



Extending the Season with Frozen Fruit Products

An Integrated Research-Extension Program Targeted Toward Determining New Market Channels for Local Producers



Introductions

Project Team



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Sponsored Program:

This project was gratefully funded by the Northeast Sustainable Agriculture & Education Program (NESARE award, project number LNE 18-370) and the Massachusetts Agricultural Experiment Station, and the Food Science department of the University of Massachusetts Amherst, under project number MAS0040.

UMASS



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Project Overview

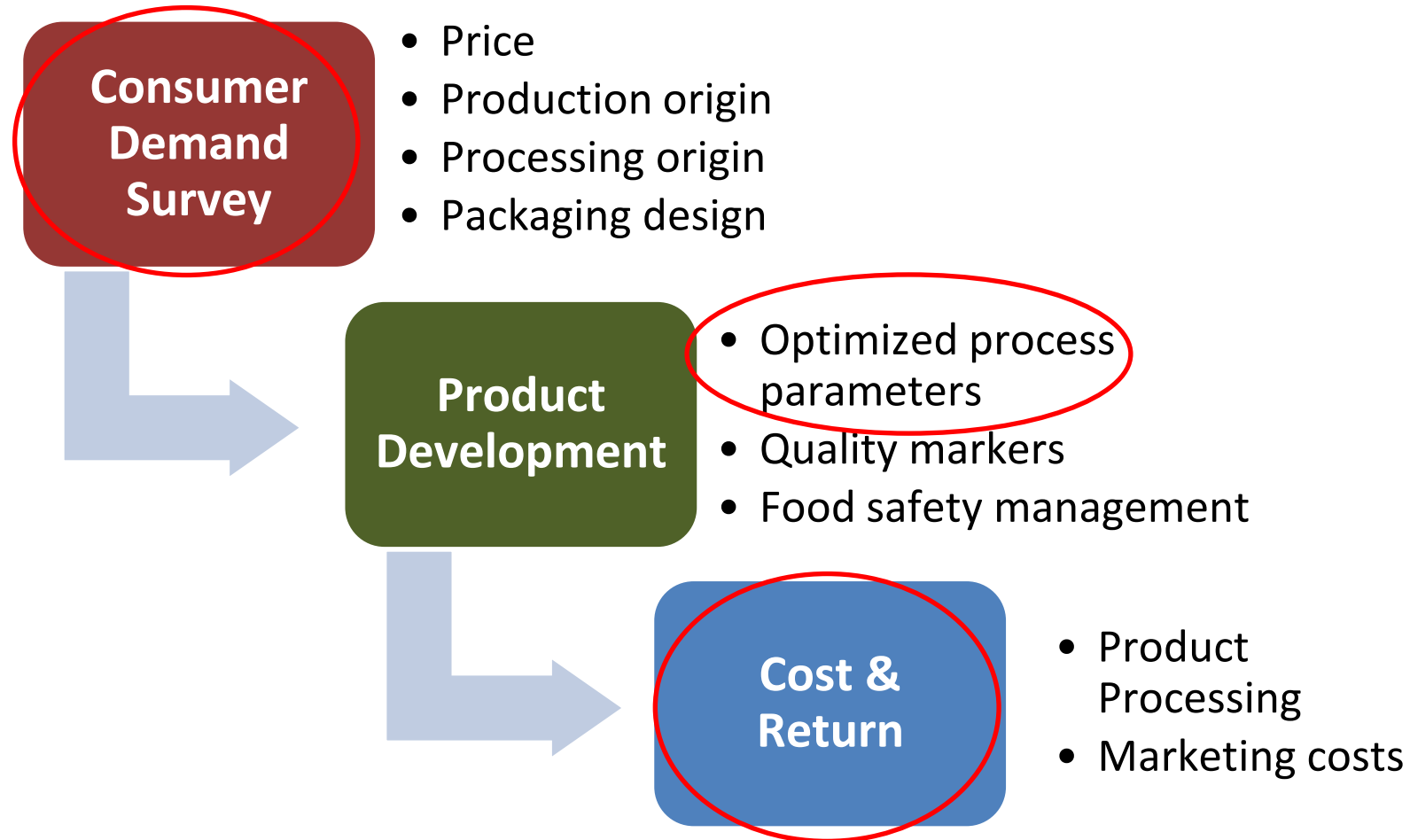
Hypothesis

Local produce can be profitably grown and processed (frozen) for off-season retail sales.



- Consumers have higher *willingness-to-pay* for locally produced and processed frozen foods
- Costs of producing safe, high-quality locally grown and processed frozen foods will not exceed consumers' *willingness-to-pay*.

Key Objectives



Presentation Overview

- How we froze the Blueberries
- How we figured out what people would pay
- How we figured it out production costs
- How we put it all together in a tool for farmers to use to figure out if it is a good choice for your operation

Process Implementation

Product Research & Development

- **Activity:** Process Optimization
- **Method**
 - Bench top screening trials (washing, blanching, dwell time, temp)
 - Scale up at FPC
- **Result/ Outputs**
 - Non-proprietary SOPs for shared-use
 - Food safety plan
 - Process to support Obj 3 (cost & return)



Blueberries Process Optimization

Key Quality Attributes & Process Conditions



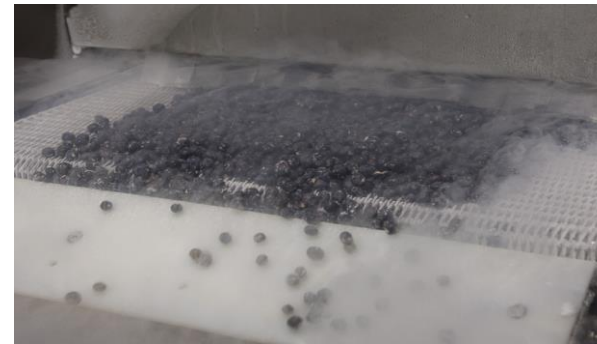
Texture



Drip Loss

Analysis

- Variants: Temperature vs Time
- Quality attributes:
 - Texture
 - Polyphenols
 - Color
 - Appearance
 - Drip Loss



Appearance

150s, -120F



150s, -140F



180s, -120F



180s, -140F



Process Optimization – Lessons Learned

- Developing optimal IQF processes depend on many factors, such as
 - Water content of product
 - Temperature of product before it is loaded into the liquid nitrogen freezing tunnel
 - Size and shape of product
 - Temperature of frozen storage

Take-away: Getting high-quality frozen product is complicated!

- Have to find the “sweet spot”!
- Ask Amanda about this!

Consumer Market Research

How Much Will Consumers Pay for Local/ Regional Frozen Products?

TAKE-AWAY: Different Marketing Approaches for
Different Consumers

- “Local Foods” Consumers care most about **where** they buy frozen “local” products
- “Traditional” Consumers are more price-sensitive

How Much Will Consumers Pay for Local/ Regional Frozen Products?

- What do consumers care about?
- Do they care enough to pay a price premium?
- Is the premium enough to:
 - ✓ Cover production costs?
 - ✓ Pay farmers a premium?

What do consumers care about?

We tested the following product characteristics:

- Where the product is grown
- Where the product is frozen
- Where they buy it
- How much they pay
- What the package looks like

Returns from Product Sales:

How much will consumers pay for a frozen retail product?

Who took part in this experiment?

Two Consumer Groups

1. “Traditional Consumer” – New England primary household shoppers
 - Purchased sample of 500 respondents
2. “Local Foods Consumer”
 - Sent to 3 mailing lists of local foods consumers ~250 responses

Choose your preferred option :

Option 1

Price **\$7.50**

Package



Grown **in the USA**

Frozen **in the USA**

Bought From **Direct from Farmer (Farmers Market, Farm Share, Farm Stand)**

Option 2

Price **\$3.75**

Package



Grown **in the Northeast**

Frozen

Bought From **Supermarket (Chain or Independent that sells only food)**

Option 3

Price **\$5.60**

Package



Grown

Frozen **in the USA**

Bought From **Supermarket (Chain or Independent that sells only food)**

None of these options

Choose your preferred option :

PRICE →

5 Variations:

\$3.75

\$4.75

\$5.60

\$6.55

\$7.50

Option 1

Price \$7.50

Package



Grown in the USA

Frozen in the USA

Bought From Direct from Farmer (Farmers Market, Farm Share, Farm Stand)

Option 2

Price \$3.75

Package



Grown in the Northeast

Frozen

Bought From Supermarket (Chain or Independent that sells only food)

Choose your preferred option :

PACKAGE →

4 Variations

- Clear Bag
- White Bag
- Printed Label
- Sticker Label

Option 1

Price **\$7.50**

Package 


Grown **in the USA**

Frozen **in the USA**

Bought From **Direct from Farmer (Farmers Market, Farm Share, Farm Stand)**

Option 2

Price **\$3.75**

Package 

Grown **in the Northeast**

Frozen

Bought From **Supermarket (Chain or Independent that sells only food)**

Choose your preferred option :

4 Variations:

- Local
- In the Northeast
- In the USA
- (no info)

GROWN →

Option 1

Price **\$7.50**

Package 


Grown **in the USA**

Frozen **in the USA**

Bought From **Direct from Farmer (Farmers Market, Farm Share, Farm Stand)**

Option 2

Price **\$3.75**

Package 

Grown **in the Northeast**

Frozen

Bought From **Supermarket (Chain or Independent that sells only food)**

Choose your preferred option :

4 Variations:

- Local
- In the Northeast
- In the USA
- (no info)

FROZEN →

Option 1

Price **\$7.50**

Package 


Grown **in the USA**

Frozen **in the USA**

Bought From **Direct from Farmer (Farmers Market, Farm Share, Farm Stand)**

Option 2

Price **\$3.75**

Package 

Grown **in the Northeast**

Frozen

Bought From **Supermarket (Chain or Independent that sells only food)**

Choose your preferred option :


4 Variations:

- Direct from Farmer (Farmers Market, Farm Share, Farm Stand)
- Supermarket (Chain or Independent that sells only food)
- Super Store ("Big Box" store that offers large household goods)
- Cooperative Grocer (Food Co-op)

BOUGHT →

Option 1

Price **\$7.50**

Package 


Grown **in the USA**

Frozen **in the USA**

Bought From **Direct from Farmer (Farmers Market, Farm Share, Farm Stand)**

Option 2

Price **\$3.75**

Package 

Grown **in the Northeast**

Frozen

Bought From **Supermarket (Chain or Independent that sells only food)**

What do consumers care about?

We found Marginal Premiums for:

- Where the product is grown
Local \$1.50; Northeast \$1.25
- Where the product is frozen
Local \$0.40; Northeast \$1.15
- Where they buy it
Farm Stand \$1.50; Super Market \$1.00; Big Box \$-1.15
- What the package looks like (They don't care!)

Cost Analysis & Tools

How We Estimated Costs



Production Costs

Cost per unit **BLUEBERRIES** is \$4.98/lb

- Fixed costs: \$0.49/lb
Include: equipment and overhead
- Variable costs: \$4.49/lb
Include: supplies, ingredients, wages



Why the high costs?

High cost of fresh ingredients

- **\$3.46 for blueberry**

Equipment and Labor

- Equip. limitations
- Associated labor costs

Other challenges

- Blueberries in pints



Costs & Returns Analysis

Overview Processing & Sales Costs:

How much does it cost a farmer to process and sell local frozen blueberries?

Processing Options

1. Will you hire a facility to Co-Pack
2. Will you invest in On-farm equipment to process

Retailing Options

1. Will you sell direct to consumer
2. Will you sell through a non-farm Retailer

Returns from Product Sales:

What price can you charge in the market place?

1. What characteristics does the final product have?
2. What market are you aiming for?

RETURNS = PRICE x QUANTITY SOLD

Profitability Calculator



Frozen Retail Blueberry Profitability Calculator

Step 1: Pre-Farm Gate Production Costs

	Costs	Quantity	Unit	Cost	Quantity	Unit	Total	Notes
Per unit on-farm production	\$ 2.30	5000	Lbs				\$ 11,500.00	
TOTAL PRE-FARMGATE COSTS							\$ 11,500.00	

Processing Assumptions

Blueberry Shrinkage		0.99	Percent					
Yield in Lbs		4950	Lbs					
Yield in Ounces		79200	Ounces					
Hours per IQF Production Day		8	Hours					
IQF Production Days		2	Days	500	IQF Production capacity: Lbs/ hour			Rounded up to the day
Actual Days		1.250	Days					
Total IQF Hours		10	Hours					
Hourly Workers		16	Worker Days	8	Per Actual day			

This Calculator was developed using data collected during site trials and market research for frozen retail blueberries.

The Calculator, however, is designed to be edited to reflect the particular costs of your facility, and any specialized knowledge you might have regarding pricing.

Fields that are a salmon or yellow color and are outlined in red can be edited.

(like this)

(or this)

All other fields are formula fields that will calculate costs and returns based on the information you enter.

You may also add or delete lines to include otherwise omitted costs and returns that may be specific to your operation or the product you are freezing.

Calculator Citation : Fitzsimmons, J. Lass, D. & Minifie, K. 2021. *Frozen Retail Blueberry Profitability Calculator*. (web address)

For more detailed information regarding the site trials, please access the explanatory white paper, *Produce Freezing Costs at the WMFPC*, by Lass, D. Minifie, K. & Fitzsimmons, J. 2021.

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Processing Option 1. Hire a facility to Co-Pack

Step 2: Processing Costs

Processing Options

Option 1) Co-pack

Variable Costs

Delivery to Processor	\$ 0.60	65 Miles	1 Loads	\$ 39.00	5,000 lbs
Bags	\$ 0.06	6600 ea		\$ 396.00	100%
Boxes for bags	\$ 0.47	550 ea		\$ 258.50	12 bags in
Labels	\$ 0.01	7150 ea		\$ 71.50	
Food Processing Operations Director	\$ 40.00	10 Hours		\$ 400.00	
Production worker (s)	\$ 18.00	25.17 Hours	8 Workers	\$ 453.06	
Co pack facility fees	\$ 55.00	13 Hours	500 lbs/ hour	\$ 715.00	
Storage	\$ 60.00	6 Pallet	4 Month	\$ 1,440.00	50 boxes
Prep and Clean up	\$ 23.00	8 Hours	2 Prod Day	\$ 368.00	
Production worker (s)	\$ 23.00	15.00 Hours	16 Worker	\$ 5,520.00	number of
Total Option 1 Variable Costs				\$ 9,661.06	
Markup	0.25	Percent		\$ 2,415.27	
Total Option 1 Costs				\$ 12,076.33	

Processing Option 1: Co-Pack Costs

Total \$ 12,076.33

Unit (Retail Bag) \$ 1.83

Processing Option 2.

Invest in On-farm equipment to process

Step 2: Processing Costs

Processing Options

Option 2) Farm-Operated Processing

Costs

Fixed

Equipment	Value/Cost	Number Used	Depreciation (straight line)	Salvage Value	Days used/yr	Equipment Useful Life	Hours used per day
IQF	\$ 20,000.00	1 ea	\$ 9.62	\$ 10,000	52	20	8
IQF Dual Pack Table & Scales	\$ 5,870.00	1 ea	\$ 16.13	\$ -	52	7	8
Electric Pallet Jack	\$ 2,200.00	1 ea	\$ 3.85	\$ 1,200	52	5	8
Check weight filler	\$ 9,457.00	1 ea	\$ 19.07	\$ 4,500	52	5	8
Band Sealer	\$ 1,602.00	1 ea	\$ 4.24	\$ 500	52	5	8
Prep table	\$ 700.00	3 ea	\$ 2.69	\$ -	52	15	8
Utility Cart	\$ 129.00	2 ea	\$ 2.48	\$ -	52	2	8
Brute	\$ 35.00	6 ea	\$ 2.02	\$ -	52	2	8
Spinner centrifuge	\$ 2,330.07	1 ea	\$ 3.19	\$ 1,500	52	5	8
Basket for Spinner	\$ 260.37	1 ea	\$ 2.50	\$ -	52	2	8
Dunk tank	\$ 5,300.00	1 ea	\$ 3.59	\$ 2,500	52	15	8
Baskets for dunk tank	\$ 310.00	4 ea	\$ 4.77	\$ -	52	5	8
Label printer 1	\$ 400.00	1 ea	\$ 2.40	\$ 150	52	2	8
Label printer 2	\$ 150.00	1 ea	\$ 0.38	\$ 50	52	2	8
Total Equipment and Depreciation¹	\$ 51,377.44		\$ 76.93				
Total Equipment Interest/Opp. Cost²	\$ 256.89	Monthly	\$ 12.84			6%	Interest Rate/Opportunity Cost of Investment
Equipment Maintenance/repair³	\$ 1,750.00	Monthly	\$ 87.50				
Equipment/ Operation Day Total			\$ 177.27				

Building & Utilities	Costs	Quantity	Unit	Quantity	Unit	Total	Notes	
WMFPC Building Total	\$ 439.80	20	Daily	2	Prod Day	\$ 879.59		
Water/sewer	\$ 25.00	20	Daily	2	Prod Day	\$ 2.50	Costs in this section can be amended in Building, Utilities, Labor tab	
Electric	\$ 129.17	20	Daily	2	Prod Day	\$ 12.92		
Gas (Hot Water)	\$ 45.83	20	Daily	2	Prod Day	\$ 4.58		
Trash Removal	\$ 37.50	20	Daily	2	Prod Day	\$ 3.75		
Cleaning Supplies	\$ 29.17	20	Daily	2	Prod Day	\$ 2.92		
Laundry Service	\$ 20.83	20	Daily	2	Prod Day	\$ 2.08		
Other supplies	\$ 21.11	20	Daily	2	Prod Day	\$ 2.11		
Pest Control	\$ 11.00	20	Daily	2	Prod Day	\$ 1.10		
Batch Overhead total						\$ 911.55		Daily Overhead Total \$ 29.95

Total Option 2 Fixed Costs			Batch Rate	\$ 2,896.25
			Per Unit	\$ 0.44

Variable

Ingredients	Costs	Quantity	Unit	Quantity	Unit	Total	Notes
Liquid Nitrogen	\$ 0.13	4,950	per pound processed			\$ 653.40	
Sandidate	\$ 2.28	4	per 500 pounds processed			\$ 9.12	
Ingredients Total						\$ 662.52	

Supplies	Costs	Quantity	Unit	Quantity	Unit	Total	Notes
Bags	\$ 0.06	6600	ea			\$ 396.00	100% retail, 12oz bags
Boxes for bags	\$ 0.47	550	ea			\$ 258.50	12 bags in each box
Labels	\$ 0.01	7150	ea			\$ 71.50	
Hairnets	\$ 0.03	2	ea			\$ 0.06	
Beard Nets	\$ 0.02	1	ea			\$ 0.02	
Gloves	\$ 0.12	4	ea			\$ 0.48	
Heavy duty edge protectors	\$ 3.40	4	ea			\$ 13.60	
Storage	\$ 60.00	10	Pallet	4	Month	\$ 2,444.44	54 boxes per pallet
Supplies total						\$ 3,184.60	

Wages	Costs	Quantity	Unit	Quantity	Unit	Total	Notes
Administrative Overhead	\$ 384.00	1	Daily	2	Prod Day	\$ 768.00	Costs in this section can be amended in Building, Utilities, Labor tab
Prep and Clean up	\$ 136.40	1	Daily	2	Prod Day	\$ 272.81	
Production workers	\$ 402.77	1	Daily	2	Prod Day	\$ 805.54	
Fringe		40%	Rate			\$ 738.54	
Wages total						\$ 3,618.83	

Total Option 2 Variable Costs			Batch Rate	\$ 7,465.96
			Per Unit	\$ 1.13

Total Option 2 Costs			\$ 10,362.21
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Processing Option 2: On-Farm Costs		Total	\$ 10,362.21
		Unit (Retail Bag)	\$ 1.57

Retailing Option 1.

Sell direct to
consumer

Step 3: Retailing Costs

Retailing Options

1) Sell at Own- Farm Store

							Depreciation (straight line)	Salvage Value	Days used/yr	Useful Life
<i>Fixed</i>										
	Frozen case - Equipment	\$ 5,000.00	1	ea			\$ 0.48	\$ 1,500	365	20
	Rent/ Mortgage Portion	\$ 300.00	1	month			\$ 3,600.00			
	Total Fixed Costs						\$ 3,600.48			
<i>Variable</i>										
	Personnel	\$ 18.00	8	Hours	8	Workers	\$ 1,152.00			
	Farm Stand Overhead	\$ 150.00	12	Monthly			\$ 1,800.00			
	Storage	\$ 60.00	10	Pallet	4	Month	\$ 2,444.44			
	Frozen Case - Electricity	\$ 100.00	12	Monthly			\$ 1,200.00			
	Delivery to Farm	\$ 0.60	65	Miles		1 Loads	\$ 39.00			
	Total Variable Costs						\$ 6,635.44			
	Total						\$ 10,235.92			

Retailing Option 1: On-Farm Costs

Total \$ 10,235.92
Unit (Retail Bag) \$ 1.55

Step 4: RETURNS

Retailing Options		Returns	Quantity	Unit	Returns	Quantity	Unit	Total	
1)	Sell at Own- Farm Store								
<i>Price</i>									
	Base Retail Price	\$ 2.50	6600	bag				\$ 16,500	\$ 16,500
<i>Premiums</i>									
	Origin Branding	Local			NE			Local	NE
		\$ 1.50	6600	bag	\$ 1.25	6600	bag	\$ 9,900	\$ 8,250
	Frozen Branding	Local			NE			Local	NE
		\$ 0.40	6600	bag	\$ 1.15	6600	bag	\$ 7,590	\$ 7,590
	Purchase Location								
	Farm Stand	\$ 1.75	6600	bag				\$ 11,550	\$ 11,550
	Suggested Retail Price								
	Local	\$ 6.90	6600	bag				Local	NE
	NE	\$ 6.65	6600	bag				\$ 45,540	\$ 43,890

Step 3: Retailing Costs

Retailing Options

2) Sell to Non-Farm Retailer

Fixed

Marketing	\$ 2,500.00	1	per year		\$ 2,500.00	
Distributor Slotting Fee	\$ 10,000.00	1	per year	0.2	\$ 2,000.00	\$10,000 per year, assume this accounts for one item in 5 -item portfolio
Retailer Slotting Fee	\$ 10,000.00	1	per year	0.2	\$ 2,000.00	\$10,000 per year, assume this accounts for one item in 5 -item portfolio
Trade Show	\$ 2,000.00	1	per year	0.2	\$ 400.00	\$2,000 per year, assume this accounts for one item in 5 -item portfolio

Total Fixed Costs \$ **6,900.00**

Variable (that contribute to SRP)

Markup						
Retailer	40%	bag			\$ 2,640.00	
Distributor	25%	bag			\$ 1,650.00	

Total Variable Costs \$ **4,290.00**

Total \$ **11,190.00**

TOTAL RETAILING COSTS

Retailing Option 2: Non-Farm Retailer Costs **Total** \$ **11,190.00**
Unit (Retail Bag) \$ **1.70**

Step 4: RETURNS

Retailing Options

2) Sell to Non-Farm Retailer

	Returns	Quantity	Unit	Returns	Quantity	Unit	Total	
<i>Price</i>								
Base Retail Price	\$ 2.50	6600	bag				\$ 16,500	\$ 16,500
<i>Premiums</i>								
Origin Branding	Local \$ 1.50	6600	bag	NE \$ 1.25	6600	bag	\$ 9,900	\$ 8,250
Frozen Branding	Local \$ 0.40	6600	bag	NE \$ 1.15	6600	bag	\$ 2,640	\$ 7,590
Purchase Location								
	Big Box \$ (1.15)	6600	bag	SuperMarket \$ 1.00	6600	bag	\$ (7,590)	\$ 6,600
<i>Suggested Retail Price</i>								
Supermark Local	\$ 5.40	6600	bag				Local	NE
NE	\$ 5.90	6600	bag				\$ 35,640	\$ 38,940

Retailing Option 2.

Sell through a non-farm Retailer

Frozen Retail Blueberry Profitability Calculator

Values Autofill from Previous Worksheets

TOTAL PROCESSING COSTS

Processing Option 1: Co-Pack Costs	Total	\$	12,076.33
	Unit (Retail Bag)	\$	1.83
Processing Option 2: On-Farm Costs	Total	\$	10,362.21
	Unit (Retail Bag)	\$	1.57

TOTAL PRODUCTION + PROCESSING COSTS

Option 1: Co-Pack Costs	Total	\$	23,576.33
	Unit (Retail Bag)	\$	3.57
Option 2: On-Farm Costs	Total	\$	21,862.21
	Unit (Retail Bag)	\$	3.31

TOTAL RETURNS

Option 1: On-Farm Sales, Local Grown & Frozen	Total	\$	10,235.92
	Unit (Retail Bag)	\$	1.55
Option 2: Supermarket Sales, Northeast Grown & Frozen	Total	\$	11,190.00
	Unit (Retail Bag)	\$	1.70

Compare Potential Profitability between Options

TOTAL PROFIT

		Processing Options										
		Co-Pack			On-Farm							
		Total	Unit		Total	Unit						
Post-Processing Options	On-Farm Sales, Local Grown & Frozen	Total Costs	\$	23,576.33	\$	3.57	\$	21,862.21	\$	3.31		
			\$	10,235.92	\$	1.55	\$	10,235.92	\$	1.55		
			\$	33,812.25	\$	5.12	\$	32,098.13	\$	4.86		
			\$	45,540.00	\$	6.90	\$	45,540.00	\$	6.90		
	Total Returns		\$	45,540.00	\$	6.90	\$	45,540.00	\$	6.90		
	PROFIT		\$	11,727.75	\$	1.78	\$	13,441.87	\$	2.04		
							Processing Options					
			Supermarket Sales, Northeast Grown & Frozen	Co-Pack			On-Farm					
				Total	Unit		Total	Unit				
				\$	23,576.33	\$	3.57	\$	21,862.21	\$	3.31	
\$				11,190.00	\$	1.70	\$	11,190.00	\$	1.70		
\$				34,766.33	\$	5.27	\$	33,052.21	\$	5.01		
Total Returns		\$	38,940.00	\$	5.90	\$	38,940.00	\$	5.90			
PROFIT		\$	4,173.68	\$	0.63	\$	5,887.79	\$	0.89			

Questions & Discussion



Thank you

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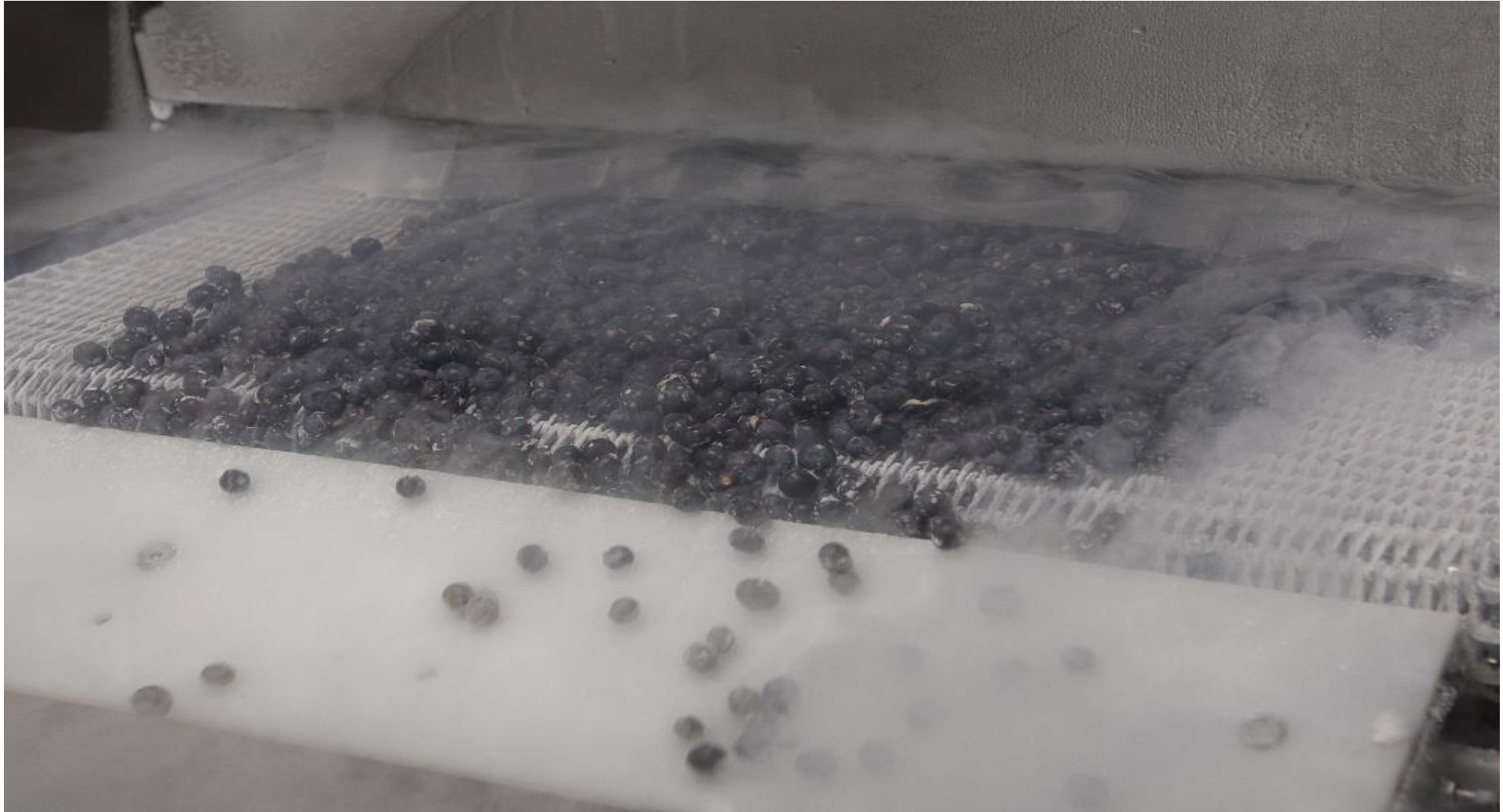


Photo Journal

Plant Trial: Investigating optimal process conditions



Plant Trial: Investigating optimal process conditions



Prototypes: Retail frozen blueberries



Pulling quality assessment samples for R&D



Spinach Washing



Blanching & Cooling



Blanching & Cooling



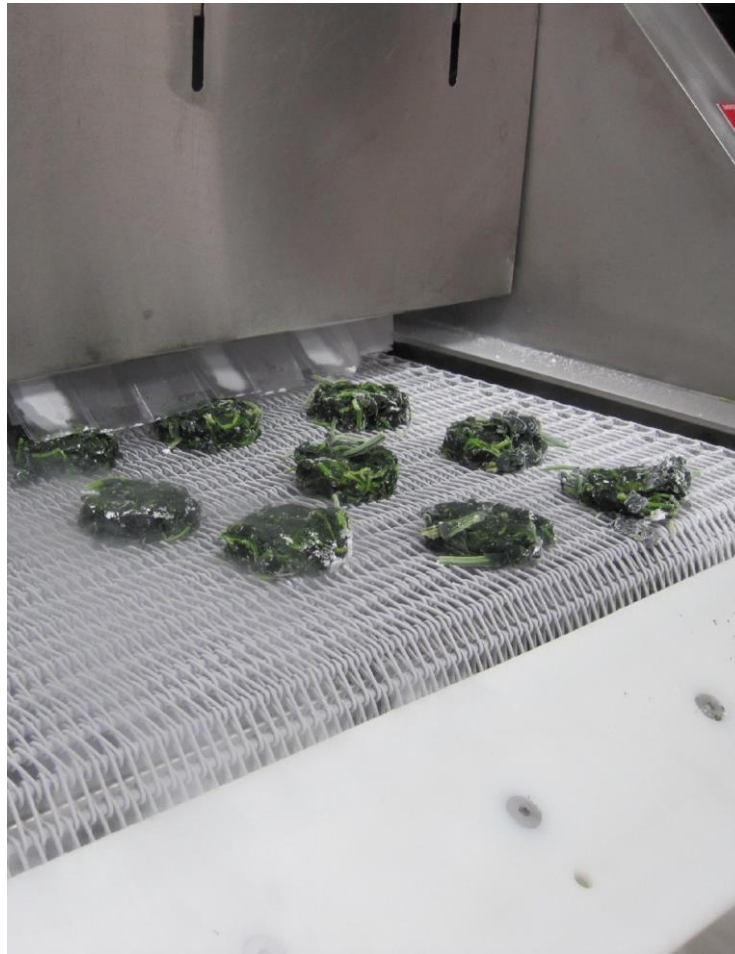
Spinach Loading on the IQF Belt



Spinach Loading on the IQF Belt – “Free Form”



Spinach Loading on the IQF Belt – “Formed”



Product Fines in the IQF Undercarriage

