Cold Chain Related Added Value Profit

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Value Added vs. Profit Added

- Adding value to a product does not necessarily result in an increase in Profit.

- Properly applied, using appropriate cold chain elements can result in significantly increased Profits.
Major Crops that Benefit from Proper Application of the Cold Chain

- Mangoes
- Dates
- Citrus
- Grapes
- Apples
- Stone Fruits (Apricots, Peaches, etc.)
- Melons
- Pomegranate
- Potatoes and Onions
- Bananas
- Tomatoes
- Okra/ Eggplant/ cabbage/ cauliflower
- Greens & Herbs
Other Sectors Requiring the Cold Chain to Maximize Return on Investment

- **Meat and Poultry:**
  - Growing poultry production
  - Growing meat production with support being given by government to develop strong export market, particularly for Halal meats

- **Dairy:**
  - Nestle' is quite large and growing but needs production
  - Collection centers being developed as are larger farms and new larger dairies

- **Pharmaceuticals:** Growing sector
The Postharvest "Golden Rule"

- "Cool it Fast and Keep it Cool"
- The Cold Chain: pre-cooling, and then constant cooling/freezing, storage (at optimum temperature/humidity), transport, market
- Do not break the chain
Cold Chain can add Value by:

- Reducing Losses
- Reducing Costs
- Expanding Markets
- Extending Time to Sell
- Extending Shelf Life
- Permitting Aggregation to Commercial Quantities
- Changing forms
F&V Characteristics

- Price doubles for two-three months
- Know when to hold and when to sell
- Costs rise with storage time
- Quality decreases with storage time
- Meats and Fish can be held for extended times as compared to F&V
The Rising Cost Factor

- Costs
  - Farm Gate
  - Initial Transport
  - Pre-cooling/chilling
  - Processing/Packaging
  - Storage
  - Selling
  - Transportation
  - Flooring
Sales Price

COSTS

QUALITY

TIME

$
Cold Chain Applications = Increased Shelf Life

- Pre Cooling / Field Cooling
- Chilled Storage
  - Controlled Atmosphere
  - Modified Atmosphere
- Freezing & Frozen Storage
  - Intermediate (to be further processed)
  - Processed (retail, food service, ingredient)
- Transport Refrigeration
PRE-COOLING: Fast removal of field heat (rapid cooling)

**ADVANTAGES**
- Reduces respiration: less perishability
- Reduces transpiration: less water loss, less shriveling
- Reduces ethylene production: slow ripening
- Increases resistance to ethylene action
- Decreases activity of micro-organisms
- Delays ripening and senescence
Pre-cooling methods

- Room cooling.
- Forced (pressure) air cooling.
- Evaporative cooling
- Hydro-cooling.
- Vacuum cooling, hydro-Vacuum.
- Contact/package/top icing.
Room cooling

- Product, usually packaged, is exposed to air in a normal cold store.
- Air velocity: at least 60-120 m/ min.
- Adequate packages/ stacking for better air flow.
- Slow pre-cooling, 18-24 hrs, air normally passes around the packages.
- Lower cost compared to other methods.
- All commodities, except very perishables.
Forced air (pressure) cooling

- Difference in air pressure at different ends of stack: pressure
- Large volume of cold air
- High air velocity
- Forces air through the stacks and packages
- Forces air to contact the product
- 4-10 x faster cooling than room cooling
- Initial cost: higher than room cooling
- Products: perishables not tolerant to water, flowers, strawberries, grapes, berries, tomatoes, mangoes, papaya, avocados
Evaporative cooling

- Air cooled with evaporative cooler,
- No mechanical refrigeration
- Cooling: humidified cold air, misting
- Limited cooling rate
- Simple process, low energy cost
- Regions with low humidity (< 65%), good quality water supply
- For chilling sensitive crops
Hydro-cooling

- Use of cold water
- Rapid cooling, better than air
- Less water loss from commodities
- Product and packages must tolerate water
- Water must be disinfected regularly
- Products: those that tolerate water: peaches, carrots, cantaloupe, sweet corn
Vacuum cooling

- **Cooling:** boiling off some water from produce at low pressure
- **Water boils at:** 100°C at 760 mm Hg, 1°C at 5 mm Hg (660 Pascal)
- **Water loss:** 1% for every 11°F reduction (6°C).
- **Hydro-vacuum cooling**
- **Rate of cooling:** surface/volume ratio, very fast
  - **Fast:** leafy vegetables (lettuce)
  - **Slower:** broccoli, celery, Brussels sprouts, asparagus
  - **Very slow (inadequate):** fruits
Contact/package/top icing

- Finely crushed ice.
- Ice slurry: liquid ice, 40% water, 60% ice, 0.1% salt
- Common during transit
- Slow/limited cooling
- 35°C to 2°C: 38% of total load is ice.
- As supplement to other pre-cooling methods
- Products: tolerate ice/water: spinach, broccoli, radishes, green onions, sweet corn
Chilled Storage (Unique for each commodity and many end uses)

- Curing
- Staged Temperature Reduction/Increase
- Temperature
- Humidity
- Controlled Atmosphere
- Modified Atmosphere
- May also be integrated with transportation and Packaging
Freezing Methods

- Blast/Forced Air
- Plate
- Drum
- Cryogenic
- Fluidized Bed
- Freeze Drying
Frigoscandia GYRoCOMPACT Spiral Freezer without insulated enclosure: self-stacking FRI GoBELT on left, coil with fans mounted above on right. Airflow is vertical - down through belt stack and up through coil.
Plate Freezers

• Plates thru which refrigerant flows
• Contact plate freezer compress the plates to make contact with the products such as fish blocks
• Plates may be horizontal or vertical
• Dole plates – plates are stationary and food is placed upon them.
• Heat exchanger variants
  – Pipes
  – Thin plates
Contact Plate Freezer
Continuous Contact Freezer

- Two stainless steel belts freezing materials as they are conveyed.
- Materials are normally consistent in thickness
- Trend to thinner products
- Can be used for fluids
Fluidized Bed Freezer

AIR DEFROST SYSTEM
is a patented system with powerful airblasts that constantly move back and forth, blowing off frost from the coils which may otherwise obstruct the airflow. Makes it possible to run continuously for 22 hours.

AIR GUIDE
Gives a three-dimensional airflow. Changes air direction and air speed, and separates product residuals and snow from the air stream before it enters the coil – providing IQF freezing efficiency throughout the entire production run.

PULSATOR
This patented technology pulsates the airflow through the IQF track to increase the degree of IQF (95-100%). Optional for the FLAFREEZE M model.

AIR BYPASS HATCHES
Adjustable to provide optimal airflow through the belts for all applications and operating conditions.

INSULATED FLOOR
Made of stainless steel, it slopes from the center and out. Drains the long side of the freezer – keeping it absolutely free of stagnant water. The floor-enclosure joint is elevated.

EVAPORATOR RINSE
Defrosts and rinses the evaporator with water.

EVAPORATORS
The fins are continuous and are easy to keep clean.

LARGE CHAMBER UNDER EVAPORATOR
Spacious, convenient and easy access inside the freezer for efficient long-running operation, cleaning and maintenance.

OUTFEED
Convenient infeed and outfeed heights for better handling of the products.

IQF TRACK
Offers stable fluidization. It is made of dirt-repellant polymer which is easy to keep clean and has two independently controlled belts and two separate pressure chambers. This patented belt agitation technology can also be run in agitation mode which ensures optimum IQF. Optional for the FLAFREEZE M model.
Brine Freezers

- Use a liquid secondary refrigerant for heat removal
- Most commonly NaCl but may also use ethanol
Cryogenic Freezing

- Cryogen is a refrigerant that changes phase by absorbing latent heat by way of sublimation or vaporization
- Immersion
- Fog/Gas
- Carbon Dioxide
- Liquid Nitrogen
- Brine
Drum Freezer

- Use a rotating drum(s), normally stainless steel, to freeze films or similar materials.
- Sometimes referred to as a “film freezer”
- Heat can be used to create a drum dryer or cooking surface
Post Refrigeration/Freezing

• Storage
• Transportation
  – Refrigerated Rail Cars
  – Refrigerated Trucking
  – Specialized cargo containers
  – Plates (local Delivery)
• Display cases (major problem)
• Insulation is a key factor
Storage – Key Temperatures

- 4 °C (38+ °F)
- -17.8 °C (0 °F)
- -28.9 °C (20 °F)
- -40 °C (40 °F)
HIGHWOOD COLD STORAGE
Londonderry, NH

100,000 SF New Freezer Warehouse w/ 25,000 SF Addition
Associated Foods Stores
Salt Lake City

56,000 SF ASRS Refrigerated Expansion
ASSOCIATED FOOD STORES
Farr West, UT

56,000 SF Refrigerated Expansion
INSTITUTION FOOD HOUSE
Florence, SC

340,000 SF New Full Line Distribution Center
CAITO FOODS
Newcomerstown, OH

65,000 SF Produce Distribution Center w/ 43,000 SF Expansion
Material Handling Design
Automated Handling
Transport Refrigeration Needs

• It does no good to chill, cool, freeze a product and then transport it in un-insulated or un-refrigerated transport.

• Estimated Pakistan Need: 2000+
  Refrigerated truck and trailer combinations

• Dedicated Containers are also needed

• Air Cargo Dedicated Freighters are also required.
Not Freezers or Chillers!!

- Transport Refrigeration Units are designed to **MAINTAIN TEMPERATURES**

- They do not have the capacity to properly freeze or chill loads.
Transport

• Road transport
  Refrigerated, non-refrigerated

• Water transport
  - River
  - Sea, ocean: refrigerated
  - Dhow

• Air transport
  - Refrigerated, non-refrigerated

• Rail transport

Intermodal (Piggyback)
Local Delivery
Refrigerated Truck & Trailer
Containers

Containers have individual Registration Numbers.
Interior of Container
Proper Container Cargo Loading & Airflow
Container Ship with Mixed Load
One of those days?
Refrigerated Container Ship
Refrigerated Fruit Juice Tanker
Refrigerated Air Cargo Containers
Simple Packaging (Gel Ice or CO$_2$)
Refrigerated Rail Cars
Cryogenic Car (Liquid CO$_2$)
Intermodal (Piggyback)
Questions

Suchbild: Wo ist der Kanarienvogel?
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