Mince Premium (Woolworths)
	25.00	Halal		"Lean" % unspecified	500g	12.50	Fettayleh Foods Lean Beef Mince (Coles)
	24.00		Organic & Grass fed	19%	500g	12.00	Coles Organic Grass Fed Beef Mince
	22.00		Grass fed	"Lean" % unspecified	500g	11.00	Woolworths Macro Grass Fed Australian Premium Beef Mince
	21.00			5% fat	500g	10.50	Woolworths Heart Smart Extra Lean Beef Mince
Mid	20.00		Grass fed	% unspecified	500g	10.00	Woolworths Macro Grass Fed Australian Beef Mince
	19.00			10%	500g	9.50	Woolworths Lean Beef Mince
	18.00	Halal		% unspecified	500g	9.00	Fettayleh Foods Beef Mince (Coles)
	16.00			10%	1kg	16.00	Woolworths Lean Beef Mince
Low	14.00			18%	500g	7.00	Woolworths Beef Mince
	13.00			18%	1kg	13.00	Woolworths Beef Mince

These same value propositions based around meat fat content, grass fed, organic and no added hormones, as well as mode of slaughter, are reflected across all beef-related product categories at Coles and Woolworths, including ready meals, soups and baby foods, highlighting the potential for premium pricing.

The nature of beef production in the NT and the fact that most is free-range, means that locally produced shelf-stable beef products could take advantage of the premium prices associated with these value propositions. The NT's large export volumes to Muslim markets such as Indonesia also mean it is well placed to provide Halal beef products, if its abattoirs gain Halal certifications. Ongoing adoption of such certifications are widespread and have received mention in the Parliament of Australia briefings (e.g. Coombs & Gobbett, n.d.).

4.4.4. Pet food

The pet food category, which contains a lot of red meat, as well as fish and seafood products, is driven by dog and cat food sales. For example, in the Australian pet food category, dog food sales are 50.1% and cat food sales 38.4% (Ezhova, 2022). Demand for pet foods that include treats and mixers, wet food, and dry food have substantially grown across the APAC market, with further expansion predicted. It has been forecast that dog food sales will significantly grow between 2022 and 2027 based on the following CAGR – dog treats 7.0%, dry food 7.1%, wet food 5.3% (Euromonitor International, 2022e). Growth in cat food demand is likely to be even higher, with a CAGR of 15% predicted for the APAC region between 2022 and 2027 (Euromonitor International 2022f).

Market growth is predicted across treats and mixers, wet food, and dry food for all pet food price bands (i.e. economy, mid-priced and premium). In Australia and other APAC markets, demand for higher-quality pet food products has risen strongly, with manufacturers increasingly developing premium varieties. For example, in Japan premium cat treats grew significantly between 2017 and 2022. This is indicative of a broader trend referred to as 'premiumisation' (e.g. Euromonitor International 2022f, p. 5), where pet owners are increasingly viewing their pets as family members, which translates into going well beyond satisfying basic nutrition needs. The proportion of ecommerce pet food sales has also grown, with online sales now accounting for almost half of all APAC cat food sales.

Marketing insights

The retail audits captured prices and characteristics of pet food products sold from Australia and New Zealand, and other APAC markets, to provide insights into pet food marketing. They verified the range of economy, mid-priced and premium pet food price bands that are present in each of the three main categories of treats, wet food and dry food.

In the context of beef products, the same premium pricing and value propositions are evident for premium pet food as they are for human consumption. Premium pet food therefore presents an opportunity for the proposed NT processing facility to serve both consumer and pet food segments via the same production line. The following presents further insights into the lucrative premium pet food segment.

Price and pack size

Raw beef is a common premium wet food for both cats and dogs. Pack sizes and portions were relatively consistent for cats, but varied for dogs based on breed and/or dog size (e.g. from small 50g patties up to 2kg sausage packs).

The prices of premium beef wet pet foods were similar to the prices of low- and mid-range beef mince for human consumption sold by Coles and Woolworths. For example, as listed at my Pet Warehouse (<https://www.mypetwarehouse.com.au>):

- Proudly Premium Raw Dog Food – \$30 for packs of 12 x 200g individual portion vacuum packs (\$12.50/kg).
- Proudly Premium Raw Cat Food – beef and kangaroo \$23 for 1.08kg packs of 12 x 90g individual patties (\$20/kg).

The Complete Pet Company premium beef pet food products, available online for home delivery, included Complete Meal Beef Rolls 2kg for \$32 (\$16.00/kg) and Complete Meal Beef Patties \$34 for 40 x 50g patties (\$17.00/kg). Similar premium price options were available for other dry pet food and treat product categories, as demonstrated at the Complete Pet Company (<https://www.completepet.com.au/>):

- Complete Meal Freeze Dried for Dogs – beef (\$90.00/kg).
- Island Treats Beef and Berries 100g (\$17.95).
- Freeze Dry Australia Freeze Dried Raw Sardines 80g (\$13.80).
- Grass fed, Australian Pure Beef Liver 100g (\$5.50).

Product information

The information about the premium beef pet food presented on packaging, websites and in stores communicated the same value propositions used by beef products for human consumption.

For example, the premium raw, wet food for cats and dogs manufactured by Proudly (<https://www.proudly.com/>) was described as:

- 100% human grade – the same quality and handling standards as food for human consumption.
- Australian-made – 100% Australian ingredients from trusted local suppliers.
- Local facility – made in our own manufacturing facility on the Sunshine Coast.
- Complete and balanced – all of the micro and macro nutrients your dog or cat needs.
- Meat content – prey model raw diet ratio of at least 95% muscle meat, organs and finely ground bone powder, plus 5% vitamins and minerals.
- Other messages specifically for the raw beef pet food included ‘low carbs’, ‘grain and soy free’, and ‘single meat source’.

The Complete Pet Company (<https://www.completepet.com.au/>) provided the following information about its premium wet pet food:

- 100% Australian-owned.
- The Complete Meal is a raw, frozen dog and cat food made from organic, free-range and human grade ingredients.
- Ethical and sustainable ingredients.
- Does not contain any factory farmed meats and does not contain any colourings, preservatives or flavourings.
- Guaranteed horse meat free.

A range of premium pet food treats were also observed across the websites, including bone broth for pets, as well as various cuts of meat, fish and seafood products more typically associated with human consumption (e.g. Applaws Whole Tuna Loin, Applaws Whole Mackerel Fillet, Aussie Pooch Beef Jerky). These were mostly packaged in plastic pouches with clear windows that displayed the product inside. As with premium beef products for human consumption, premium pet treat prices were also justified in terms of being organic and grass/pasture fed.

Halal

Another premium emerging segment is Halal pet food, which presents another viable and lucrative opportunity for exports to APAC markets for Muslim consumers, as also recognised by others (e.g. Vorotnikov, 2022). Relevant pet food products include Halal beef, and Halal fish and seafood.

There is a range of pet food value propositions across the Halal pet food price bands. For example, there is an ultra-premium product in the UK which is the Tiana Halal Goat Feast retailing at \$430/kg, while at the lower end there is a PowerCat Halal Organic Cat Food available in Malaysia for \$10/kg.

4.4.5. Collagen and protein powder

This study's industry experts believed that collagen and protein powders offer strong market potential as shelf-stable products derived from beef processing, for the growing health and beauty categories. (See the previous 'tropical fruit market opportunity' section for further insights on health and beauty market trends in the APAC region.)

Marketing insights

The retail audits also identified a range of shelf-stable beef products where protein and/or collagen powders were the main ingredient. Collagen was a functional ingredient for various foods as well as health and fitness and beauty products, including:

- cooking ingredients (e.g. Nutra Organics Natural Gelatin Powder)
- fitness, health and beauty products:
 - powders (e.g. Dose & Co Pure Collagen, jar and Vital Protein Collagen Peptides, sachets)
 - supplement tablets/capsules (e.g. Nature's Way Beauty Collagen Tablets)
 - snacks (e.g. Gym Bod Collagen Sticks and Aussie Bodies Collagen Wafer)
 - beauty (e.g. Olay Regenerist Collagen Peptide 24, skin and OGX Biotin and Collagen Conditioner, hair).

As with beef for human consumption and pet food, low-, mid- and high-price bands were evident for collagen and protein products. These products also used similar value propositions to differentiate brands, particularly 'grass fed' and 'pasture raised', as well as country of origin. As illustration, price and packaging details are provided in Table 9 of a sample of collagen powder products.

Table 9. Collagen powder – summary of prices and packaging specifications

Price band	Type	\$AU/kg	Pack size	Price** \$AU	Brand	Manufacturer
High	Dietary supplement	181.53	450g	81.69	New Zealand Collagen*	Antler Farms
	Health & beauty	176.50	300g	52.95	Collagen Beauty*	nutraorganics.com.au
	Health & beauty	175.00	200g	35.00	Pure Collagen Powder	Dose & Co.
Mid	Dietary supplement	99.95	1kg	99.95	Collagen Peptides*	Amandean
	Sports nutrition	80.00	250g	20.00	Coles Perform Elite Hydrolysed Collagen Powder	Coles
	Dietary supplement	71.87	2268g (5lb ***)	163.00	Clean Collagen *	Custom Collagen

Price band	Type	\$AU/kg	Pack size	Price** \$AU	Brand	Manufacturer
Low	Dietary supplement	43.32	1kg	43.32	Hydrolyzed Collagen (Bovine) Powder	BulkSupplements.com

*Grass fed or pasture raised

**Web prices change regularly in line with currency fluctuation

***Also available in 1lb (454g) and 2lb (908g) options

Source: Online retail audits (Sept/Oct 2022)

4.5. Strategic marketing considerations for NT shelf-stable products

The future success of NT-produced shelf-stable products is heavily dependent on the strategic approach that is adopted. This includes the selection of appropriate APAC market segments and the development of effective marketing activities.

The broad scope of this market opportunity analysis provides indicators on which NT food types and associated shelf-stable products offer the greatest potential, as well as insights on how to effectively market and promote them.

4.5.1. Acceptance of new food processing technology and adoption of corresponding shelf-stable foods

To leverage APAC market growth in shelf-stable sales and the growing demand for healthier shelf-stable food products (e.g. Euromonitor International, 2020), initial marketing should promote the advantages of new NT shelf-stable products to overcome any perceived adoption barriers (see 'New Shelf-stable Food Processing Technologies' section for detailed discussion of these benefits and barriers).

The extended shelf-life of the proposed new shelf-stable food products (e.g. Eilert, 2005) and their improved quality and health properties should be particularly appealing (Grant et al., 2021), but only if the particular new technology is readily understood by consumers (e.g. Grebitus et al., 2013). Therefore it may be essential to educate consumers, retailers and suppliers about the new preservation processes and the value proposition presented by the corresponding shelf-stable products.

Grant et al.'s (2021) research highlighted that providing appropriate information about new food processing technology is critical for improving awareness and acceptance. In terms of quality and health, there needs to be an emphasis on the benefits of processing foods with fewer ingredients (i.e. less food preservatives) compared with the current preservation practices, which will help to overcome any negative perceptions regarding lack of healthfulness. Consumers have generally viewed shelf-stable food as lower quality, which can be a challenge for manufacturers, especially for perishable produce like meat and fruit where quality is often prioritised over price (Almenar et al. 2010).

Almenar et al. (2010) described food quality perceptions as comprised of sensory properties (i.e. appearance, texture, taste and aroma), nutritional value, chemical constituents, mechanical properties, functional properties and potential defects. Visual appearance and the colour in particular are the critical quality indicators used by consumers across shelf-stable food types, especially meat and fruit. For example, consumers in the USA and Germany have clear preference for ground or minced beef that is cherry red in colour. In line with this, the gradual colour

deterioration of shelf-stable strawberry juice is a major purchasing limitation (Buvé et al., 2018). As food quality including colour is better maintained via the new preservation methods, these are additional value-add attributes that should be leveraged. This also has marketing implications, in terms of the packaging (e.g. clear glass jars and plastic pockets with windows), which may be an effective way of presenting NT shelf-stable food products.

4.5.2. Competition and competitive strategy (including pricing)

“The major food retailers and producers that are already supplying Defence. They’re the ones that are also supplying businesses, the hospitals, the old folks’ homes.”

To be successful in the longer term, the proposed NT food processing facility needs to produce market-specific products that are defensible against competitors in both domestic and international arenas. Such competition includes Australia’s major supermarket chains such as Coles, Woolworths and Aldi, as well as the leading global manufacturers of shelf-stable food products (e.g. see Table 10).

Table 10. World's top 10 packaged food manufacturers based on retail sales, 2014–2019 (US\$1,000M)

Retail sales, 2014–2019 (US\$1,000M)	Packaged food manufacturer
61.5	Nestle SA
50.4	PepsiCo Inc
41.1	Mondelez International Inc
30.9	Danone Group
30.5	Kraft Heinz Co
28.8	Unilever Group
28.5	Mars Inc
22.0	Lactalis Groupe
19.3	Ferrero & related parties
17.8	Inner Mongolia Yili Industrial Group Co Ltd

Source: Euromonitor International (2020, p. 10)

Given the highly competitive nature of the global food sector, the proposed NT food processing facility needs to identify customer segments that its unique shelf-stable food products can provide distinct benefits to. This will help to ensure that it is defensible against price undercutting from larger manufacturers with lower production costs (as derived from economies of scale and/or from production in emerging markets with lower labour costs).

In comparison with other shelf-stable product manufacturers that use legacy conventional processing methods e.g., canning, new technologies involved different sterilisation treatments, and corresponding specialised packaging. NT shelf-stable products should be differentiated to support premium prices that cover the higher production cost, reflective of the range of benefits associated with the new technology and the NT-produced shelf-stable foods.

It is imperative that the competitive strategy capitalises on the NT’s unique selling points, such as the high quality of its local produce.

“Australia’s well-deserved ‘clean and green’ reputation will not be enough to ensure our sector remains competitive in either the domestic or export markets. In a fast-moving environment shaped by digital technology and social media, consumers are opting for

innovative and premium products that are convenient and in harmony with a growing focus on healthy and sustainable living. Meeting these market trends requires investment, in new products, innovative packaging and digital technologies that provide consumers with rich experiences and assure them of authenticity and provenance.” (Australian Food and Grocery Council, 2022, p. 4)

Consideration also needs to be given to existing competition that already serves potential consumer segments with conventional products. It is unlikely that these competitors will sit idly by and lose produce supply as well as customers to a new market entrant. It will therefore be important to leverage the perceived benefits of the proposed NT food processing facility and the corresponding products, and to attentively monitor competitor activities and responses in each market.

Throughout the research numerous potential unique selling points for locally manufactured and NT produce based shelf stable products were identified. These can inform marketing mixes to provide competitive advantage in the marketplace. They can also inform the rationale for locating the food processing facility in the NT.

To assist in identifying appropriate avenues for gaining competitive advantage and to inform corresponding marketing mixes of specific products, the unique selling points have been divided up according to four key sustainability dimensions (Greenland et al., 2022) and are presented in Table 11. Some points will be more relevant than others depending on the specific product being marketed and the ingredient source used.

Table 11. Summary of unique NT selling points and key marketing message themes

SOCIAL – satisfying needs, including health and wellbeing, and supporting society
<ul style="list-style-type: none"> • Health and wellbeing imparted by the product • Satisfies local and international demand for convenient, healthy, quality food • Quality assurance that the product meets robust industry standard <ul style="list-style-type: none"> ◦ Grade or quality of produce used • Better shelf-stable food processing technology <ul style="list-style-type: none"> ◦ Healthier products ◦ Maintains quality - nutrition, colour, texture, flavour, therapeutic benefits ◦ ‘Cleaner’ - less added colours, preservatives, flavourings, sugars, fillers, allergens ◦ Added convenience - longer shelf life, ease of storage, transport, use • Provenance of species origin - natural/authentic Australian or NT native species origin • Provenance and traceability of produce & manufacture imparts Australian, NT or Aboriginal brand values <ul style="list-style-type: none"> ◦ Location of wild harvest/capture, farm / aquaculture, or aboriginal land, people, community ◦ Grown / raised in pristine unpolluted, natural, environment • Cultural / consumer values relate to mode of production - incl. certification <ul style="list-style-type: none"> ◦ Halal ◦ Indigenous ◦ Ethical and sustainable (produce, manufacture and distribution) such as organic, free range / not factory farmed, wild source, Fairtrade, non GMO ◦ Social enterprise, supporting worthwhile organisations, disadvantaged regions and communities ◦
POLITICAL – governance, security, regulation and legislation
<ul style="list-style-type: none"> • Support national and local government priorities <ul style="list-style-type: none"> ◦ Protect against foreign investment that may conflicts with national priorities • Food sovereignty, food security and supply chain resilience <ul style="list-style-type: none"> ◦ Protect against commodity price fluctuation ◦ Protect against changing political relations and over-reliance on one market • Regulation and improved industry standards <ul style="list-style-type: none"> ◦ Reduce informal / illegal trade

<ul style="list-style-type: none"> ○ Reduce live export dependence and the associated risks • Develop APAC and international trade relations
ECONOMIC – <i>growth, investment, infrastructure development, employment</i>
<ul style="list-style-type: none"> • Support remote, regional and community development • Develop key NT industry sectors – Horticulture, fisheries, livestock, manufacturing • Support local business to support local community <ul style="list-style-type: none"> ○ Employment ○ Value-add processing to make local business more competitive (domestically, internationally) ○ Improve productivity – less waste, and undervalued and/or underutilised resources • Less reliance on commodity markets
SUSTAINABLE PRODUCTION (ENVIRONMENTAL) – <i>corporate values and practices that help maintain the natural ecosystem</i>
<ul style="list-style-type: none"> • Indigenous traditional values incorporated in the produce / production process • Sustainable production values <ul style="list-style-type: none"> ○ Using produce that would be wasted ○ Efficient processing technology ○ 'Green' low energy consumption and reduced carbon footprint ○ Recycled and biodegradable packaging ○ No pesticides / herbicide ○ No antibiotics / hormones ○ No chemical fertilisers ○ No environmental degradation / impact - water, fertility/productivity of land and sea ○ No depletion of species, stocks, bushfoods, ○ Maintain natural resources water, fertility/productivity of land and sea ○ No overproduction / overfishing or depletion of species and bushfood stocks ○ Sustainably sourced ○ Wild harvest / wild catch ○ Grass/pasture fed ○ Natural / suited to the conditions / not artificial • Ethical production values <ul style="list-style-type: none"> ○ Enhanced animal welfare outcomes ○ Worker welfare ○ Supporting local communities ○ Supporting local business ○ Single source meat - horse meat free ○ Factory farm meat free ○ Free to roam / range ○ Ethical company/organisation reputation

4.5.3. Product and market focus versus diversification

An important strategic decision relates to whether the NT food processing facility should focus on a small number of products and markets, or have diversified offerings and a broader customer base that includes both consumers (end-users) and manufacturers.

“There are manufacturers who are looking for a portfolio of protein ingredients that come from different organisms because they have different functionalities. They have different nutritional benefits. So you need to produce a diverse portfolio of these ingredients.”

The industry experts in this research considered it important to operate an explicit diversification strategy to maximise opportunity in the long term and reduce over-reliance on one or two products and markets. This is particularly relevant for the initial pilot of the NT food processing facility, which will need to have built-in flexibility to facilitate testing of a range of products and markets. It should therefore:

- process a variety of NT produce using wet and dry manufacturing lines
- produce a range of shelf-stable foods from the same raw ingredient(s)
- produce different grades or qualities within each product type (e.g. premium and economy)
- service a range of markets and customers (consumer and B2B) segments therein.

It was also considered important by the industry experts to target complementary B2B and consumer market segments and shelf-stable food product lines, such as:

B2B

Protein powder manufacturers
Shelf-stable beef products for the
food service industry

Consumer

Protein powders for health/wellness shops
Smaller packaged shelf-stable beef products
for the end-user/consumer

Furthermore, complementary B2B and consumer market product lines should align with the facility's market entry strategy. For example, by initially identifying and exploiting larger B2B opportunities to generate sales volume in the nascent business phase, related consumer/end-user food product lines could then evolve to exploit those additional lucrative market segments.

“Things that go directly to consumers have a much higher price point; you can afford much smaller processing volumes for these.”

4.5.4. Product portfolio strategy

A diversified product portfolio can help to overcome the seasonality associated with NT produce. It also provides some protection against the risks of market demand fluctuation, which manufacturers of single products lines are more exposed to. Although having a larger product portfolio can also present complications, such as required variations of the production processes and efficiencies. For example, for premium products such as bushfood nutraceuticals, protein powders or dried fish maw that attract very high prices, lower scales of production are acceptable. However, lower-value product lines require larger output and economies of scale.

“If we’re talking about value adding to Kakadu plum, it’s a uniquely Australian product that will occupy a premium place in the market. If we’re talking about processing out of spec (waste) mangoes to juices or other perhaps shelf-stable functional ingredients, then that occupies a different pricing point. Whereas shelf-stable meats to eliminate cold chains is a different value proposition.”

There is also opportunity for diversification within the same product lines, such as differentiating by quality of the raw produce ingredient (e.g. by grade/quality of ingredients used). In this manner, shelf-stable food product portfolios can be differentiated by price. However, the NT's unique selling points, such as wild harvest, may mean that corresponding items within a particular food product category could still attract a higher price within the low or economy price band.

4.5.5. Test marketing via a pilot NT food processing facility

An initial pilot facility will enable experimentation with shelf-stable food manufacturing lines. It will also facilitate the refinement of products, in conjunction with customer segment and targeted marketing development, and will likely foster collaboration with key stakeholders. These stakeholders include produce suppliers, as well as distributors, retailers, manufacturers and consumers in the NT, Australia and specific countries in the APAC region.

4.5.6. Ongoing/future market research and analysis

To ensure long-term success, ongoing market research activities will be critical to provide more detailed insights into product line viability, to refine the various products and associated marketing.

A pilot NT food processing facility is important to refine production processes, including production cost estimates and efficiency improvements (e.g. including economies of scale from supply, production and distribution perspectives). The pilot facility would also deepen understanding of the most profitable food product lines, including the degree that the end-product value overcomes production costs.

Market research will also be necessary to refine the shelf-stable product offerings, so they more closely match customer needs, such as required formats, specifications, quality dimensions and grades. Collaboration with food, pet food, cosmetic and nutraceutical manufacturers and retailers in Australia and in the APAC region is a recognised business model for achieving this (e.g. Hernandez et al., 2021). Collaboration with suppliers and distributors will also be important for developing and refining raw material supply and product distribution channels.

Detailed analysis of shelf-stable product consumer segments within specific markets will also be required, to further inform targeted marketing strategy that is tailored to each. This will include analysis of publicly available market research data, as well as primary data collection in the form of retail audits and customer surveys such as for product concept testing, which is a standard market research approach for estimating likely market uptake of new products. Such market research could also investigate the following:

Market demand

- What is the potential market demand (volume and value) for specific shelf-stable products from the target market segments?
- Does market demand vary seasonally or is it consistent throughout the year?
- Can the NT shelf-stable food facility and supply chain satisfy the predicted demand from customer segments? For example: *“An international drinks manufacturer would buy everything we produce [Kakadu plums], but their minimum is a 100-tonne-order. We can’t supply that much”.*

Satisfying customer needs

- How can the shelf-stable products be designed to more closely match and satisfy different customer segment needs? For example, preferred flavours, pack size, heating/cooking options, for both B2B and consumer market segments.
- Which shelf-stable product attributes and unique NT selling points are most appealing to specific market segments?
- What is the price point where customers (consumers and B2B) will be willing to trial/buy new shelf-stable products, and what volume will they purchase?
- What are the ingredient/product specifications and different grades, along with associated pricing points required by B2B customers?

Perceived risks and barriers

- What is the level of believability of the shelf-stable food benefit claims?
- Are there negative nutrition perceptions of microwave-assisted shelf-stable food processing, and how can these be reduced?
- What are customers’ perceived risks of switching from conventional shelf-stable food products, and how can these be overcome?

Supply of feedstock for the NT food processing facility

- What is the feasibility of securing a consistent supply of the required volume of raw materials, and what strategies and incentives can be used to overcome supplier hesitancy to guarantee supply of the required volume of a raw material? For example: *“If 1 tonne of meat per hour is required by the production line, this equates to 8,760 tonnes per year”*.
- At what price point will suppliers be willing to switch their supply of produce to shelf-stable food production, and what volume can they supply?
- What is the feasibility of encouraging suppliers to expand their own produce ranges, such as pastoralists growing other lines? For example: *“Get farmers to diversify into chickens, or horticulture such as peanuts, chickpeas or another shelf-stable produce item”*.
- What are the raw material cost variations based on different produce grades, properties and seasons?

Technology challenges

- What is the feasibility of overcoming any maximum pack size/volume production limitations?
- What is the feasibility of expanding production flexibility in terms of the range of produce and shelf-stable products that can be processed at one location/facility?
- Can alternative processing technology options be used to produce different product options?

(NB Refer back to the section on disadvantages and challenges of NT produced shelf-stable food for further insights to limitations)

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