



**KELLOGG**

RURAL LEADERSHIP  
PROGRAMME



# Adding value to Onions

## Kellogg Rural Leadership Programme

Course 39 2019

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I wish to thank the Kellogg Programme Investing Partners for their continued support:



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## **1.0 Executive Summary**

This paper is aiming to add value to second grade onions that unable to be sold locally or exported. The aim was to understand what could be done with them to make them more saleable in the market place here and overseas.

It is very early on looking into the process of adding value to second grade onion, by freeze drying or dehydration. While freeze drying has been the obvious first choice due to the lack of nutrition loss during the process and longer shelf life. The cost of investment is high for freeze drying which results in a high cost product to sell into the market place.

While looking into the adding value to second grade onions by freeze drying, the following areas were researched:

- Difference between Freeze drying and Dehydrating,
- Understand the freeze drying process,
- Advantages and Disadvantages of Freeze Drying,
- Financial analysis of freeze drying costs,

The paper recommends that this is looked into further as from what I have obtained this is a viable business. Margins are not overly high while contracting freeze drying, but once business is established and is it is feasible to purchase a Cuddon Freeze Dryer the margins would increase substantial.

## **2.0 Acknowledgements**

I would like to acknowledge all of the people who helped with this project. It was pleasing to have so many people contribute their time to discussing and sharing their experiences, ideas and thoughts. The passion and enthusiasm for the freeze drying industry, thanks for their openness about the challenges and risks associated with the process and industry.

I'd also like to thank the Kellogg Rural Leadership team Anne Hindson, Dr Patrick Aldwell, Dr Scott Champion and Lisa Rogers.

A special thank you to Patrick for his encouragement for me to undertake Kellogg's, along with the support with my project. Your feedback, guidance and ideas were very timely.

A massive thank you to my family for allowing me to have time off during the busy harvest season to undertake Kellogg's, also for the final read of my report along with Duncan. Thank you for all of your support, assistance and encouragement.

Finally, thanks to Co-Hort 39 peers who have helped with general support and reassurance throughout the last six months with this project.

### 3.0 Introduction

Onions (*Allium cepa*), are ranked third in the world production of vegetables. They are the largest trade fresh vegetable from New Zealand as shown below in figure 1, also being the second largest fresh vegetable traded worldwide. Onions are a widely used vegetable being used in most cuisine in the world. New Zealand is considered to be a niche, high end supplier of onions, with premium prices received when exporting to the market place. New Zealand as a country we currently exports 82% of the onions produced, these onions are sent far and wide being exporting to over 45 markets.

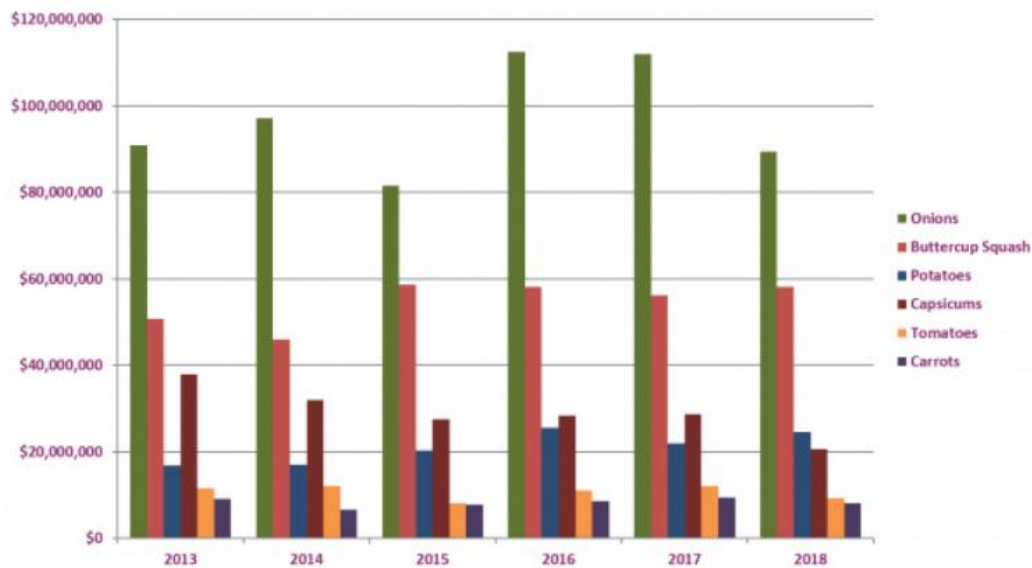


Figure 1. New Zealand Top Fresh Vegetables Export (Value)<sup>1</sup>

## 4.0 The Project Definition

### 4.1 Background Information

There were a number of main drivers behind me looking into this as a project. The main one was to add value to second grade onions that do not meet export quality. The parameter around exporting onions into some markets are extremely tight including size, shape, skin quality and colour. With approximately 8-9% of the onions graded from the pack-house that are unable to be sold to export or local market.

Currently we further processes a small portion of the second grade onions. Being sliced and diced for sale to restaurants and manufacturing into food goods, like chutneys and sauces. This is not a very large market along with having other companies participating in this space too. These onions once sliced and diced have a shorter shelf life.

<sup>1</sup> Onions NZ, New Zealand onions export history. (n.d.). Retrieved from <http://www.onionsnz.com/all-about-onions-2/export-history/>

I believe there is a gap in the New Zealand market for the further processing of onions to extend their shelf life, along with making use of lower grade onions. This can be undertaken by dehydrating or freeze drying, putting the produce through one of these processes will enable the shelf life to be extended to 15 - 30 years. Freeze dried and dehydrated vegetables are becoming very common in some parts of the world to substitute fresh vegetables. This market is expected to grow in the next five years, as people start to worry about wastage and convenience. With freezer drying or dehydration of onions I don't believe that there are any threats to entry in New Zealand, there is currently not anyone in New Zealand who is in the space.

## **4.2 Dehydrated vs Freeze drying**

Dehydrated / Dehydration is a common way of increasing the shelf life of a product by removing the moisture from the food. Dehydrating has been practiced for thousands of years. This can easily be done at home with modern-day dehydration not being expensive or complex. Hot and dry air is circulated around the food, this process removes much of the water from the food. The temperature of the air is hot enough to remove the water, but not hot enough to cook the food. The product is usually shrunken and harder.

Freeze drying is a relatively modern process of preserving. Freeze drying requires a higher amount of investment and is not commonly done at home. It is a very simple process with the food being placed on large racks inside a vacuum chamber. The temperature is lowered to below freezing and then raised slowly, this process along with the pressure in the chamber moves the water from solid state to gaseous state. The product usually maintains its structure and keeps its nutritional value. Freeze dried process was developed commercially during World War II when it was used to preserve blood plasma and penicillin. Freeze dried coffee is one of the most well known freeze dried products. Majority of things can be freeze dried but once the water content is higher than 90% freeze drying can become difficult. This is dependent on the texture of the fruit or vegetable, watermelon and lettuce are a few items that don't freeze dry very well.

### 4.3 The Main Differences

- **Moisture Content** with these two types of preservation of food the main object is the removal of moisture. Freeze drying removes 98-99% while dehydration removes 90-95%. The moisture content of the product has a direct impact on the shelf life. At home dehydration will typically not remove as much moisture as professional.
- **Nutritional Content** normally freeze dried food retains more of its nutrition compared to dehydrated. The heat used in the dehydration process often results in the loss of some of the vitamins. Table 1 below shows the nutritional contents of the two alongside raw onions.

Table 1. Nutritional Information of Onions, dehydrated and Freeze Dried

Particulars	Big onion	Small onion	Onion stalks	Dehydrated onion	Freeze dried onion*
Moisture, g	86.6	84.3	87.6	4.6	0.0
Protein, g	1.2	1.8	0.9	10.6	2.2
Fat, g	0.1	0.1	0.2	0.8	0.1
Minerals, g	0.4	0.6	0.8	3.5	0.7
Fibre, g	0.6	0.6	1.6	6.4	1.1
Carbohydrate, g	11.1	12.6	8.9	74.1	80
Energy, K cal	50	59	41	–	94
Calcium, mg	46.9	40	50	300	88
Phosphorus, mg	50	60	50	290	94
Iron, mg	0.6	1.2	7.43	2	1
Carotene, µg	–	15	595	–	-
Thiamin, mg	0.08	0.08	–	0.42	0.1
Riboflavin, mg	0.01	0.02	0.03	0.06	0.01
Niacin, mg	0.4	0.5	0.3	–	0.7
Folic acid, mg	6	–	–	–	11.3
Vitamin C, mg	11	2	17	147	20.7
Magnesium, mg	16	–	104	–	30.2
Sodium, mg	4	–	2.2	40	7.5
Potassium, mg	127	–	109	1000	240
Copper, mg	0.18	–	0.45	–	0.3
Manganese, mg	0.18	–	0.74	–	0.3
Molybdenum, mg	0.03	–	2.29	–	0.05
Zinc, mg	0.41	–			0.7
Proximate composition and energy values of raw, dehydrated onion and freeze dried (per 100 g of onion) (Source: Onion crop details, NHRDF 2009)					

- \*Nutritional Information for Freeze Dried has been based on some assumption.



- **Shelf life** is largely driven by the moisture content. Dehydrated foods mostly have a shelf life of 15-20. Freeze dried foods as a general rule of thumb have a longer shelf with expectations of 25-30 years, if being stored at temperature of 15°C or below.
- **Appearance** this is something that is very noticeable between the two processes. Freeze drying keeps its shape and form more so than dehydrating. The image below shows both dehydrated and freeze dried mango's



Figure 2. Dehydrated and freeze dried mango<sup>2</sup>

- **Weight** of the product from the two processes is less from the freeze drying as the moisture content removed via Freeze Drying is greater. Water content of fruit and vegetables can be up to 80-90 percentage (Onions 89%).
- **Cooking** with freeze dried food is much simpler than dehydrated as with freeze dried all you have to do is add cold or hot what for it to regain its original structure. Where dehydration can form a slight slick out layer and doesn't reabsorb moisture the same.
- **Cost** is dependent on what you buy, but generally dehydrated is cheaper than freeze dried, as shown in Table 3 & 4 on page 15.
- **Texture** for dehydrated food is stickier whereas freeze dried is normally crunchier and crisp.

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<sup>2</sup>Difference Between Freeze Dried and Air Dried Food. (2019, January 30) Retrieved from <https://superlife.co/difference-freeze-dried-air-dried-food/>

## 5.0 The Principles of Freeze Drying

Freeze drying also known as lyophilisation is an important process for the preservation and storage of biological, pharmaceuticals and foods. Freeze drying is essentially completely removing water from the subject such as food while leaving the basic structure and the composition of the material intact. Freeze drying is a process whereby water or other solvent is removed from frozen material by converting the frozen water directly into vapour without the intermediate formation of liquid water.

The fundamental principle in freeze drying is sublimation. This is the transition of a substance directly from solid to the gas phase, without passing through the intermediate liquid phase. When you increase the temperature of water above  $0^{\circ}\text{C}$  while keeping the atmospheric (ATM) pressure below  $0.06\text{ATM}$ , there will not be enough pressure for a solid to form into a liquid therefore it will become a gas.

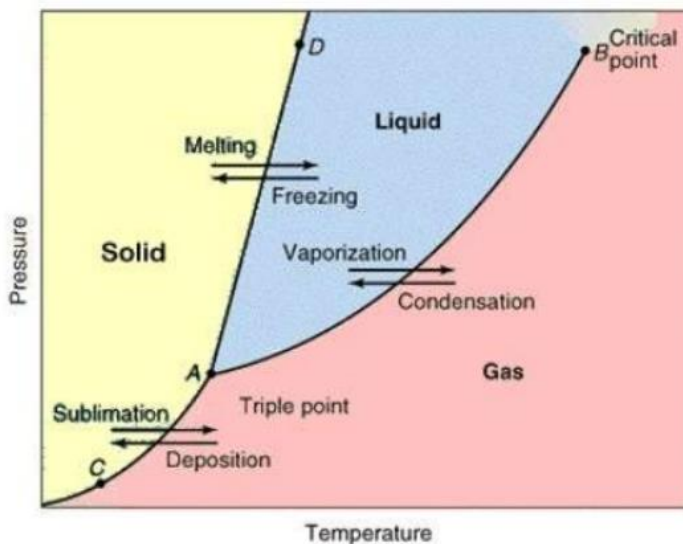


Figure 3. Phases Diagram <sup>3</sup>

As shown above in the diagram at triple point ( $0.0098^{\circ}\text{C}$  and  $4.58\text{ mm Hg}$ ) shown in point A is where water, gas and ice coexist. When you heat the water above triple point the water will change from liquid to vaporization / gas. If the temperature is cooled to below triple point it will change from liquid to freezing / solid.

<sup>3</sup> What is the triple point? (n.d.). Retrieved from <https://www.quora.com/What-is-the-triple-point>

Freeze drying process is made up of three stages these are show in the below diagram, they include:

- **Freezing** – Cooling the material until completely frozen, freeze temperatures are between  $-50^{\circ}\text{C}$  and  $-80^{\circ}\text{C}$ .
- **Primary Drying** – The pressure is lowered, and enough heat is supplied to the product for the ice to sublimate. This is the phase maybe slow depending on the product, because if too much heat is added the structure could be altered.
- **Secondary Drying** – to remove unfrozen water molecules, since the ice was removed in the primary drying phase. In the temperature is raised higher than in the primary drying phase, to break any physicochemical interaction that have formed between the water molecules and the frozen material.

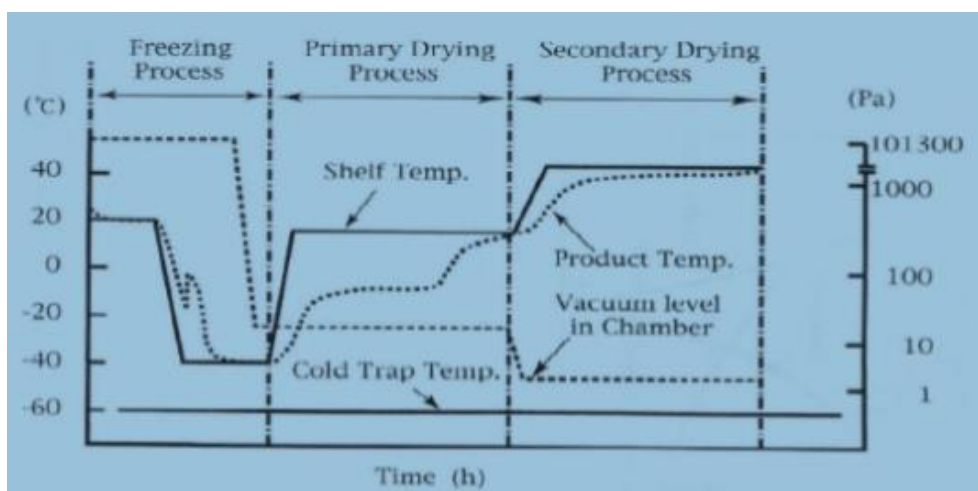


Figure 4. Three Phases of Freeze Drying

## 5.1 Advantages and Disadvantages

The main area that are seen as advantages and disadvantages of freeze drying are as follows:

### Advantages

- Removal of water without high level of heat
- Can be easy rehydrated
- Retains all of it nutrients and health properties
- Lengthens life of product
- Lightweight, which reduced freight cost
- Requires no refrigeration, long term storage costs are reduced
- Physical structure of the food is not altered food retains much of its colour, shape, texture and flavour when prepared
- Less wastage of second grade onions and less household wastage if household was to use freeze dried products

## Disadvantages

- Increased handling and processing time
- Cost – CAPEX or contract drying
- Cost – Increase cost of goods

## 6.0 Business Objective

By freeze drying the onions this would enable the product that was not the right specifications to be exported to still be utilised for human consumption along with extending the shelf life of the product. As New Zealand exports 82% of the onions grown to a wide range of countries, this is a practical way of gaining more value for our second grade onions on the world stage. As a high export country of onions, we are exporting them in their fresh form all over the world. With onions having a water content of 82-89%, with the further processing of onions and reducing the water that we are exporting with our onions.

Looking at the graph below this shows the seasonality of New Zealand onion exports. Our exports are higher for the first half of the year, this is the opposite of other larger export countries like Netherlands, China, and Mexico. Global export of onions in 2014 was \$3.4 billion with Netherlands making up approximately 20%.

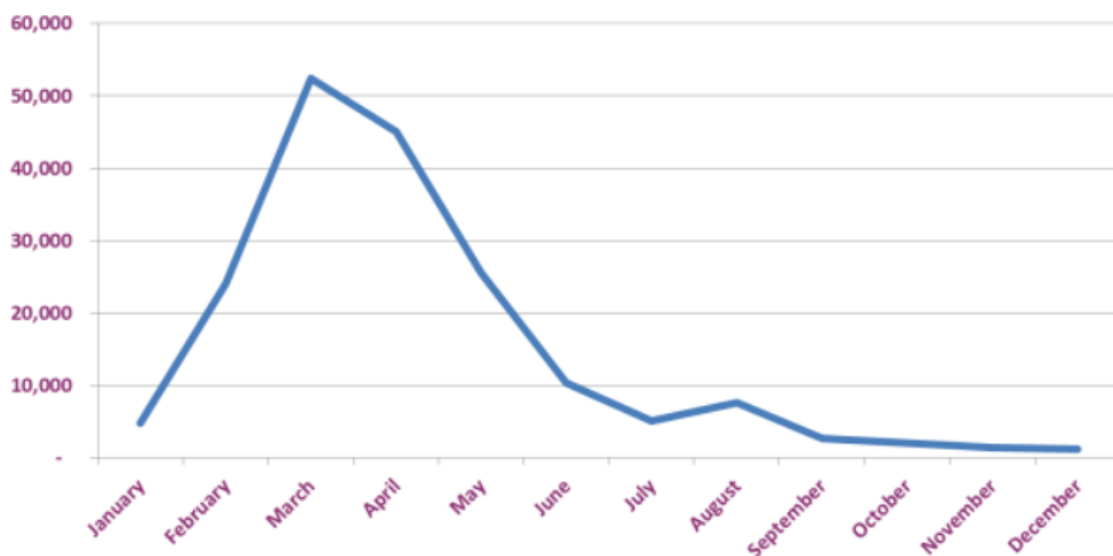


Figure 5 Tonnes of Fresh NZ onions Exported (2014)<sup>4</sup>

Figure 5 above shows the seasonality of New Zealand exports, this curve also lines up with the seasonality of onions. Onions in New Zealand are largely harvested in the warmer months of the year between December – March. Once the onions are harvested they are dried either in the field or in specialised drying sheds. Onions can be kept for approximately eight – ten months if they have been handled and stored correctly. As a country New Zealand exports 82% of the onions produced.

<sup>4</sup> Onions NZ, Post harvest onion production. (n.d.). Retrieved from <http://www.onionsnz.com/all-about-onions-2/post-harvest/>

## 7.0 The Finance Section

### 7.1 Freeze Drying

With the freeze drying of onions, there is three ways that the freeze drying process can be undertaken, they are as follows –

- **Under Contract**

There are a number of companies in the South and North Island that have surplus capacity and currently undertake freeze drying on contract. Freeze drying under contract takes out the capital cost of purchasing a freeze dryer. The cost to freeze dry in New Zealand ranges from \$████ - \$████, these cost have been obtained from companies that undertake freeze drying along with companies that contract freeze drying

- **Buying a Harvest Right Freeze Dryer**

There is company based in the USA that sells at home freeze driers, they are inexpensive and of a smaller scale. They sell three different sizes and they range from 2 kg – 7kg wet weight and are priced at \$████ - \$████ NZD (Excluding additional duties, taxes, and brokerage fees). The review that I have read online for these driers are mixed. This is reasonable new technology, so there might be some initially teething problems.

- **Buying a Cuddon Freeze Dryer**

Cuddon Limited are a Blenheim based business that make and export driers all over the world. They make a huge range of size with smallest drier that they make is a R&D dryer and costs around \$████, with the size only being 5.5 kg it doesn't give you much scale as this would only result in 605 grams per dry cycle which takes 24 hours. There smallest commercial dryer of theirs is FD80 and costs \$████ and give you 8kg dry product per batch (24hrs), which would result in 880 grams.

They also make larger dryer up 1.5 tonnes, something with scale would be the best long term out come so you could do the drying in house and have control of all of the cost. Buying a Cuddon Freeze Dryer would be the best financial decision, but this is a substantial investment for the business.

## 7.2 Financial Appraisal

The financial appraisal has been based on freeze drying on under contract. The reason I have looked at modelling the viability of the business this way is due to the large investment involved in purchasing a dryer. Along with the nature of onions having a long shelf life the freeze drying could be done in the winter months when some freeze drying companies are not so busy.

Table 2. Cost of Freeze Drying

	<b>Cost / kg</b>
<b>Total cost (Wet weight)</b>	<b>\$ [REDACTED] - \$ [REDACTED]</b>
Weight left after Freezer Drying	11%
<b>Freeze Dried Cost / kg</b>	<b>\$ [REDACTED] - \$ [REDACTED]</b>

The freeze drying under contract includes the price of processing, Freeze Drying, packaging and milling if required. These costs above do not take into consideration transportation to drying facilities or to warehouse.

Once the company has been established and has been running for about four years the under contract vs buying should be reassessed based on how profitable the business has been or earlier if the sales and establishment of the market is going well. The cost for contracting freeze drying will be negotiated on an annual basis to take into consideration volume

## 7.3 Comparable Price Analysis

With research of overseas market of price and size of packages for both freeze dried and dehydrated onions are in table 2 and 3 below. As shown in the table freeze dried onions receives a premium in the market place due to its niche process and the superior shelf life.

The selection of a comparable product that I could find on amazon was very limited, the three above products in the table shows that freeze dried onions all come in cans of approximately 400 grams and the price range received per kilogram is \$71- \$82 which equities to \$7.80 - \$9.00 per kilogram of fresh onions.

Table 3. Prices of comparable product - Freeze Dried Onions

	<b>Weight kg</b>	<b>Price (NZD)<sup>5</sup></b>	<b>Price /kg</b>
Honeyville Freeze Dried Onions	0.40	28.49	71.36
Fresh and Honest Food 100% all Natural Freeze Dried Chopped Onions	0.45	37.43	82.51
Saratoga Farms Freeze Dried onion	0.40	31.44	79.22
<b>Price and weight</b>	<b>0.42</b>	<b>\$32.45</b>	<b>\$71-\$82</b>

<sup>5</sup> Currency converted USD/NZD @ 1.50

While looking for comparable prices as there were limited freeze dried onions I also looked at the cost of dehydrated onion. These are a lower value product than freeze dried, as shown in the table below.

Table 4. Price of comparable product – Dehydrated Onions

	<b>Weight kg</b>	<b>Price (NZD)<sup>4</sup></b>	<b>Price /kg</b>
Marshall Creek Spice Onion Chopped refill	0.17	11.67	68.61
Marshall Creek Spice Onion Seasoning	0.45	22.77	50.20
Augason Farm Dehydrated Chopped Onions	0.65	17.21	26.39
Badia Onion Flakes	2.38	50.51	21.21
Frontier Co-op Organic White Onion Chopped (bag)	0.45	11.61	25.60
Simply Organic - Minced Onion	0.06	14.84	236.78
Frontier Chopped White Onion, Allium Cepa	0.91	28.88	31.83
Minced Onion	0.45	18.08	39.85
Tone's Minced Onion	0.43	27.57	64.83
Naturevibe Botanicals Organic Onion Flakes	0.45	18.02	39.72
McCormick Organic Minced Onion	0.28	29.31	103.39
Marshall's Creek Spices Onion Seasoning, Chopped	0.28	22.38	78.94
Honeyville Dehydrated Onions	0.79	21.14	26.63
<b>Price and weight</b>	<b>0.60</b>	<b>\$22.61</b>	<b>\$21-\$236</b>

The range of prices per kilogram is very wide with two main outliers, they are both organic onions therefore a premium is paid above normal onions. With excluding this two the range is \$21 - \$78, with some of the higher end price being sold in premium package, being of the smaller nature and in glass.

## 7.4 The Five P's of Marketing

### - Product

The freeze dried onions would come in three different forms cubed, sliced and powder. These would be sold in foil like zip lock bags to help prolong the shelf life of the product. The onions used would be second grade onions that cannot be export of sold on the local market. These onions would still be the same standard as New Zealand export onions but have a slight defect, skinless or out of shape once slice and diced they still have the same characteristics as a fresh New Zealand onion.

### - Price

The product would be sold in line with the current freeze dried onions being sold in the country, but not sold below the breakeven price. Selling price would be standard from each country, if the price is not above breakeven then the country marketed to would be reassessed.

- **Promotion**  
A Facebook, Instagram, Web and LinkedIn pages will be used to handle the promotion of the business. Also we would look to align our company with like mind companies / people who use and enjoy our freeze dried onions.
- **Place**  
Product would be sent via sea freight and distributed to the main ports, the product would then become the merchandiser property until sold. The product would first be sold in New Zealand, China, India and USA as the later three already have an established market. Each country would have merchandiser that would represent the product in that country they would manage the logistics once the product is unloaded in the given country.
- **People**  
Friendly New Zealand and USA based staff members who understand the brand story. All staff members will have followed the product from paddock to plate in person or via a short company video. This helps them understand the company core values and enables them to provide exceptional customer service.

## **7.5 Sensitivity Analysis**

The element that has the most effect on the price of the cost of production is the contracting of freeze drying, which is outside of your control. If the price of onions are increase significantly this has very little to no effect on the cost of production as this is a very small percentage of production costs. While working out the cost of freeze drying I used a range of price which provides some sensitivity about the costing of undertaking freeze drying onions.



## **8.0 Conclusions**

Unfortunately there will not be a large volume that would be sold locally. It would be best marketed and sold to countries that already have an established market. There is a limited market for freeze dried onions in New Zealand is due to the cost per kilogram vs fresh onion as onions are not seen to be a premium product or shortage. In saying that there may be a small market in New Zealand for high end restaurants.

My advice is that there is still a lot that needs to be done on the R&D front. They are as follows:

- Sample Tests of second grade onions,
- Packaging of product,
- Markets to target / export countries,
- Niche Market,
- Marketing plans,
- Brand story,
- Prices to be sold for.

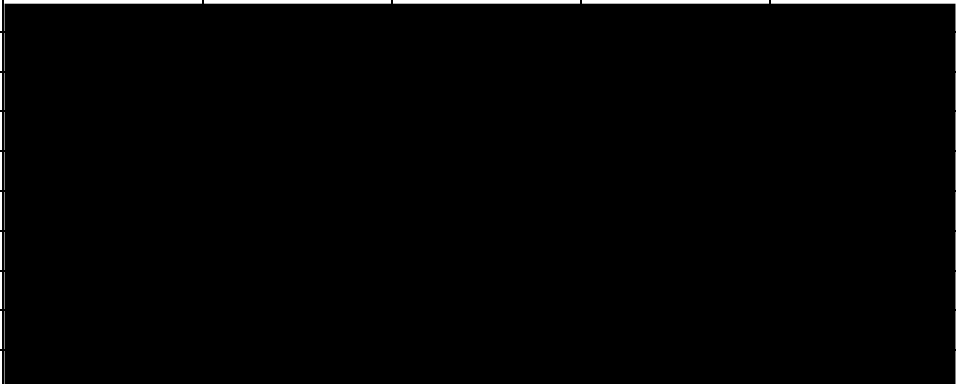
In conclusion there is a market for freeze dried onion but once the further R&D has been done we will worked out if it is viable with New Zealand onions, As New Zealand onions are regarded as premium product in majority of the countries that we currently export our onions too.

## 9.0 Appendix

### 9.1 Expected Revenues

The expected revenues has been estimated bases on pricing and information that has been obtain.

Table 5. Expected Revenues for years 1 - 5

	Year 1	Year 2	Year 3	Year 4	Year 5
Cost / kg	59.00	59.00	59.00	59.00	59.00
Marketing					
Shipping					
Revenue / kg					
Profit / kg					
Tonnes (wet)					
Kg's					
Revenue					

\*Costs have been based on assumptions as stated earlier on in report in Table 2

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