

# Iron Fortified Dulce de Alegria

Fortification of Amaranth Candy with Regionally Produced Spirulina



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# Agenda

## ▣ Introduction

- ▣ Rationale
- ▣ Target region and Population

## ▣ Product Ingredients

- ▣ Amaranth and Spirulina

## ▣ Production and Specifics

- ▣ Production
- ▣ Packaging, shelf life and regulations
- ▣ Nutrient Bioavailability

## ▣ Impact

- ▣ Iron Deficiency Prevention
- ▣ Cultural and economic feasibility
- ▣ Production scale and distribution



# Introduction

- ▣ Alegria Candy
  - ▣ Highly nutritious
  - ▣ Culturally accepted and widely consumed
  - ▣ Locally produced



**Adequate food vehicle**



**Locally produced fortificant:  
Spirulina.**



# Target Region + Population

## ▣ Valley of Mexico

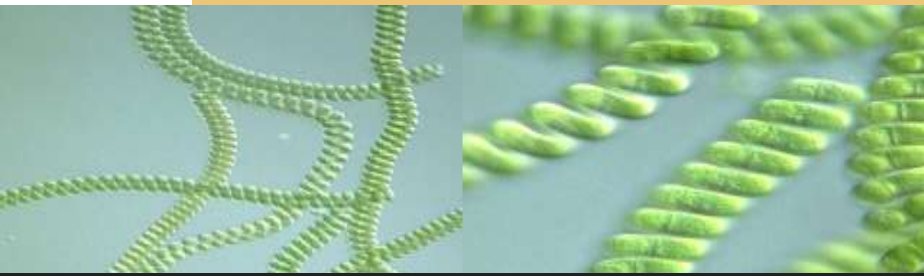
- ▣ Low economic status
- ▣ Demographic low in iron stores
  - ▣ Women
  - ▣ Children



# Amaranth

- ▣ Amaranth in Mexico
  - ▣ Hardy, drought resistant fast-growing, cereal-like plant
  - ▣ Major grain crop in the pre-conquest Aztec Area
- ▣ Nutritional Content of Amaranth
  - ▣ Crude Protein 15%
    - ▣ Lysine, methionine, cysteine
  - ▣ Fat Content – 5 to 17%
    - ▣ Essential fatty acids linoleic acid( 50%)
- ▣ Traditional Preparation of Amaranth Grain
  - ▣ Expanded or popped
  - ▣ Risks of loss of lysine





# Spirulina

- ▣ High Iron Content
- ▣ Contains all essential amino acids
- ▣ Contains vitamins A,B,C and E



(Falquet & Hurni, 2000)

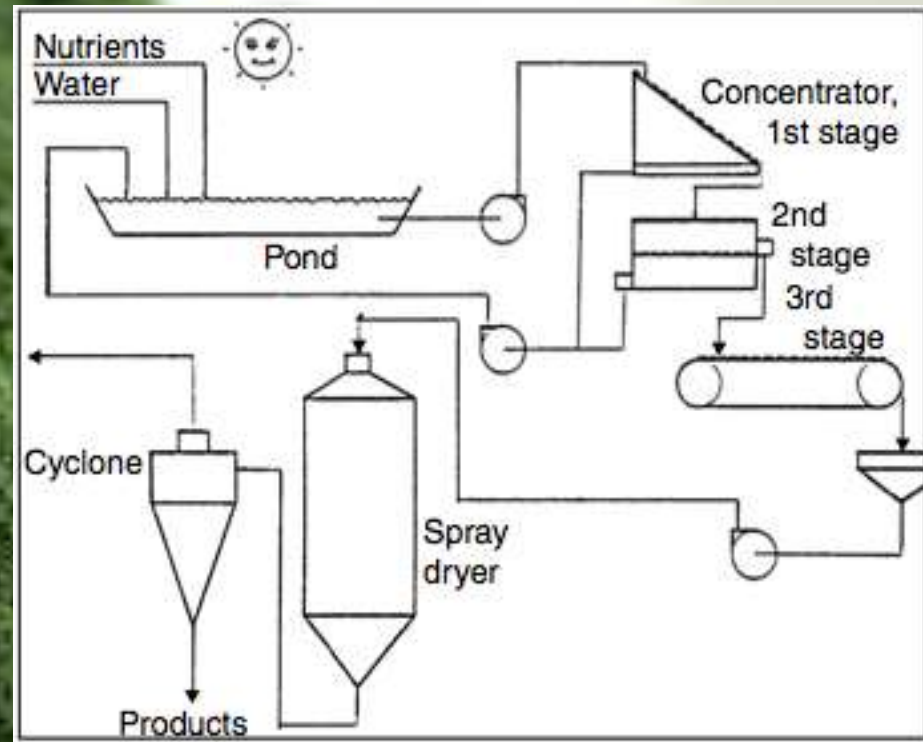
# Spirulina Production

- ▣ Factors affecting productivity
  - ▣ Available Light
  - ▣ Climate
  - ▣ Stirring/Mixing
  - ▣ Nutrient Medium
  
- ▣ Would it grow in Mexico?



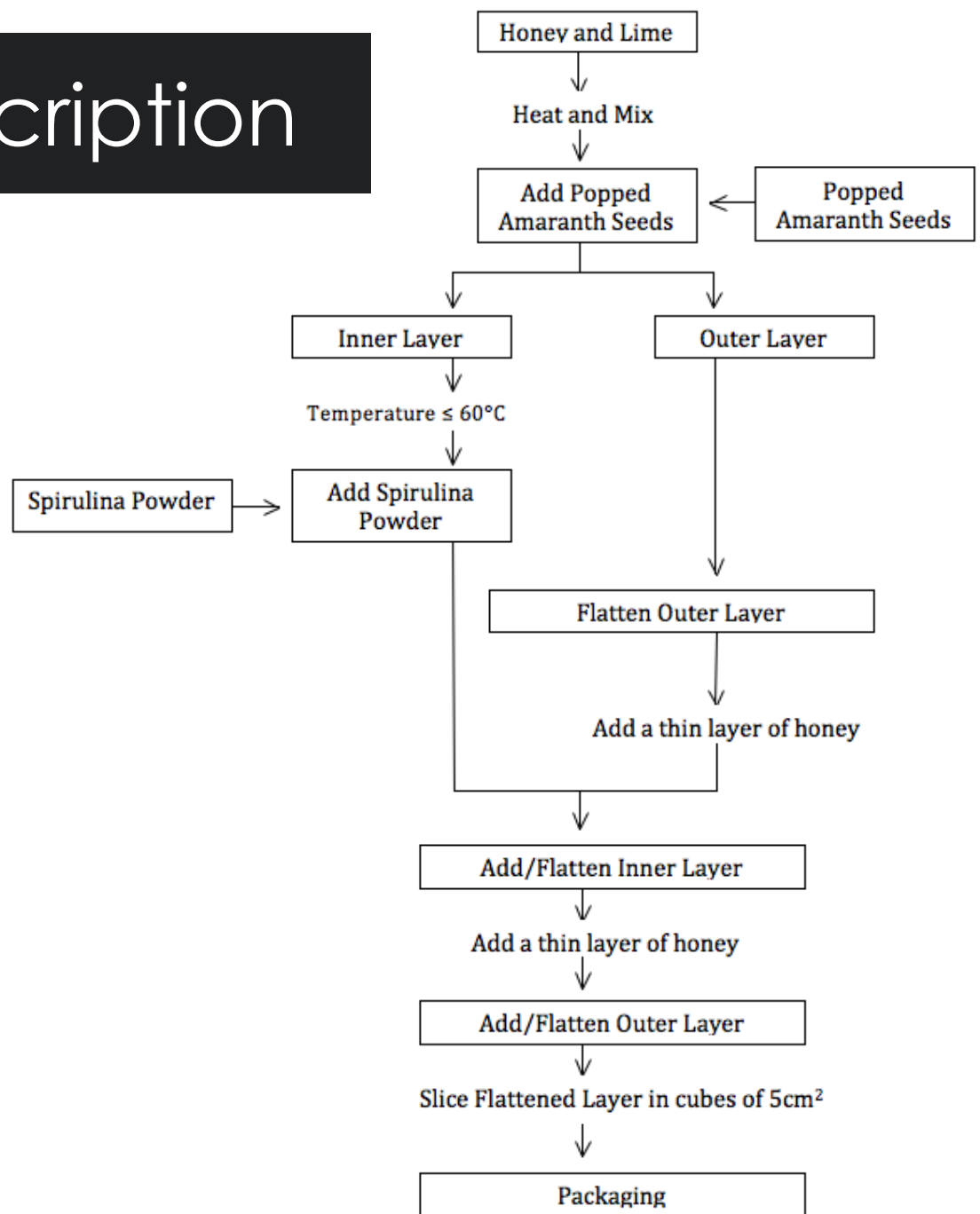


# Spirulina Processing





# Product Description



# Layering of Fortified Amaranth Candy



## ▣ Outer Layer

- ▣ Amaranth and honey

## ▣ Inner Layer

- ▣ Amaranth, Spirulina and honey

# Packaging

Plastic	Oxygen Barrier	Moisture Barrier	Transparency	Flexibility
PET	Excellent	N/A	Clear	Slightly rigid
LDPE	Poor	Good	N/A	Soft, flexible
PET/LDPE Laminate	Excellent	Good	Clear	Flexible

# Shelf Life

Ingredient	Shelf Life	Issues
Popped Amaranth	75 days	Lipid oxidation
Spirulina	4 years	Beta-carotene degradation
Honey	2 years	Loss of aroma, colour, and flavour
Lemon Juice	2 years	Unfavourable flavours and browning

# Food Safety

## HACCP

- ▣ Product Ingredients and Incoming Materials
- ▣ Process Flow
- ▣ Plant Schematic
  - ▣ Regulations in Mexico
- ▣ Raw Ingredient Specifications
- ▣ Sanitation (COFEPRIS)

Table 1. Raw ingredient specifications for amaranth candy with added spirulina.

Raw Ingredient	Chemical Specifications	Microbiological Specifications
Amaranth <sup>1</sup>	Iron, general impurities, insect parts, moisture, protein, peroxide content, aflatoxins	N/A
Spirulina <sup>2</sup>	pH, protein, iron, gamma-linolenic acid, colour, odor, taste, moisture, heavy metals (lead, arsenic, cadmium, mercury), algal toxins	Pathogens, yeasts, molds
Honey <sup>3</sup>	Moisture, flavor, color, turbidity, solids, ash, pH, clarity,	Total plate count, yeast, coliforms
Lemon Juice <sup>4</sup>	Brix, acidity, pH	Total plate count, yeast, mold

<sup>1</sup>Norma Mexicana, 2009; <sup>2</sup>Spirulina World, 2011 and Belay, 2008; <sup>3</sup>Honey Specification Sheet for Light Amber Honey (Strained); <sup>4</sup>Tides Commodity Trading Group, 2010.



# Fortified Amaranth Candy

- ▣ Energy: 697kJ or 167.5kCal
- ▣ Rich in iron (10.3mg/serving)
- ▣ Contains all essential amino acids
- ▣ Essential fatty acids
  - ▣ 50% linolenic acid
- ▣ Low phytate content ( 0.09%)

# Nutrient Content

<b>Nutritional information</b>	<b>Per serving size (50g)</b>
Energy content	167.5Kcal/697kJ
Proteins	1.7g
Fat (lipids)	2.4g from which 0.65 g of saturated fat
Carbohydrates (hidratos de carbon)	31.0 g of which 3.4 g of sugar
Dietetic fiber	3.3g
Sodium	128mg
<b>Iron</b>	<b>60% RDI</b>

# Nutrient Content cont'

## Nutriments/VNR Percentage (RDI or SDI)

Vitamin A	6.72%
Vitamin B1 (thiamine)	0.04%
Vitamin B2 (riboflavin)	0.05%
Vitamin B6 (pyridoxine)	0.00%
Vitamin B12 (Cobalamin)	0.00%
Vitamin C (ascorbic acid)	3.20%
Niacin (Nocitinic acid)	20.32%
Folic acid (Folacine)	3.57%
<b>Iron</b>	<b>60.7%</b>

# Iron Bioavailability

- ▣ 10.3mg/serving
- ▣ Non-heme iron
- ▣ 60% more absorbable than ferrous sulfate
- ▣ Vitamin C
- ▣ Vitamin B12- not bioavailable
- ▣ Presence of phytates in amaranth and traditional diet

# Iron Deficiency Prevention

- ▣ Rural Central Valley region of Mexico
  - ▣ Lake Texcoco area
- ▣ Identified as having a demographic low in iron stores
- ▣ Traditional Diet - Aid in Iron Absorption
  - ▣ Citrus Fruits
  - ▣ Pulque
- ▣ 10mg of Iron per serving of Amaranth Candy
  - ▣ Women 19-50: 55% of RDI
  - ▣ Men 19-70: 125% of RDI



# Economic Feasibility



- ▣ Traditional Candies of Mexico
- ▣ Few Ingredients
  - ▣ All produced in Mexico



- ▣ Government Subsidies
- ▣ Example from India
  - ▣ Chikki





# Cultural Appropriateness



- Consumed since the Aztec Era
- Spirulina historically grown in Mexico
  - Tecuitlatl
- Traditional Method of Production/Preparation
- Colourful Candies Common In Mexico



# Production Scale and Distribution

- ▣ Local 'Large' Scale
  - ▣ Utilizing pre-existing production facilities
- ▣ Long Term
- ▣ A modification of an existing product that is already in the market and has its own marketing channels
  - ▣ New Fortified Amaranth Candy will utilize marketing channels

# Concluding Remarks

Needs editing  
sorry

- Iron Fortified Dulce de Alegria
  - Amaranth widely available in target region
  - Locally produced and inexpensive fortificant
    - Local ownership, awareness, sustainable
    - Job opportunities
  - Colourful and tasty
  - Culturally appropriate
  - Accessible and inexpensive product
  - Iron highly bioavailable.