FRUIT JUICES & NECTARS

Fruit juices have been prepared from food material either with or without the addition of other material, where it contains any additional ingredient. The majority of fruit juice is made by reconstituting concentrated juice with water to a composition similar to that of the original state. The fruit juices and nectars represent the largest volume of non-carbonated beverages that are sold in almost every marketplace**.**

Processing

Fruit juices and nectars are highly susceptible to fermentation and other forms of microbial spoilage and with few exceptions it is essential that some form of pasteurization is employed when these products are packaged. The exceptions that are seen usually relate to freshly squeezed orange (or other) juices that are processed directly from fresh fruit and packaged immediately. These products have a very short shelf life, usually a few days, and are maintained by storage at temperatures between 0 and 5°C**.**

Flash pasteurization:

Typical flash pasteurization conditions will use temperatures between 85 and 95°C with holding times varying between 15 and 60 Seconds. Selection of the appropriate conditions will depend on the product, including the level of microbial load pre-pasteurizing. When flash pasteurization is used, care should be taken to minimize product recirculation. Excessive recirculation can lead to thermal damage to the product, resulting in unpleasant cooked flavors and product browning.

In-pack pasteurization:

In-pack pasteurization can be achieved at very low cost by simply immersing bottled product, with closures tightly applied, in tanks of heated water. Typical pasteurizing conditions will be 70–75°C for up to 20 min.

Hot filling:

Hot filling provides a further means of ensuring the microbial integrity of fruit juices and nectars. The bulk product is heated to the required temperature then filled into containers and the closure applied.

Packaging

Boxes: Most fruit juices for retail sale are now in cartons, a high proportion of which will be aseptic packs. Cartons are formed, filled and sealed in a single operation. Typical packs

include TetraPaks, Combibloc and Elopak. The long-shelf-life packs for aseptic products are often made of a board, foil, plastic (polyethylene) laminate which gives protection from oxygen ingress and light as well as mechanical strength and an excellent surface for printed material.

Bottles: The selection of a container for fruit juices will often be based on a combination of the technical, cost and marketing needs. Many outlets for fruit juices require relatively small unit packs and these will invariably be glass bottles.

Cans: The sale of fruit juice in cans to either the retail or industrial markets has largely died out with the availability of other forms of packaging and storage

Bulk packs: Juice for industrial use has, over many years, been packed in a wide variety of drums. Plastic drums usually larger containers have been very successfully used – especially for chemically preserved juices.

Analysis of soft drinks & fruit juices

This can be done in a number of ways, including

- Sensory assessment and,
- The analysis of certain key ingredients, such as sweeteners, acidity, color and, in a carbonated soft drink, the level of dissolved carbon dioxide.

Sensory Evaluation

As the flavor and odor of a soft drink or fruit juice are very important elements of a product they should be closely controlled.

Every batch of finished product should be checked to ensure that it tastes 'normal' (i.e. is free from off-tastes)

Water

- In a soft drink, the quality of the water is an essential element.
- Checking the water quality includes assessment to ensure that it does not contain any off-tastes or odors.
- It also involves checking that any water-treatment processes have been effective and have not introduced defects into the water.
- The water should also be assessed to ensure that it does not contain materials that are likely to precipitate from the product on storage. Such precipitates are often called 'flocs'. The most common cause of floc formation in a clear soft drink is microbiological growth (yeasts).

Sweeteners

The sweeteners used in soft drinks can be divided into two main categories.

- These are the natural sweeteners, such as sucrose, invert syrups, corn-derived syrups and honey,
- The high-intensity sweeteners (artificial sweeteners) such as saccharin, aspartame and acesulfame

In soft drinks the type of sugar used in a formulation will often depend on where the product is being produced.

High-intensity sweeteners are used in diet formulations but they also often appear in regular soft drinks.

Preservatives

There are three main preservatives used in soft drinks

Benzoic acid,,,,,,Sorbic acids ,,,,,Sulphur dioxide

Benzoic and sorbic acids

One of the older methods used to detect the presence of preservatives in soft drinks and juices is thin-layer chromatography. This provides a useful method to detect benzoic and sorbic acids as well as the substituted benzoic acids

Sulphur dioxide:

Sulphur dioxide is a widely used preservative. There is a very simple and quick method that can be used to detect sulphur dioxide, is the Ripper titration and steam distillation

Acidulants

After sweetness, the second most important feature of a soft drink is acidity and the balance of the sweetness to acidity (sourness), commonly called the Brix to acid ratio. An acceptable range for this ratio is often laid down in juice specifications. It is important to determine the levels of the individual acids to assess authenticity and quality.

ROLE OF BEVERAGE IN HUMAN DIET

ROLE OF BEVERAGE IN HUMAN DIET

- Main source **of** water **in** geographical areas**.**
- Immediate sources of carbohydrate **(**20 g of sugar-76 cal**)**
- P**rovide** micronutrient minerals**.**
- Enriched with minerals and vitamins**.**

Serve a nutritional function **in** undernourished communities and countries

BEVERAGES HELP TO REDUCE URIC ACID IN YOUR DIET

➲ Uric acid is a waste material present in the blood**.**

➶ **Present in** alcohol and meat**.**

➲ Avoid drinking alcoholic beverages.

➶ Alcohol contains compounds called purines, which increase uric acid levels.

➲ Drink highly concentrated lemon **drink:**

➶ Squeeze five lemons **in one** glass of water**.**

➶ I**t contain** high amount of vitamin c**.**

➶ Breaks down uric acid**.**

➶ Forcing it out of the urine**.**

FIBER DRINK

According to Food and Drug Administration**, F**iber drink **helps to:**

➶ Promote regularity, helps provide a feeling of fullness**.**

➶ Support intestinal function**.**

➶ Eliminate wastes**.**

➶ Cholesterol levels**.**

PROTEIN BASED **DRINK**

➲ **Protein is a** essential nutrient **and** building block of muscle**.**

➲ **P**rotein drinks**:**

➶ Supplement for bodybuilders.

➶ Excellent tasting supplements**.**

➶ **Provide same** levels of protein at a lower cost than commercial **meat** products**.**

➶ **Can be made by c**combining high protein ingredients with good tasting ones

SPORTS DRINKS

➲ P**lay an** important role in athletics**.**

➲ **Provide enery in three phases:**

➶ Carb loading**:**

Take**s** place during the days before the event

➶ Carb depletion **:**

Takes place during the event**,**Glycogen has been used up and the body starts to lose energy**,**sports drinks, help augment this process.

- Carb repletion**:**

Takes place from the middle of the event to immediately**.** Restore glycogen levels back to or at least close to normal levels

HARMFUL EFFECTS OF CARBONATED DRINKS

- Dental Health**:**

keeping sugars in the mouth where they contribute to increased rates of tooth decay**.**

- Bones **weakness:**

Women who consumed carbonated beverages--specifically cola -- more than three times a week had weaker bones than women who did not drink carbonated beverages.

- **Obesity:**

High consumption of sweated beverages cause obestiy

- Internal Organs

According to the Journal of Heparology**;** people who consume two or more carbonated beverages each day may be at risk of liver failure.

- O**thers**
- aluminum cans **contain BPA.**
- **May** be leached out of cans lined **in form of resin.**
- **According to** Environmental Working Group found **that it will lead different problem in brain and reproductive system.**

PROBLEMS WITH FRUIT BASE BEVERAGES

MICROBIAL SPOLIAGE

CHEMICAL HAZARDAS

PHYSICAL HAZARDS

MICROBIAL SPOLIAGE OF FRUIT BASE BEVERAGES

- Bacteria
- Yeasts and molds
- Indicator bacteria and pathogenic organism
- Viruses

MICROORGANISM	FOOD PRODUCTS	EFFECTS
Acetobacter	Apple juice	Oxidation of ethanol
Gluconobacter	Fruit juice concentrate	Increased turbidity
Lactobacillus, Luconostoc	Orange juice	Ropiness, off-flavour
Alicyclobacillus	Apple-cranberry beverages	Phenolic odor, Sedimentation
Bacillus spp.	Tomato juice	Flat sour spoilage
Clostridium spp.	Tomato juice, Fruit juice	Increased acidity and butyric odor

Yeast

- Dekkera bruxellensis
- Dekkera naardenensis
- Saccharomyces cerevisiae
- Sachizosaccharomyces pomb
- Hanseniaspora spp.

EFFECTS;

- Forming ethanol and co2 from sugar.
- Split cans and cartoons.
- Explosion in glass and bottles.

Molds

- Auerobasidium
- Cladosporium
- Penicillum
- Talaromyces
- Neosartorya

Effects;

- Off-flavor described as ‘Stale’ or ‘old’.
- Reduction in sugar contents.

Viruses

- Hepatits A
- Norwalk-like viruses

Effects;

Cause viral gastrointestinal infection**.**

Chemical contamination of fruit based beverages;

- Pesticides
- Mycotoxins
- Environmental contaminants (that may include toxic metal species).

Pesticides

- Pest management programs used to control pests in fruit crops.
- Fruit utilized in the production of fruit juice can contain residues of pesticides.
- Possible impact on children's health.
- As, fewer pesticides are used on fruit, the fruit juice would have less pesticide residues.

Metals

Fruit juice may contain metals originating from a variety of sources.

- As a result of processing.
- From the addition of food additives.
- Processing equipment.
- Environmental contamination.

METALS RELATED TO CONTAMINATION IN FRUIT JUCIES

Metal	**Food product**	**Source**	**Effect**
Tin	Pineapple juice	Plated cans	Off taste, Cause intestine infection
Lead	Canned fruit nectar	Conventional steel cans	Increased acidity
Copper	Grape juice	Steel cans	Off-flavour
Aluminum	Lemon juice, Orange juice	Processing equipment	Cause can corrosion

Mycotoxins

Mycotoxins are a natural toxin produced by fungi and can be very toxic. For example, patulin appears in apples when fungi causes rot. Others mycotoxins produced in fruit juices by molds include;

- Ochratoxin A
- Citrinin
- Penicillic acid
- Aflatoxin

Physical hazard

- Pieces of glass and plastic
- Toxic seed material
- Sand
- Debris
- Physical hazards reduced in production process by ‘washing’ or ‘inspection’

QUALITY MANAGMENT SYSTEM IN BEVERAGE INDUSTRY

- QMS means by which quality management practices are made an integral part of an organization.
- Permanent part of an organization with a direct bearing on how the organization conducts its business.

A QMS has a:

- Structure
- Defined scope
- Responsibilities
- Required resources

REASONS FOR IMPLEMENTATION

Management's motivation for implementing a QMS:

- To improve productivity
- Improve product quality
- Reduce time-to-market
- Competitive pressure

- Commitment to quality
- Develop quality-oriented and customer-focused mind-set in the organization

Benefits of QMS:

- Product quality verification
- Increase customer confidence
- Provide protection for public health
- Instant production of up to date manuals at any time
- Allow system access to each organization with in the group

IMPACTS OF MANAGEMENT

- Sustainability:
- Brand equity
- Competitive situation
- Multiple and varied products
- Customer satisfaction
- Product safety and security
- Supply chain integration
- Integrated architecture

OTHER QUALITY MANAGEMENT SYSTEMS IMPLEMENTED IN BEVERAGE INDUSTRY

- BRC (British Retail Consortium)
- EFSIS (European Food Safety Inspection Services)
- IFS (International Food Standard)
- Global Food Business Network (CIES) and Global Food Safety Initiative (GFSI)
- The Quality of an Auditor

ISO-9000 series standards

- According to the latest edition of ISO-9000 in 2000, ISO has three standards

1- ISO-9000:2000 QMS, 2- ISO-9001:2000 QMS

3- ISO-9004:2000 QMS

Modern preservation techniques in fruits and vegetable processing

Modified atmospheric packaging

Created by replacing the atmosphere around produce

Types of MAs

- High oxygen MAP
- Argon and nitrous oxide MAP

Use of high oxygen MAP:

- Inhibit aerobic and anaerobic microbial growth
- Active oxygen radical specie damage vital cellular macromolecules
- Prevent discoloration

Argon and nitrous oxide MAP:

- Permitted gases to be used in food
- Sensitize the micro organisms to antimicrobial agent
- Sensation involve alteration of membrane fluidity of microbial cell walls

High hydrostatic pressure

- The application of pressure uniformly throughout the product
- First pressure processed foods were strawberry, kiwi, and apple jams

Microbial and enzyme response to high hydrostatic pressure treatments

- Microbial vegetative forms are in activated at 400-600MPa
- Spores may resist pressure higher than 1000MPa at ambient temperatures
- Enzymes inactivation by HHP requires a minimum pressure

Processing fruits and vegetables by pulsed electric field technology

- Non-thermal method of preservation that uses short bursts of electricity
- Minimal or no detrimental effect on food quality attributes

How does this technology benefit consumers?

- Offers high quality fresh-like liquid foods with excellent flavor, nutritional value, and shelf-life.
- Preserves foods without using heat
- Application: Fruit juices e.g. orange, carrot, apple and cranberry juices

How does PEF inactivate microorganisms?

- High-voltage pulses breaks the cell membranes of microorganisms
- Membranes of cells become permeable to small molecules

- Permeation causes swelling and eventual rupture of the cell membrane

Ohmic heating as a preservative technique

- Food material, which serves as an electrical resistor, is heated by passing electricity through it.
- Electrical energy is dissipated into heat
- Also called electrical resistance heating, Joule heating, or electro-heating

Ohmic heating differs from conventional thermal processing

- During conventional thermal processing product quality damage occur
- Ohmic heating is rapid and uniform
- Ohmic heating inactivates microorganisms by heat

Ultra sound

- At lower power values can sensitize microbes to heat
- Used in combination with other techniques
- heat ultrasound synergism disappear at the boiling point
- Use in tomato juices, orange juices

UV radiation

- Microbiologically most destructive wavelength range of UV radiation is between 240-280 nm
- Radiation can damage nucleic acid
- Prevent repair and reproduction.
- Used mainly for disinfection of air e.g. in aseptic filling of liquid food, such as fruit juices

Magnetic field effects

- Cause a change in the orientation of bio-molecules and bio-membranes
- Induce a change in the ionic drift across the plasma membrane
- Affect growth and reproduction of microorganisms

Biopreservation

- Use of natural or controlled antimicrobials
- Inhibit the spoilage without changing the physical-chemical nature of food
- Biopreservation by controlled acidification is usually done by adding organic acids e.g. in fruit juices, sauces

FACTORS EFFECTING QUALITY AND SHELF LIFE OF BEVERAGES

A drink, or beverage, is a liquid specifically prepared for human consumption. In addition to basic needs, beverages form part of the culture of human society.

SHELF-LIFE

It is defined as the time during which the food product will remain safe; be certain to retain desired sensory, chemical, physical and microbiological characteristics; comply with any label declaration of nutritional value when stored under the recommended conditions.

FACTORS AFFECTING QUALITY AND SHELF LIFE

There are some common factors that affect the quality and shelf life of any product or food including drinks or beverages. They can bring changes in the product, can increase shelf life or can decrease it. These can be categorized into intrinsic and extrinsic factors.

Intrinsic factors are the properties of the final product. They include the following:

• Water activity (*a*w) (available water).
• pH value and total acidity; type of acid.
• Redox potential (*E*h).
• Available oxygen.
• Nutrients.
• Natural microflora and surviving microbiological counts.
• Natural biochemistry of the product formulation (enzymes, chemical reactants).
• Use of preservatives in product formulation (e.g. salt).

Intrinsic factors are influenced by such variables as raw material type and quality, and product formulation and structure.

Extrinsic factors are those factors the final product encounters as it moves through the food chain. They include the following:

• Time–temperature profile during processing; pressure in the headspace.
• Temperature control during storage and distribution.
• Relative humidity (RH) during processing, storage and distribution.
• Exposure to light (UV and IR) during processing, storage and distribution.
• Environmental microbial counts during processing, storage and distribution.
• Composition of atmosphere within packaging.
• Subsequent heat treatment (e.g. reheating or cooking before consumption).
• Consumer handling.

These intrinsic & extrinsic factors can interact with each other, bring out many changes and may increase or decrease the rate of reaction that can affect the shelf life. These reactions or changes can be named as

- Microbiological changes
- Physical changes
- Chemical changes
- Temperature related changes

➢ Microbiological Changes

The microbes that grow during storage depends on many factors such as initial microbial load, the physiochemical properties of food, moisture content, pH, preservatives, production method, environmental conditions, storage temperature. All these factors combine either to allow the microbes to grow or in other case retard their growth.

➢ Physical Changes

Many physical changes can reduce the shelf life such as freezer burn, moisture migration, development of taint either by the absorption of volatiles into the product or by the interaction with packaging material. This can affect the quality and shelf life of product thus reducing both.

➢ Chemical Changes

Many chemical changes can cause the reduction in the shelf life of product such as rancidity. Oxidative rancidity, lipolytic reactions and flavors reversion reactions can affect the product. Chemical hydrolysis can occur in products containing intense sweeteners, reducing sweetness. Changes can also occur on exposure to light, including colour loss in natural food colours.

➢ Temperature Related Changes

Some of the processes that can take place at elevated temperatures and that change the deteriorative processes are as follows

- ❖ Phase changes from the melting of fats, and change in solvent properties.
- ❖ Crystallization of amorphous carbohydrates.
- ❖ Change in the relative rate of chemical reactions with different activation energies.
- ❖ Increased water activity.
- ❖ Denaturation of proteins.

- ❖ Decreased solubility of gases.

EFFECT OF CARBON DIOXIDE ON SHELF LIFE OF BEVERAGES

Carbon dioxide provides soft drinks with a pungent taste, acidic bite, sand sparkling fizz. Carbon dioxide also acts as a preservative against yeast, mold, and bacteria. The carbon dioxide used in soft drinks must be food-grade and free of impurities that may affect the taste or odor of the final product. The volume of gas used must match the standards and effectively controls the shelf life of beverages.

SHELF LIFE OF DIFFERENT BEVERAGES

Shelf life of bottled water: The bottled water normally is not stored under recommended conditions and bottles are often used without any cleaning. But the specified expiry date for bottled water is normally 2 years**.** Storage at ambient temperature can aid in the multiplication of contaminants if any. The shelf where it is stored and organic matter around the storage area can affect the shelf life of bottled water.

Shelf life of fruits juices: Shelf life of fruits juice is affected by ascorbic acid. Ascorbic acid added to beverages is readily oxidized and lost during staying, at a rate depending on the conditions of storage. When ascorbic acid reacts with oxygen there is more rapid decrease in vitamin C content in juice.

Shelf life of carbonated soft drinks: The shelf life of a carbonated soft drink is determined primarily by loss of carbonation. Recent developments in PET have greatly increased the shelf life that it can offer because of significant improvements in barrier materials and technologies which help to retain CO2. The shelf life is determined not only by the material of the container and closure (gas permeation through the bottle closure can be significant for small bottle sizes) but also by the way the bottle is designed and manufactured.

Shelf life of alcoholic & non alcoholic beverages: Alcoholic beverage such as beer has some compounds like phytonutrients epicatechin that may produce during brewing process. The poly phenols contents increase during the storage of almost 30 days in the alcoholic drinks but not in the non alcoholic beverages. The storage time if increased in the alcoholic or non alcoholic beverages, their shelf life increased. or if kept at refrigerated temperatures.