

# Final report

---

## Hides to Riches Milestone 8 – Final Report Public

Project code: P.PSH.1274  
Prepared by: Fiona Dobbrick, Michael Buckley & Anna Hendra  
Freeze Dry Industries  
Date published: 2 June 2022

PUBLISHED BY  
Meat & Livestock Australia Limited  
PO Box 1961  
NORTH SYDNEY NSW 2059

This is an MLA Donor Company funded project.

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

**This publication is published by Meat & Livestock Australia Limited ABN 39 081 678 364 (MLA). Care is taken to ensure the accuracy of the information contained in this publication. However MLA cannot accept responsibility for the accuracy or completeness of the information or opinions contained in the publication. You should make your own enquiries before making decisions concerning your interests. Reproduction in whole or in part of this publication is prohibited without prior written consent of MLA.**

**Abstract**

Freeze Dry Industries (FDI) have completed an earlier MDC funded Research Project – P.PSH.0999 – “Developing High Value Freeze Dried Australian Red Meat Products and Services”. The objective was to identify a 3-to-5 fold value adding opportunity for the red meat industry through the application of freeze drying technology.

The design led approach highlighted waste hides and the extraction of collagen as the lead opportunity; coinciding with record low prices for Australian hides. The knowledge gathered in the previous project got further explored in this project, with focus on optimising and commercialising the organic collagen extraction process.

Throughout this project the process has been refined, certified as organic and a provisional international patent has been filed. FDI has launched a brand under which consumer facing organic collagen products will be sold. The initial range will consist of 5 supplements and 3 skin care products.

The commercialisation of the process will create a whole new industry for the red meat sector within Australia and will create a guaranteed price of hides for producers, up to 4x what the current market value is.

## Executive summary

### Background

Freeze Dry Industries (FDI) have completed an earlier MDC funded Research Project – “Developing High Value Freeze Dried Australian Red Meat Product and Services” (P.PSH.0999). The objective was to identify a 3 to 5-fold value adding opportunity for the red meat industry through the application of freeze-drying technology. This design led approach highlighted waste hides and the extraction of collagen as a lead opportunity.

FDI has developed a certified organic collagen production process to extract the collagen from the waste hides. The results will be used to commercialise the organic collagen.

### Objectives

The objectives of the project were:

- Optimise the collagen extraction process
- Receive organic certification for the collagen
- Create 3 different grades of collagen: pet, food and cosmetics.
- Commercialise the organic collagen under a new brand.

All four objectives were achieved.

### Methodology

When developing and optimising the collagen production process, 3 key factors were considered.

- Creating a production process which was efficient, scalable and cost effective.
- Ensuring that every step of the process was suitable for organic accreditation.
- Ensuring the quality of the product and by extension the process by a NATA accredited laboratory.

### Results/key findings

A scalable and efficient collagen extraction process was developed, and certified organic by the ACO. A brand, Organic Collagen Australia™, and consumer goods containing the organic collagen were developed.

### Benefits to industry

Costing models show a clear benefit to the red meat industry. It will provide up to a 4x increase in the value of hides and creating a whole new sector for the red meat industry in Australia, as there currently is no collagen production.

### Future research and recommendations

The project has been a success and has met all the milestones. FDI has developed a Certified Organic extraction process which they are ready to commercialise.

## Table of contents

<b>Executive summary .....</b>	<b>3</b>
<b>1. Background .....</b>	<b>5</b>
<b>1.1 Project .....</b>	<b>5</b>
<b>1.2 Collagen Opportunity .....</b>	<b>5</b>
<b>2. Objectives.....</b>	<b>6</b>
<b>3. Methodology .....</b>	<b>7</b>
<b>3.1 Organic Collagen Production .....</b>	<b>7</b>
<b>3.2 Organic Certification .....</b>	<b>8</b>
<b>3.3 IP Developed.....</b>	<b>8</b>
<b>3.4 Bioavailability &amp; Molecular Size .....</b>	<b>8</b>
<b>3.5 Consumer Insights.....</b>	<b>9</b>
3.5.1 Collagen .....	9
3.5.2 Natural & Organic .....	10
<b>4. Conclusion .....</b>	<b>11</b>
<b>4.1 Key Findings.....</b>	<b>11</b>
<b>4.2 Benefits to Industry.....</b>	<b>11</b>
<b>5. Future Research and Recommendations .....</b>	<b>11</b>
<b>6. References.....</b>	<b>12</b>

## 1. Background

### 1.1 Project

Freeze Dry Industries (FDI) have completed an earlier MDC funded Research Project – “Developing High Value Freeze Dried Australian Red Meat Product and Services” (P.PSH.0999).

The objective was to identify a 3 to 5-fold value adding opportunity for the red meat industry through the application of freeze-drying technology.

This design led approach highlighted waste hides and the extraction of collagen as a lead opportunity. At the same time, the Australian hide (and skin) market continues to drop to almost record low prices meaning not just hide waste streams, but indeed alternate uses for hides need to be fast-tracked. Further, the demand from wellness, beauty and fitness trends for collagen continues to grow globally.

This projects aim was to further research and develop the potential to extract human food grade bovine collagen using FDI’s technology and advance the business model to procure raw material and produce powdered product for these adjacent markets to the traditional meat sector.

The output from this stage 2 project therefore will be to define and deliver extraction and supply protocols in a commercial mode and to secure key partnerships and a model to describe the value created and captured for Australian red meat industry from this full scale initiative. This aligns to MLA 2025 Strategy of doubling the sales of “meat” and developing new products from utilising more of the carcass.

### 1.2 Collagen Opportunity

The collagen market is very well established with global sales of approximately US\$4.9 billion in 2020 over these three main groups being cosmetics, food and beverages, healthcare. (Grandview Research Collagen Market 2016 - 2027).

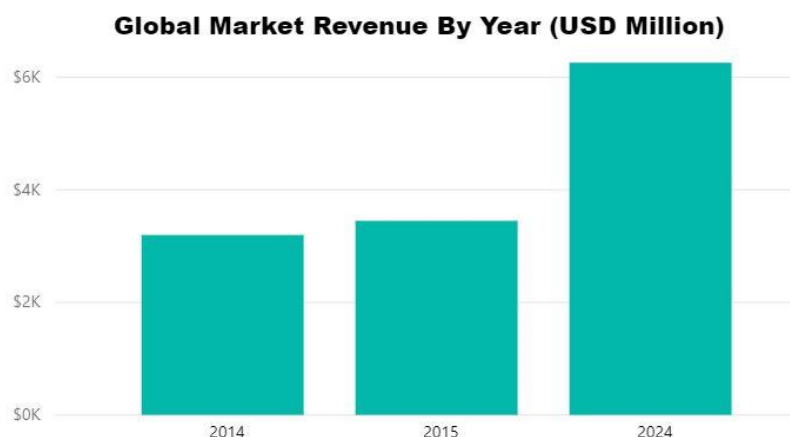


Figure 1 Global Collagen Market

The growing demand for high protein in pet and human food /plus collagen as a base for cosmetic, nutraceutical and pharmaceutical products is exciting for the Australian red meat industry.

As shown in the graph below, the collapse of the hides market has continued with very serious consequences for the red meat industry on two primary fronts. Firstly, the now near valueless hides remove a huge amount of base revenue from the incomes of producers and abattoirs. Secondly, these waste and low value hides contribute to known environmental problems - namely greenhouse gas emissions. Both are focus areas for collaboration with MLA to innovate in.

***“The hide market remains in the worst position it has seen in living memory. The market in China and Italy, although opened, remains reticent to purchase until they confirm sales contracts for finished leather which is in soft demand due to the worldwide COVID-19 lockdowns.”***

MLA Source

**Figure 13: Trends in hide prices (East Coast Ex Works)**



Figure 2 Trends in hide prices

This MDC funded research project intended to discover and develop the all-natural method to process bovine hides to extract human food grade collagen. This research and development aimed to generate a high-quality collagen with measurable scientific results in consultation with key industry to secure supply and demand partners to scale up.

These results were compared to known commercial products and will set the foundation for commercial collagen peptide production for the Australian red meat industry. The ability to repurpose low value and indeed waste cattle hides into high value collagen products provides enormous benefits to the red meat industry. An opportunity to promote a ‘natural’ manufacturing process that is environmentally friendly, sustainable and commercially viable and enable provisions for food grade “clean and green” Australian beef collagen to compete against South American and European derived beef collagen will be a first for Australia.

## 2. Objectives

The previous work (Project P.PSH.0999) undertaken by FDI has proven that a scientifically validated high value collagen production capability is possible for Australia. The prime objective of this project was to build on that scientific evidence then develop the capabilities to scale production nationally.

Specific project objectives were to refine the production process of freeze-dried hides to extract, then prove, three main grades of collagen.

1. Pet food grade collagen,
2. Human consumption grade collagen,
3. Cosmetic/medical grade collagen.

A Dalton is a unit used in expressing the molecular weight of proteins, equivalent to atomic mass unit. Traditionally the Dalton unit has been treated as a score of bioavailability which is disclosed on the Certificates of Analysis provided by collagen manufacturers. As such, buyers often use this as a measure of bioavailability (absorption), quality and potential application of the collagen.

An overarching project objective was to be able to produce commercial quantities of all three grades of collagen as soon as practical and to describe the value creation and capture for the Australian red meat industry. Validating the value proposition for whom will desire these products and what is the value chain to supply – make – sell collagen was completed. This included a forecast business plan presented to MLA to outline commercialisation and contribute to MLA measurement and evaluation attribution of “collagen” impact and investment.

### **3. Methodology**

#### **3.1 Organic Collagen Production**

When developing and optimising the collagen production process, 3 key factors were considered.

1. Production process

While developing the process every adjustment needed to be considered in terms of effectiveness, scalability and cost. Small scale experiments were run to test new processing aids and optimise the different variables before being tested on a larger scale. This ensured that the project could move forward quickly and cost effectively.

2. Organic accreditation

All processing aids and steps were added and designed in accordance with the ACO’s organic standard as well as the national standard. The key differential factor between FDI’s process and the commercial collagen extraction processes is the organic status and what that means (i.e. sustainability and purity) and as such this had to be considered when adapting the process.

3. Laboratory testing

In order to confirm the quality of the final product, the Organic Collagen was sent off for testing at NATA accredited laboratories. The main factors to be tested were the nutritional profile as well as the amino acids profile as this will be used to determine the nutritional quality of the product. Microbial testing was also conducted to test the suitability of the process to produce human grade food.

### 3.2 Organic Certification

FDI has achieved an Organic Certification for their collagen extraction process from the ACO. By continuously working with the ACO and their guidelines the process can be continuously optimised as long as the base process stays the same. This process can also be used to produce other types of collagen, such as ovine or porcine. So long as certified organic hides are used for the production of the collagen, the final product can be certified organic.

This is significant, as it is the World's first Certified Organic Collagen. It allows FDI to make claims about their collagen that no other company can. Organic Collagen is better for the environment, being produced with less chemicals and energy consumption, while also supporting humane conditions for the animals. It also produces a purer product, without antibiotics, heavy metals, herbicides, pesticides and synthetic hormones which is much healthier for the people who consume it, allowing them to access the full benefits of eating collagen without any of the negative impacts of traditionally produced collagen. It will make you, the animals and the environment feel better. The ACO certificate is included in Appendix H ACO Certification for Organic Collagen.

### 3.3 IP Developed

Extensive IP has been developed, as FDI has created the World's first Certified Organic Collagen extraction process. All parts of the process have been developed in house by FDI and as such only FDI has access to the knowledge. FDI has a filed a provisional international patent for the extraction process to further protect this IP.

Furthermore, the collagen will be processed on the Freeze Dry Eagle™ – High Performance, Ultra Low Energy - a high tech drying system that runs on up to 75% less energy than competitors. The system is advanced in both productive through put and reporting analytics. In built freezing capability combines with high tech abilities translating to a 24-hour turnaround time on up to a 1250kg batch. The running software platform includes live data feeds, visual product monitoring, weights and moisture levels with fully automated and adjustable critical control points.

### 3.4 Bioavailability & Molecular Size

The size of the collagen molecule, commonly given in Daltons, has traditionally been used as a stand in for the bioavailability of the collagen. The current available scientific data does not back this assumption up.

While studies on other types of proteins have found that hydrolysing the protein increases bioavailability this has not been found to be true for denatured collagen. A 2019 study did not find a significant difference in peak glycine concentrations or in total plasma amino acid availability in participants after the ingestion of either 20g of denatured collagen or 20g of hydrolysed collagen (Alcock, Shaw, Tee, & Burke, 2019).

A follow up study corroborated these findings. No significant difference was found between in the levels of plasma glycine, lysine, proline or hydroxyproline 1 hour after ingestion of either 15g hydrolysed collagen or 15g of denatured collagen (Lis & Baar, 2019). There was a small difference in plasma leucine levels however since collagen is a poor source of leucine, compared to other protein sources such as milk, this is not of dietary importance.



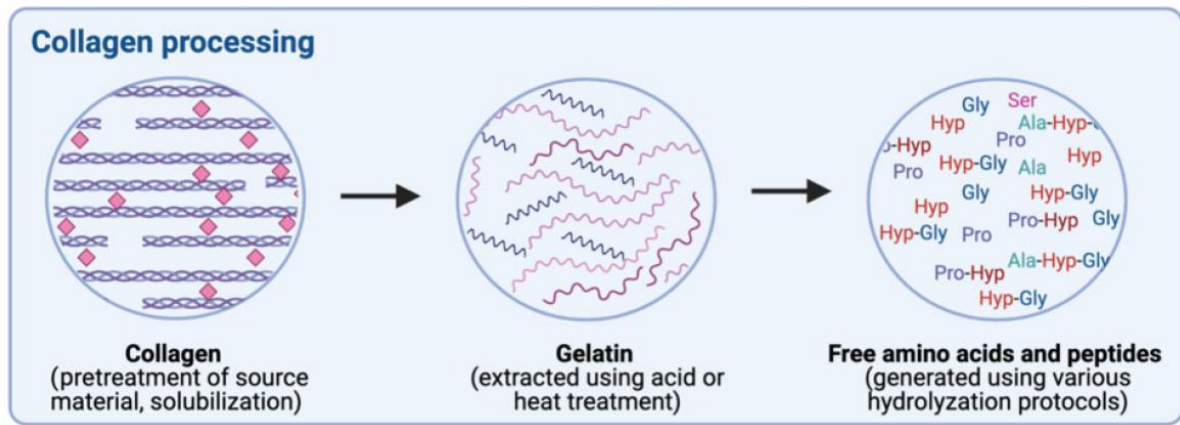


Figure 3 Graphic representation of collagen processing (Holwerda & van Loon, 2021)

The key concern regarding the bioavailability of collagen is to ensure that the triple helix of the native collagen is broken. Due to its tight helix formation, native collagen is resistant to peptide cleavage by digestive enzyme and so bioavailability is poor. Some studies suggest as low as 10% of native collagen is absorbed in the gut, hence 90% of the collagen is of no nutritional value (Holwerda & van Loon, 2021).

### 3.5 Consumer Insights

#### 3.5.1 Collagen

A 2021 report by the Ingredient Transparency Report surveyed 2000 German, British and American consumers about collagen. They found that collagen users main reason for consuming collagen is its' so called beauty benefits, i.e. benefits to skin, hair and nails.

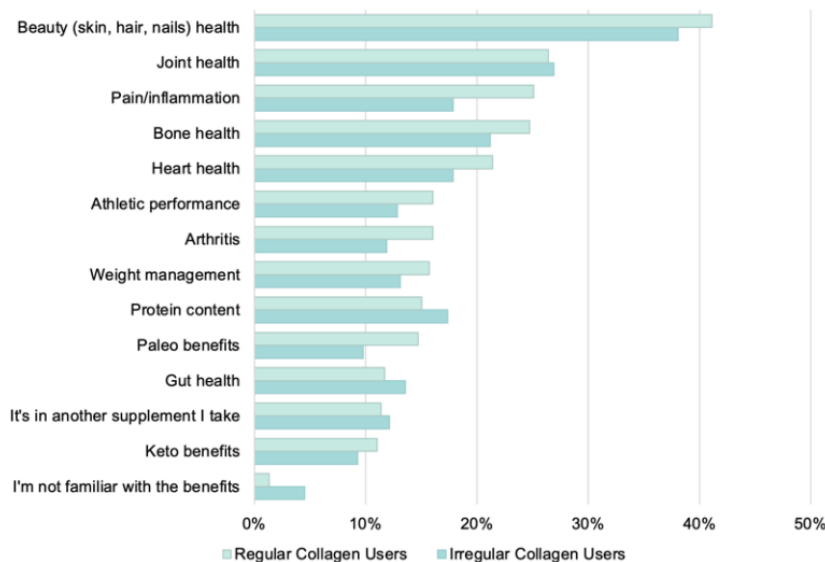


Figure 4 Reasons why consumers take collagen (Ingredient Transparency Center, 2021)

Consumers are starting to recognise the relationship between their diet and their skin. As such, people have started to combine their topical skincare with supplements. 54% of UK women aged over 16 years agreed that diet has an impact on skin. Almost one third of consumers in China purchased health supplements from beauty purposes and 22% of consumers in the US had taken a beauty supplement for skin, hair and nails (Culliney, 2020).

Collagen is already an ingredient that is well established and known among consumers for its beauty benefits. This new growing sector is opening up an exciting opportunity for collagen, and new innovative forms are being developed – bar, supplements, drinks, etc. to fit everyone’s lifestyle and needs.

### 3.5.2 Natural & Organic

In 2017, CSIRO released a report on the most significant growth opportunities they identified for food and agribusiness in Australia. The sections are outlined below in Figure 5. Free from and natural make up 11% of the \$25 billion opportunity they identified.

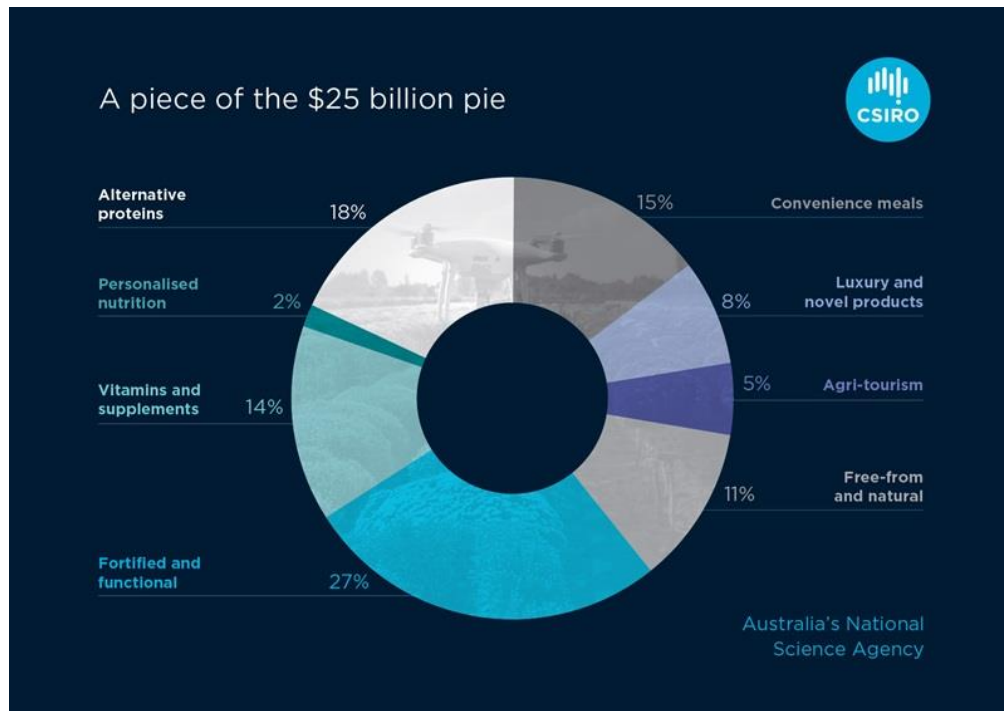


Figure 5 Break down of market size for the identified opportunities for Australian food and agribusiness (CSIRO, 2019)

Consumers are looking for foods that are produced naturally, sustainably and ethically. Having a recognised certifier approve your product gives consumers confidence that it is natural and healthy. A 2022 study from Europe surveying more than 2000 consumers found that they had a high level of trust in certified organic products (Murphy, et al., 2022).

As FDI’s collagen is Certified Organic, it gives consumers confidence that is a high quality natural product and makes the collagen stand out on the market, as it is the World’s first collagen to be Certified Organic. It also allows FDI to capitalise on Australia’s global reputation for producing ‘clean and green’ high quality food when exporting products.

77% of American consumers said that they are concerned about the conditions of animals raised for food. The same study found that 78% of consumers thought that there should be an objective 3<sup>rd</sup> party checking on the welfare of the animals and 67% would purchase these animal welfare certified product, even if that meant an increase in price (Meadow & Ulibarri, 2016).

Using organic certified hides ensures that animals were raised in a pasture without unnecessary antibiotics and hormones and guarantees a higher living standard for the cattle. As this is a main concern for consumers, which is increasing, this will be a key claim to stand out among the competition.

## 4. Conclusion

FDI has developed a Certified Organic collagen extraction process that has been proven to work on a pilot scale. Next step is to commercialise the product which will happen in the middle of 2022.

### 4.1 Key Findings

The key findings from the project are;

- A clean organic process to extract collagen from bovine hides was developed and optimised and is now ready to be commercialised
- The extraction process has been Certified Organic by the ACO
- An international provisional patent is pending for the process
- The amino acid profile of the organic collagen produced is superior to the current market leader
- There is a growing desire for consumers to buy collagen that is ethically and sustainably produced
- Animal welfare is of particular concern for consumers

### 4.2 Benefits to Industry

By taking a low value 5<sup>th</sup> quarter product FDI can guarantee a minimum price for the hides, ensuring that the producers will get paid and won't need to dump the product. FDI will then in turn take the hides and increase the value further, growing the market size of the red meat industry.

## 5. Future Research and Recommendations

This project has been an overwhelming success based on all the intended objectives and research outcomes.

In particular:

1. The participants have proven out the methodology for extracting commercial grade collagen from bovine hides.
2. Scientific validation through reports on amino acid profiles, nutrition, microbial measures and molecular weight support a variety of commercial applications.
3. The development and adaptation activities have been established to now encourage stakeholders to capitalise on the projects findings. This in turn delivers value to the Red Meat Industry.

Recommendations are:

- Freeze Dry Industries to generate a suite of products that capture the essence of clean, green collagen production. Explain the free from, purity and provenance 'Real Australia' USP's.
- Engage with industry and other participants to achieve a business model that delivers on the commercial opportunity.
- Continue research into high value consumer products and export markets.

## 6. References

- Alcock, R. D., Shaw, G. C., Tee, N., & Burke, L. M. (2019). Plasma Amino Acid Concentrations After the Ingestion of Dairy and Collagen Proteins, in Healthy Active Males. *Frontiers in Nutrition*.
- CSIRO. (2019). *Growth opportunities for Australian food and agribusiness*. Commonwealth Scientific and Industrial Research.
- Culliney, K. (2020, July 20). Collagen a 'hero ingredient of the moment', says Mintel. *Cosmetics Design Europe* .
- Holwerda, A. M., & van Loon, L. J. (2021). The impact of collagen protein ingestion on musculoskeletal connective tissue remodeling: a narrative review. *Nutrition Reviews*.
- Ingredient Transparency Center. (2021). *Insights Consumer Supplement User Collagen report*. Trust Transparency Center.
- Lis, D. M., & Baar, K. (2019). Effects of Different Vitamin C-Enriched Collagen Derivatives on Collagen Synthesis. *International Journal of Sport Nutrition and Exercise Metabolism*, 526-531.
- Murphy, B., Martini, M., Fedi, A., Loera, B. L., Elliot, C. T., & Dean, M. (2022). Consumer trust in organic food and organic certifications in four European countries. *Food Control*.