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Processing of Fruits and Vegetables

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Introduction

- The need to preserve food products as natural as possible, protection against rapid breakdown, the possibility of a continuous consumption, not related to the seasons and the place of production, has made the Conservation Industry play a decisive role in the economies of the most advanced countries and at the same time in the fight against hunger in the world.

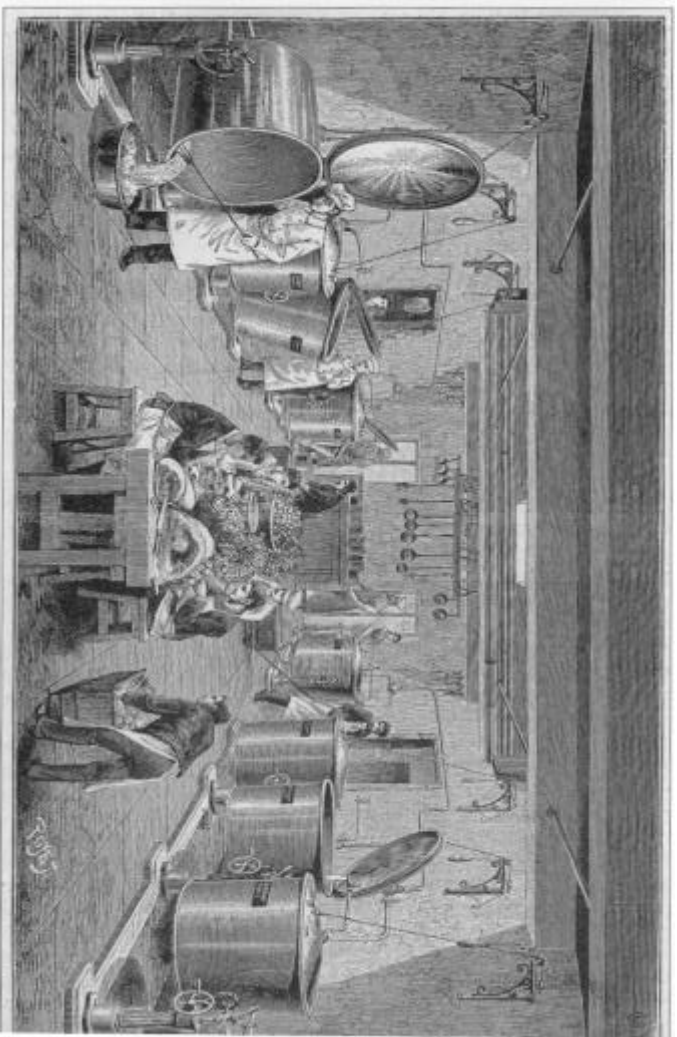
- The road described by this industry is very long and often accompanied by mistrust and unjustified suspicions.

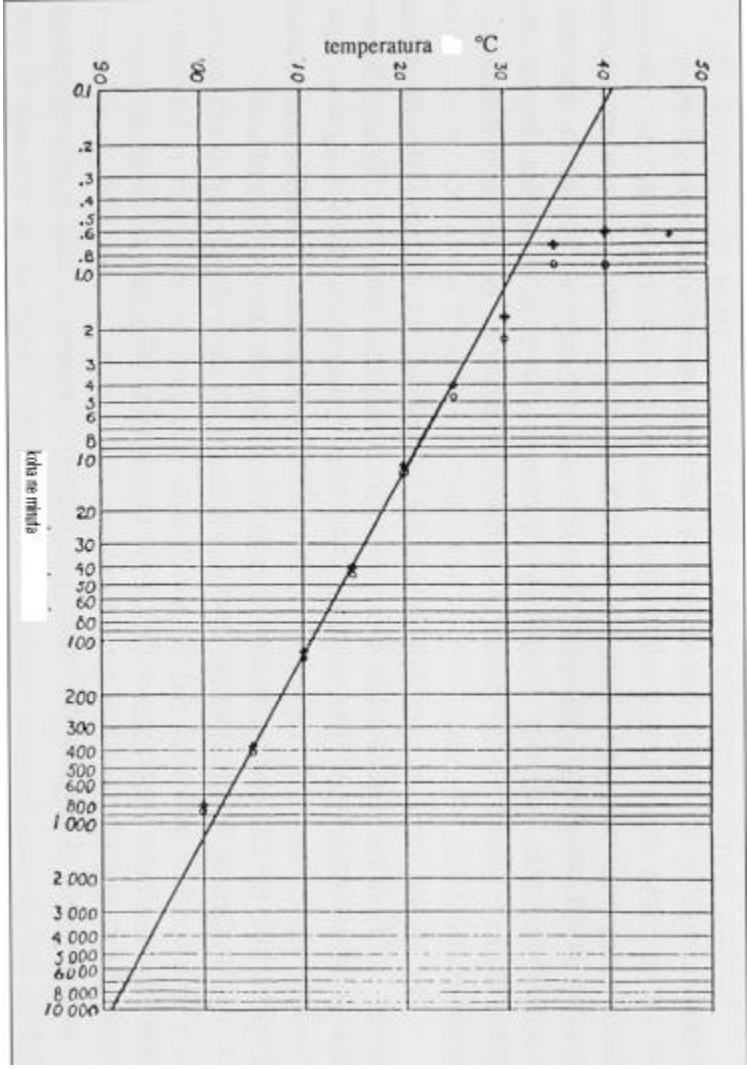
- The canning industry is driven by the development of consumer demands and is conditioned by socio-economic factors, such as: rapid urbanization, industrialization and development of modern life, better knowledge of physiology and dietary problems, etc.

BRIEF HISTORY ON THERMAL TREATMENT OF FOOD

- The first experiments on the thermal treatment of foods, to preserve them for a longer time, began during the late eighteenth century, a period of social change and scientific revival, which was characterized by new inventions and discoveries, but at the same time and from the transition of production from domestic to industrial conditions.
- The treatment of conservation is prescribed to the following stages:
- putting food in bottles (jars), after preparation;
- complete closure of bottles with wooden caps;
- putting them in boiling water for different times, depending on the food;
- cooling the bottles with cold water

- In this way, they determined the relationship between the time and temperature required for the complete destruction of the spores of some thermophilic bacterial colonies;
- temperatures ranged from 100-140 ° C, at 5 ° C intervals, and the environment was pressurized liquid juice from corn introduced into the box at pH 6.1.
- **Treatment temperature**
- The purpose of thermal sterilization of foods is the destruction of microorganisms and inactivation of enzymes that change under normal storage conditions, canned food products in the void and that harm the health of the consumer.
- Enzymes play the role of catalysts and can induce reactions between food ingredients or between oxygen, changing the composition of food.

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General properties of fruits and vegetables

- Fruits and vegetables have many similarities:
- Composition
- Cultivation and harvesting methods,
- Properties during storage and processing.
- In the true botanical sense,
- Fruits are those parts of the plant where the seeds are located.
- On this basis, products such as: tomatoes, cucumbers, eggplants, peppers and the like, should be classified as fruits.
- The most prominent difference between fruits and vegetables is based on their use.
- Plant products, which are generally consumed at the main meal, are considered vegetables.
- They, which are usually consumed as cakes, are considered fruits.

Classification of fruits

- Sustainable Area Fruits:
- Asian pears, European pears, ftoji
- Kernel fruits: apricot, cherry, nectarine, peach, plum
- Small fruits / grains: grapes, strawberries, berries and forest fruits.

- Subtropical fruits:
- Citrus fruits: citrus, lemon, orange, tangerine, grapefruit
- Non-citrus fruits: avocado, fig, kiwi, olive, pomegranate,

- Subtropical fruits:
- Large tropical fruits: banana, mango, papaya, pineapple
- Small tropical fruits: carambola, cashew applle, durian, guava, longan, lychee, mongosteen, passion fruit, rambutan, sapota, tamarind

The contribution of fruits to human nutrition

- Fruits are a source of:
- energy,
- vitamins,
- minerals and
- dietary fiber.

- The consumer should consume at least two fruits and three vegetables a day,
- choosing them fresh, frozen, dried or in canned forms, with a wide range of colors and variety.

- Calories: Carbohydrates contain mainly: bananas, plums, grapes;
- Protein and amino acids: nuts, dried apricots, figs;
- Fats: avocado, olive, walnut.

Vitamins: Fresh fruits and vegetables contribute:

91% of vitamin C,

48% of vitamin A,

27% of vitamin B6,

17% of thiamine

15% of niacin.

Minerals: Fresh fruits and vegetables provide:

26% of the amount of magnesium

19% of iron

potassium (bananas, peaches, oranges, dried fruits such as apricots and plums),

phosphorus (bananas, oranges, peaches, figs, raisins),

calcium (citrus oranges, tangerines), iron (strawberries, bananas, apples, oranges)

- Dietary fiber: All fruits and nuts have in dietary fiber. Dietary fiber consists of cellulose, hemicellulose, lignin, pectic substances, which come mainly from the fruit cell walls and skin.
- Antioxidants: Fruits, nuts and vegetables in the daily diet, are associated with reducing the risk of some forms of cancer, heart disease and other chronic diseases.
- This is partly due to the content of antioxidant phytochemicals. Red, blue and pink fruits (apples, forest fruits, red oranges, grapes, nectarines, peaches, plums, etc.) are good sources of flavonoids and other phenolic compounds.
- Fruits with orange pulp (apricot, nectarine, mango, orange, papaya, peach)
- Other fruits with red pulp (tomato, watermelon, red grapefruit), are good sources of carotenoids.
- The suitability of lycopene in humans increases during tomato processing.

Factors that affect the composition and quality of fruit

- The pre-harvest factors are:

- 1. Genetics: cultivar selection, grafting.
- 2. Climate: temperature, light, wind.
- 3. Cultural practices: soil type and composition, water supply, flowering, pesticide control.
- Fruit ripeness, ripening and quality aspects

Biological factors, which are part of the decomposition of fruits

- Breathing affects carbohydrates, proteins and fats to break them down into simpler compounds and release energy.
- Loss of food reserve, during the process of respiration accelerates fading;
- These phenomena are accompanied by changes such as: nutritional value (energy value) decreases, aroma-taste quality is reduced and sweetness is lost, the amount of dry matter also decreases.
- The energy released, such as heat or vital heat, influences post-harvest technology considerations, such as the assessment of cooling and ventilation requirements.
- The degree of decomposition of fruits is generally in direct proportion to the degree of their breathing.

Classification of fruits according to their degree of respiration and degree of decomposition under optimal conditions

- Relative respiration rate and breakdown
- Fruits
- Very low: Nuts, dried fruits
- Low: Apples, pears, kiwi, pomegranate
- Moderate: Citrus fruits, bananas, cherries, nectarines, plums, peaches, avocados
- High: Apricot, fig, papaya
- Very high: Strawberry, berries, other forest fruits

- Water loss: Water loss is the main cause for decomposition because it results not only in direct quantitative loss, but also in fruit appearance, composition quality and nutritional value.

- Physical Injuries: Different types of physical injuries (surface damage, bruising and shock) are the main factors in the decomposition process.
- Mechanical damage accelerates water loss, promotes high levels of respiration and ethylene production, favoring decomposition phenomena.

- Pathological Injuries: Decomposition is one of the most common or obvious causes of disintegration.
- The attack of many microorganisms, however, usually follows mechanical or physiological damage, which allow their entry.
- In some cases, pathogens can infect healthy tissues and become the primary cause of breakdown.

Environmental factors, which affect the decomposition of fruits

- Temperature: is the most important environmental factor, which affects the degree of decomposition of harvested fruits.
- For each increase of 10 degrees Celsius, above an optimum temperature, the rate of decomposition increases two or three times.

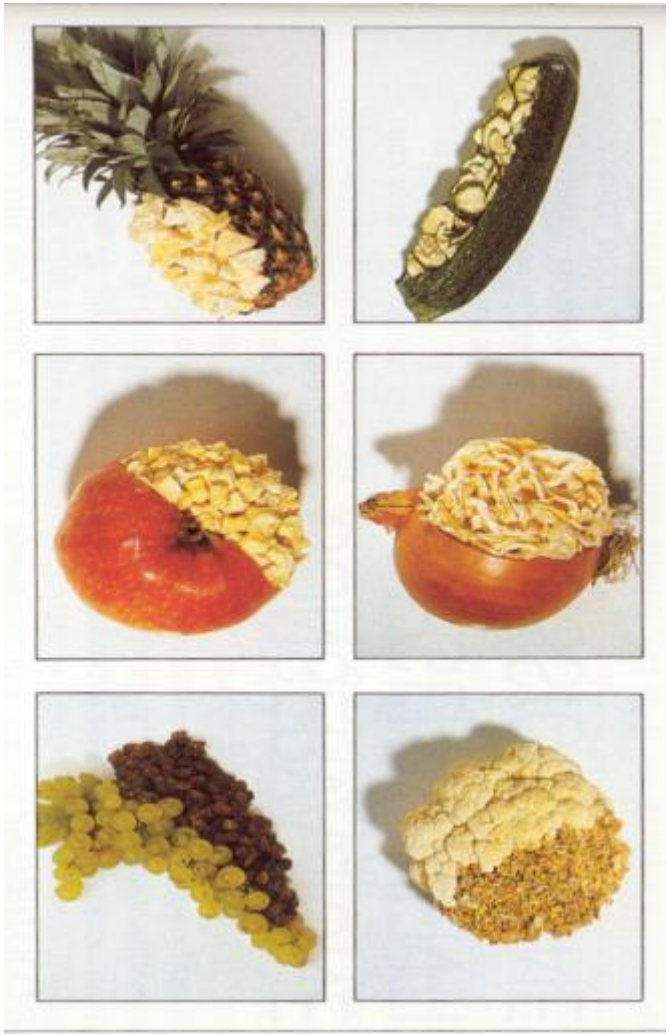
- Exposure to unwanted temperatures results in many physiological disorders.
- Temperature also affects the amount of ethylene, CO2, oxygen, etc. The increase in the rate of pathogens is affected by temperature.

- Relative humidity: The degree of water loss depends on the vapor pressure between the storage environment and that of the surrounding air, which affects the temperature and relative humidity.

- Air movement: The rate of air circulation and speed can affect the uniformity of temperature and relative humidity in a given environment and, consequently, the loss of water in the storage environment.
- Atmospheric composition: Reducing oxygen and increasing the amount of carbon dioxide (controlled atmosphere), can greatly affect the decomposition processes.
- The magnitude of these effects depends on the environment, cultivar, physiological age, oxygen, carbon dioxide, temperature, and shelf life.
- Ethylene: is a natural plant hormone, which affects fruit harvest and may or may not be useful (shortening storage time and softening).
- The effects of ethylene are increasing during the post-harvest process and depend on the temperature, exposure time, ethylene concentration.

Post-harvest processes

- Diving:
- Washing:
- Choice:
- Size:
- Baking:
- Inhibitory action of ethylene:
- Cooling:
- Save:



CHEMICAL COMPOSITION OF FRUITS AND VEGETABLES

- **Water, Minerals, Dry matter content**
- Plant cells contain significant amounts of water.
- Water plays an important role in performance, the reproductive cycle as well as in physiological processes.
- It affects the length of the storage period as well as the consumption of reserve substances, which are deposited in the tissues.
- Both fruits and vegetables contain on average high percentages of water, from 75-96%.
- The high moisture content in fruits (82-88%) and vegetables (75-96%) is the main cause that they spoil, within a very limited time frame.
- Minerals are present in the form of salts of organic and inorganic acids, or as complex organic compounds (chlorophyll, lecithin, etc.); they are, in most cases, dissolved in the cell fluid.
- Vegetables are richer in minerals.
- The content of mineral substances usually ranges between 0.6% - 1.80%.
- More than 60 elements are constituents of mineral substances; among the most important are: Potassium, Sodium, Calcium, Magnesium, Iron, Manganese, Aluminum, Phosphorus, Chlorine, Sulfur.

Carbohydrates

- Carbohydrates are the main component of fruits and vegetables; represent more than 90% of their dry matter.
- Carbohydrates represent the most valuable part of nutrients; Adult daily consumption should consist of about 500 grams of carbohydrates (energy production).
- Carbohydrates play a major role in biological systems and in food products.
- They are produced by photosynthetic processes in green plants.
- Serve as structural components, as in the case of cellulose; they can be stored as energy reserves (case of starch in plants); they can function as essential constituents of nucleic acids (the case of ribose) and as components of vitamins such as: ribose and riboflavin.
- Carbohydrates can be oxidized giving energy; Blood glucose is a ready source of energy for the human body.
- Fermentation of carbohydrates from yeast and other microorganisms can produce carbon dioxide, alcohol, organic acids and other compounds

Starch

- Starch ($C_6H_{12}O_5$), which is the polymer of a-d (+) glucose, is found concentrated, especially in some vegetables such as potatoes (14-25%) on average 17%, in unripe fruits and vegetables.
- During the maturation phase, starch is hydrolyzed to ozone (glucose). Different amounts of starch are contained in some vegetables such as beans, peas, carrots, etc.
- Of the fruits, a small percentage of starch, 1-1.5%, is found in apples.
- Rich in starch are bananas, chestnuts.
- Some properties of starch:
- Starch provides a reserve energy source in plants and provides energy during feeding;
- It is found in seeds and tubers, in the form of characteristic starch granules.

Cellulose

- Cellulose ($C_6H_{10}O_5$) polymer of b-d (+) glucose.
- It is a component of cell walls.
- The cellulose content in fruits varies from 0.5-2%, in vegetables 0.2-2.8%.
- Watermelon and squash contain less cellulose (0.2-0.5%); rich in cellulose are rhizocarps (0.7-1.7%).
- The small amounts of cellulose contained in fruits and vegetables, although it is not assimilated, are beneficial, as they promote intestinal peristalsis.
- Hemicellulose. From their decomposition are obtained hexoses such as: mannose, glucose, galactose, and pentose: arabinose and xylose.
- The most common are pentosans and arabesques.
- In fruits the content of hemicellulose varies from 0.3 –2.7%, in vegetables from 0.2 - 3.1%.
- In fruits and vegetables in smaller quantities, there is linseed and alcohols of oats, mulberry and sorbitol.

Fats

- They are glycerol esters (CH2OH-CHOH-CH2OH) with fatty macromolecular acids, such as saturated ones;
- stearic acid (C17H35-COOH)
- palmitic acid (C15H31-COOH)
- unsaturated acids,
- oleic acids (C17H33-COOH);
- linoleic acid (C17H31-COOH)
- linoleic acid (C17H29-COOH).
- Fruits and vegetables contain very low levels of fats, <0.5%.
- Significant amounts are found in nuts (55%).
- The heart of seeds and kernels is rich in fats;
- plum kernel contains 33% fat, tomatoes 20-25%, soy 15%, apricot kernel 40%, 16% grape seeds, apple seeds 20%.
- Fruit pulp has a very low percentage of fat.

- On the surface of the fruit membrane with the kernel and seed, there is a layer of wax.

- Fruit and vegetable wax is composed of a mixture of different substances; hydrocarbons, fatty acids, alcohols.

- The wax layer protects fruits and vegetables from moisture evaporation (wilting), from mechanical damage and from the penetration of microorganisms.

Organic acids

- In the composition of fruits and vegetables, there are some natural organic and inorganic acids as well as their salts.
- The sour shade of fruits and vegetables is due to these acids, but also to substances such as: tannins, breakdown of proteins into amino acids, pectic substances, etc.
- The presence of acids slows down the process of bacterial decay of fruits and vegetables.
- It is already a well-known practice to ferment some food products with desirable bacteria, to obtain acids, improving the bouquet of the food product, while maintaining its quality.
- Examples are: fermentation of cabbage to obtain lactic acid, in the production of sauerkraut and fermentation of apple juice, to produce first alcohol and then acetic acid, to obtain vinegar.
- Organic acids affect the color of the food product, since many plant pigments are natural indicators of pH.

Nitrogen-containing substances

- These substances are found in plants as various combinations: proteins, amino acids, amides, amines, nitrates, etc.
- Vegetables contain these compounds in amounts of 1.0% -5.5%, while in fruits these substances, in most cases are less than 1%.
- Among nitrogen-containing substances, the most important are proteins; they have a colloidal structure that upon heating above 50 ° C, their aqueous solutions undergo reversible reactions, making them insoluble.
- Proteins, in addition to amino acids, contain other substances of non-amino acid character, prosthetic groups such as H3PO4, glucose, dyes, etc.
- According to the type of prosthetic group they contain, they are called phospho-proteins, glyco-proteins.
- The nutritional value of proteins is determined by the type of amino acids they contain.
- The more irreplaceable amino acids that the human body cannot synthesize to contain a protein, the more nutritious it is.

Vitamins

- Vitamins are defined as organic matter, which the human body must take in small amounts, in addition to essential amino acids or fatty acids.
- Vitamins function as enzymatic systems, which facilitate the metabolism of proteins, carbohydrates and fats, but there is evidence that their role in maintaining health goes beyond that.
- Vitamins are divided into two main groups: those that are fat-soluble and those that are water-soluble. Fat soluble vitamins are A, D, E and K.
- Their absorption by the human body depends on the normal absorption of fat, which it receives from food.
- Water-soluble vitamins include vitamin C and some components of the vitamin B complex.
- Vegetables and fruits are very rich especially in vitamin C, provitamin A and some of the B vitamins.

Enzymes

- Enzymes are biological catalysts and stimulate most biochemical reactions, which occur in vegetable cells.
- Some properties of enzymes are presented below:
- Control the reactions that accompany the baking phase;
- After harvesting, unless destroyed by heat, chemicals or other factors, the enzymes continue the baking process, until they reach the breakdown of the product;
- Responsible for changes in flavor, color, structure and nutritional values;
- Thermal processing processes in fruit and vegetable processing technology aim not only to destroy microorganisms, but also to inactivate enzymes, thus improving the shelf life of fruits and vegetables.

Aromatic substances

- The aroma of fruits and vegetables is mainly due to the content of various essential oils.
- Aromatic compounds of these products consist of esters of organic acids with alcohols, terpenes, aldehydes, ketones, hydrocarbons, alcohols, acids.
- Essential oils are generally concentrated in the skin of the fruit (it is mainly acetic aldehyde and amyl alcohol esters with these acids: formic, acetic, capronic and caprylic).
- For example, in quince the characteristic aroma is caused by the esters contained in its membrane as: the ester of ethyl alcohol with enantic acid and that of ethyl alcohol with pelargonic acid.
- Citrus peel is rich in essential oils: orange 1.2-2.1%; mandarin 1.9-2.5%; lemons 1.5-2.0%.
- Orange essential oil contains d-limonene, citral, linalool, nonilic alcohol etc.

Minerals

- They are the constituent substances of the ash of fruits and vegetables, which is obtained by burning them, at high temperatures.
- The ash content in the fruit varies from 0.3-1%. In the ash of fruits and vegetables there is about 50% potassium in the form of K2O, while the content of Na2O, MgO and CaO reaches several percent; very rich are spinach leaves or seeds of fruits and vegetables.
- Phytoncides are substances that are isolated in different plants.
- They are poisonous and inhibit the growth of various microorganisms and are also called herbal antibiotics.
- The phytoncides of onion, garlic, carrot, spinach, orange have been studied in particular.
- From phytoncide is isolated phytoncide allicin, from onion allyl sulfocyanate, etc.

Activity of living systems

- Fruits and vegetables are in vital condition after harvest.
- Carbon dioxide, water and heat are released from the respiration process, which affects storage, packaging and refrigeration conditions.
- Further activities of fruits and vegetables, before and after harvest, include changes in carbohydrates, pectins, acids, etc., as well as the effects they have on different quality properties of food products.
- Regarding the changes in carbohydrates, some generalizations can be made, regarding starch and sugars.
- In some plant products, sugar decreases rapidly and starch increases in quantity immediately after harvest.
- Unripe fruits, on the other hand, have a higher content of starch and lower sugar content.

The phenomenon of spoilage of fruits and vegetables

- Vegetable spoilage is caused by:
- physical injuries,
- enzymatic activity,
- overcooking,
- security problems
- microbial decomposition.
- Physical damage causes the largest losses of the processing process.
- Decay of vegetables can occur:
- before harvest, due to problems related to the fields of pedology and fruit growing
- after harvest, periods with greater problems.

- Vegetables have:
- a certain pH,
- certain water activity,
- parameters that affect the growth of decay bacteria, some of which, the initiators of a common decay are:
- Bacillus Clostridium, Coryrebacterium, Cytophaga, Erwinia, Pseudomonas and Xanthomonas.
- Erwinia cartovora is more associated with bacterial softening of vegetable roots.
- These bacteria break down pectin and give it the appearance of water-soaked roots.

Pathogenic bacteria, which live together with vegetables

- Pathogens include:

- bacteria,
- viruses
- parasites.

- These organisms are present in irrigation water or in the soil where vegetables are grown.

- Pathogenic bacteria are a serious threat to human health.

- In the US, 12.6 million cases of foodborne illness are reported each year.

CANNING OF DRY FOOD

- The purpose of drying is to reduce the amount of water present in food products, to such levels, as to inhibit the growth of microorganisms and to prevent or reduce to a minimum, enzymatic activity and chemical changes.
- It is known that at very low humidity levels, microorganisms cannot multiply; for their development, in addition to the amount of water present in a given product, its activity is important, ie the coefficient of activity, which represents the ratio between the water vapor pressure contained in product P and the water vapor pressure clean Yes at the same temperature, according to the equation:

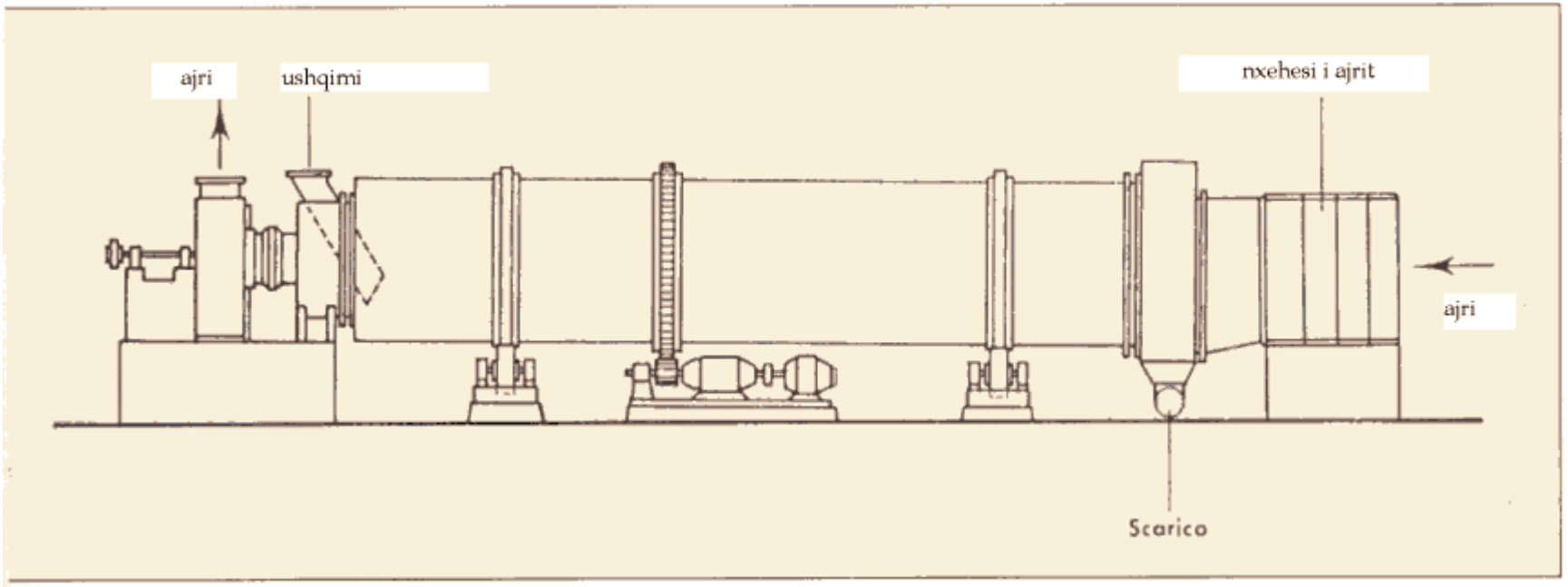
- $A = P / Po$

- To illustrate the importance of this concept, we cite the following example:

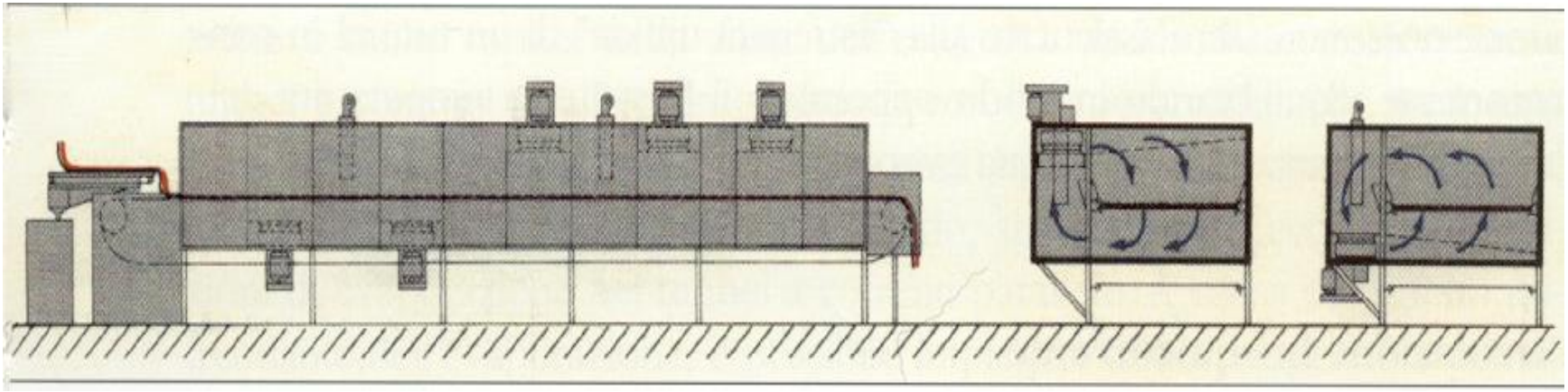
DRYERS

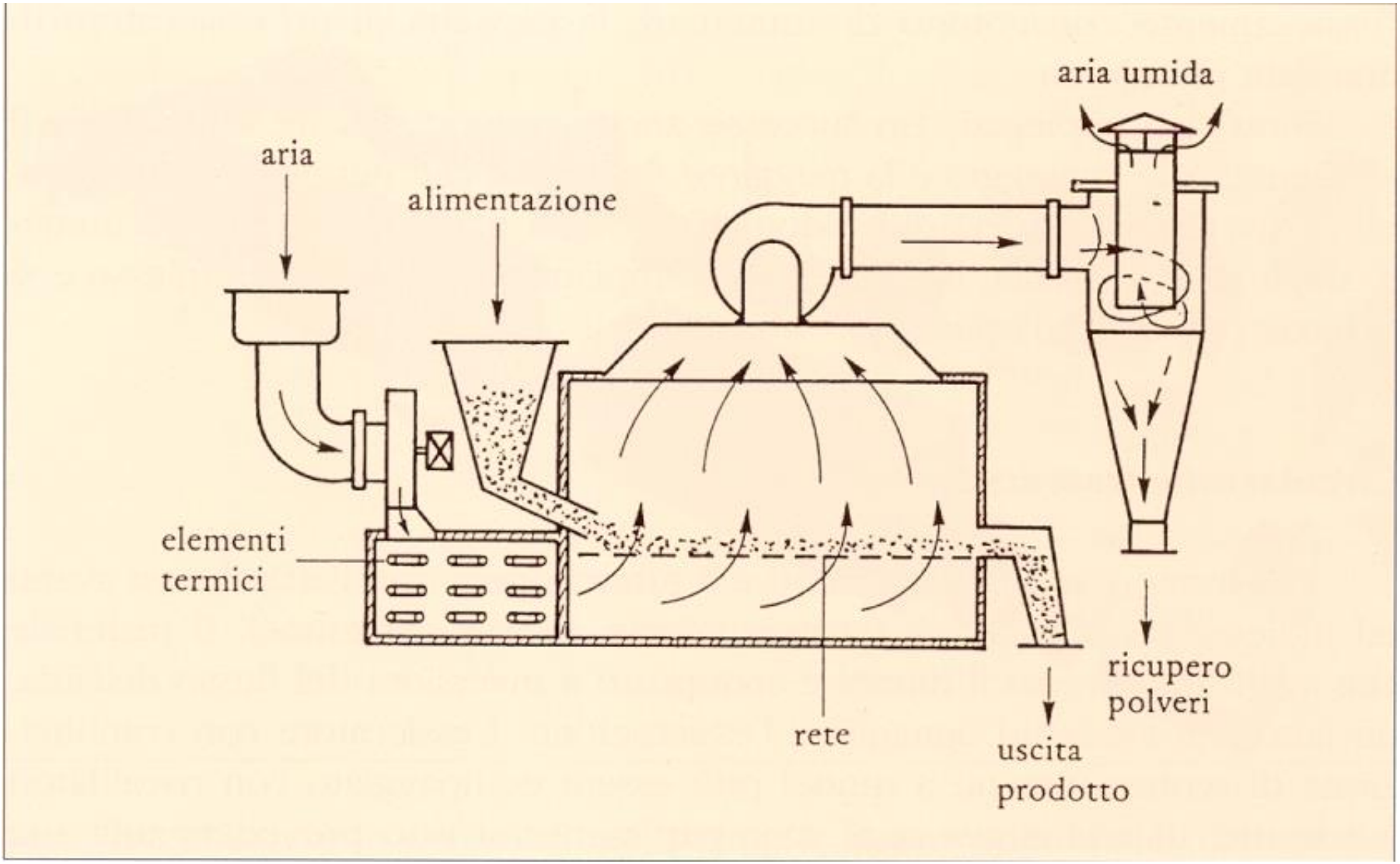
- A general classification of dryers is based on the method of heat transfer to the material containing moisture inside the appliance.
- In this way, dryers are divided into two groups: direct and indirect; the former use hot gas in direct contact with the material to supply it with heat and to dissipate water.
- In indirect dryers the heat transfer from the heating device to the damp material comes through a wall which separates them.
- Direct dryers
- The simplest type of direct dryer is in the form of a non-continuous cupboard, which can have different characteristics.
- The heating of the air circulating inside comes to the device through a steam pipe.
- Dryers with conveyor belts
- They are formed by a series of conveyor belts placed so that the material falls from the top belt to the one below; they work similarly to flat dryers, but the material does not suffer from various scratches or cracks.

- **Cylinder dryers**
- These types of dryers consist of a sheet metal cylinder placed against the discharge of the material; from the highest part enters the wet product that falls directly from the space of an elevator.
- It fits the device by a fixed slider on the central part of the cylinder which is in continuous slow rotation around its axis.
- During the rotation of the cylinder the material is withdrawn from the surface containing the hot air and combustion fumes, which penetrate the cylinder parallel or in the opposite direction to the material containing the moisture.



- Tunnel dryers
- Tunnel dryers figure 10 are also used in the drying of food products.
- They are built of a long and narrow room (tunnel) through which the material placed in the equipment or arranged in movable carts moves.
- The product to be dried, in small pieces, is placed in thin layers on a wooden or metal surface.
- Depending on the product, the device is loaded for more with 5-15 kg; flat loaded surfaces, are placed on top of each other, in movable carts with a height of 1.5-2.2 m.
- Reverse current circulation
- Circulation by current
- Two-stage tunnels, Transverse air circulation

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Other types of dryers

- Horizontal dryer
- Simple vertical dryer with downstream flow
- Complex vertical dryers according to the current
- Vertical dryer with increasing flow and downstream
- Vertical dryer with reverse current
- Vaporizer dryer according to Birs method
- Indirect dryers
- Cylinder dryers
- Vacuum dryers

- **Drying of products of plant origin**

- For most vegetables and fruits, the drying preparation procedure has many features in common.

- In general, the sequence of actions is as follows:

- Weighing, washing, selection, peeling (mechanical, chemical, thermal), washing after peeling, cutting into pieces or slices, sulfitation, parasitization, cooling.

LYOFILIZATION

- As mentioned in traditional drying procedures, the heat used to remove water results in a sometimes noticeable increase in product temperature, which can accelerate chemical and enzymatic decomposition.

- In addition, dissolved substances can migrate together with water, towards the surface of the product, creating a non-homogeneous distribution of dissolved salts and sometimes even surface crusts, which make it difficult not only to continue drying, but also further rehydration, at the moment of consumption.

- One drying technique, which removes water from the originally frozen product, is cold drying or lyophilization, which through sublimation, avoids or greatly reduces these drawbacks.

- This technique is based on the ability for water to pass directly from the solid to the vapor phase, under suitable temperature and pressure conditions; upper temperature limit is 0 ° C and maximum pressure 4.58 mm mercury column.

Sublimation

- The frozen product is introduced into a room, in which the necessary vacuum is rapidly created; for the sublimation of ice it is necessary to give heat.

- The most common heating is that with two plates placed above and below the product, which are heated by electricity or through the circulation of heating liquids from outside.

- Water vapor, obtained during sublimation, condenses on surfaces held at temperatures much lower than that of sublimation (-50 to -70 ° C) to reduce the pump operation in the vacuum, which is limited by the removal of exhaust gases, uncompensated.

- In the beginning sublimation is performed on free water, while when the first layers begin to form, the rate of dehydration decreases, because it is easier to transfer heat but also because it is more difficult to remove steam.

STERILIZATION

- The most widely used system nowadays for the preservation of food products is the one based on the use of high temperatures.
- Purpose of thermal sterilization of foods:
- destruction of inactive microorganisms and enzymes,
- in order to store, under normal storage conditions, food products, packed in airtight boxes.

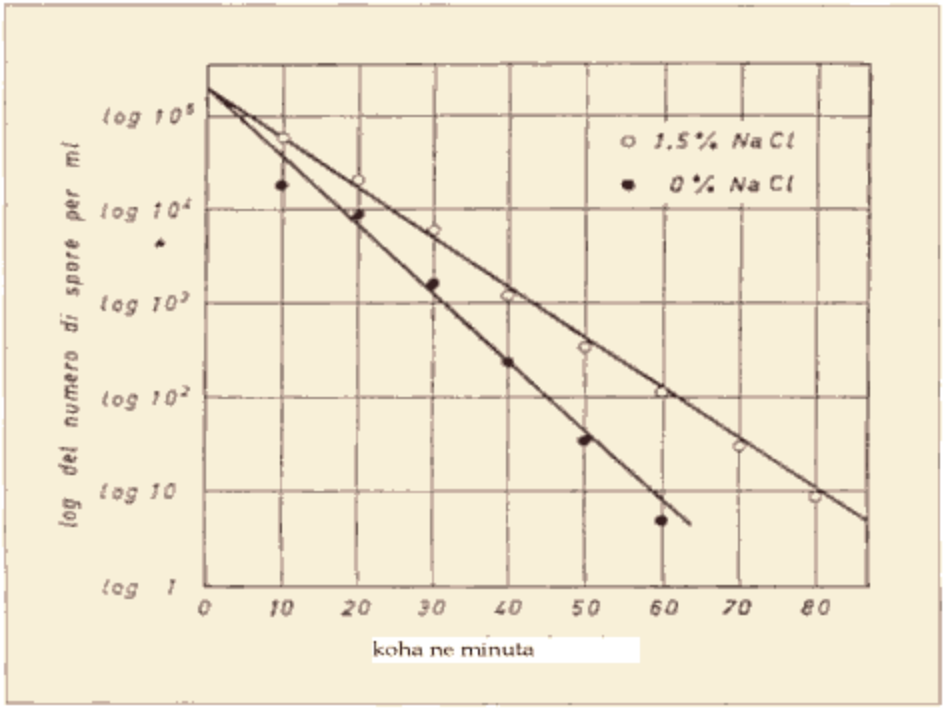
Thermal stability of microorganisms

The ability of a microorganism to withstand heat is much greater than that of other life forms.

There are thermophiles able to tolerate the usual sterilization conditions, such as a treatment at 121 ° C for 20-30 minutes.

The spores of microorganisms generally have a greater persistence than the corresponding vegetative forms.

Bacterial spores and vegetative forms, when heated in aqueous solutions at constant temperature, tend towards destruction at a constant relative speed; thus in each unit of time the same percentage of living organisms is destroyed, at the beginning of each treatment.



As an example are the results of the classical test of Viljoen, who placed in thermal treatment a suspension of spores in the middle of the liquid culture with peas, keeping as constant as possible the temperature.

At time intervals of 10 min, samples were taken and the surviving organisms were counted.

Repeat the test by adding 1.5% salt in the middle of the culture, the results are shown in the figure

- The rule of destruction of microorganisms is logarithmic
- and the relationship between the duration of thermal treatment and the logarithm of the number of survivors is linear.
- The simplest explanation of a logarithmic rule is that death is the result of a single cause and that every spore, with an average development, has the same probability of escaping such a phenomenon and thus surviving in each unit of thermal treatment.
- According to some authors, the cause that induces death may be a lethal mutation or the coagulation by heat action of a single gene that inhibits reproduction.
- The development of logarithmic rule theory gives some considerations on the nature of the role of heat

Reduction time December

$N1 = No\ 10^{-}\ t1 / D$

No = initial number of microorganisms;

N1 = number of microorganisms at time t1

t1 = duration of heat treatment at constant temperature;

Duration of thermal treatment at T ° C Number of surviving spores

0 min	10 f4
D min	10^{3}
2D min	10^{2}
3D min	10^{1}
4D min	10º
5D min	10^{-1}
6D min	10^{-2}

D, which is the same as 2.303 / k (December reduction time)

- Classical methods
- The Bigelow method
- High temperature sterilization for a short time
-
- Process Martin
- HCF process: heat, cool, yarn (heat, cooling, filling),
- Avoset Process

High temperature sterilization for a short time.

- In thermal sterilization of foods, high temperature thermal treatments, for a short time, allow to obtain generally finished products with better nutritional and chemical taste characteristics to an equivalent, low temperature treatment.

- Ideal for sterilizing food products would be to heat them rapidly to the sterilization temperature, keeping them at that temperature for the minimum time required to sterilize them, and to cool them rapidly to ambient temperature.

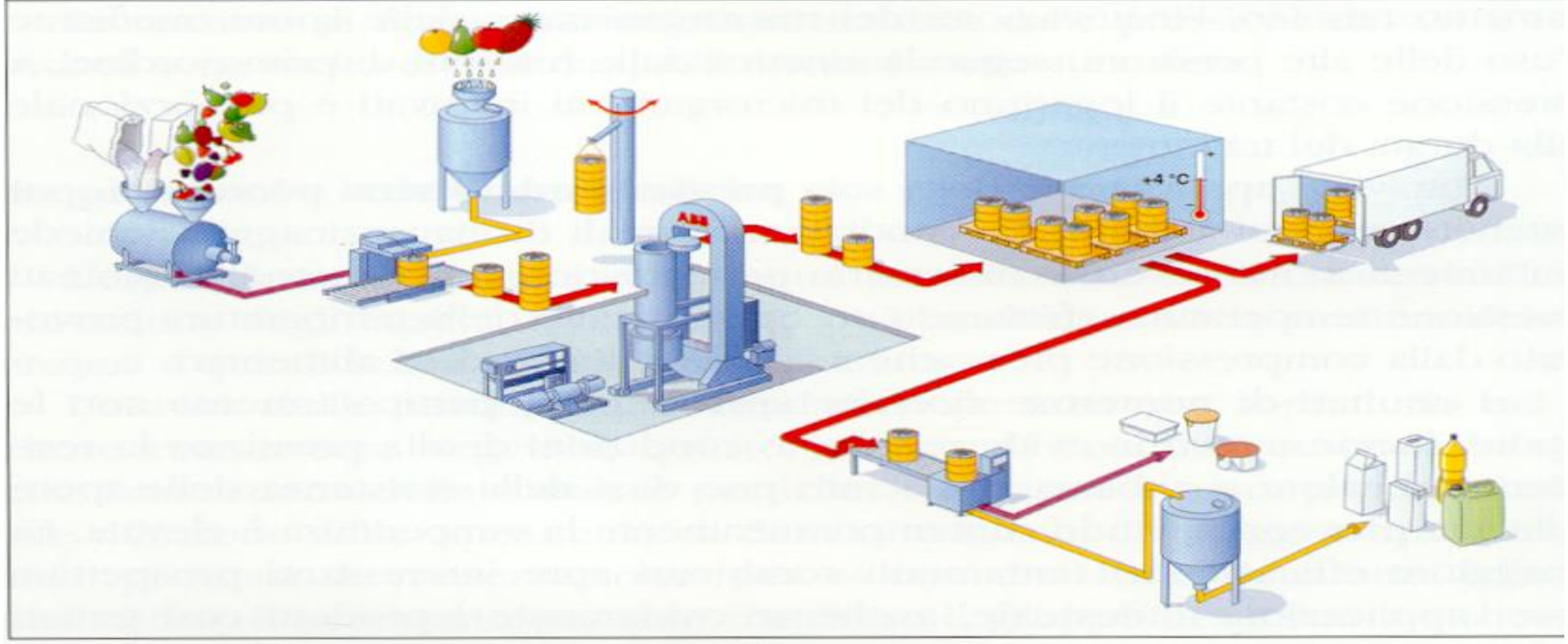
- By sterilizing food products, in empty containers as is generally done, not only is it difficult to control the treatment at very high temperatures, making treatments with very short durations, but it is difficult to maintain a uniform heat penetration into the mass of the product without overcooking that part, which is in contact with the walls.

STERILIZATION: PRINCIPLES AND APPLICATIONS

- Installation and conduction of an autoclave
- Types of autoclaves
- Autoclave equipment
- Steam and water cooling
- Cooling with air and water
- Sterilization of food in glass containers
- Autoclaves with rotating boxes
- Sterilizers - Continuous open coolers (or at atmospheric pressure)
- Continuous sterilizers under pressure
- Hydrostatic cooling sterilizer

Autoclave construction

- 1. Glass mercury thermometer
- 2. Recording thermometer
- 3. Manometer with graduated quadrants
- 4. Automatic pressure and temperature control
- 5. Non-condensing gas discharge taps
- 6. Air discharge valves
- 7. Water discharge valve
- 8. Steam supply
- 9. Baskets
- 8. Placing the boxes in the basket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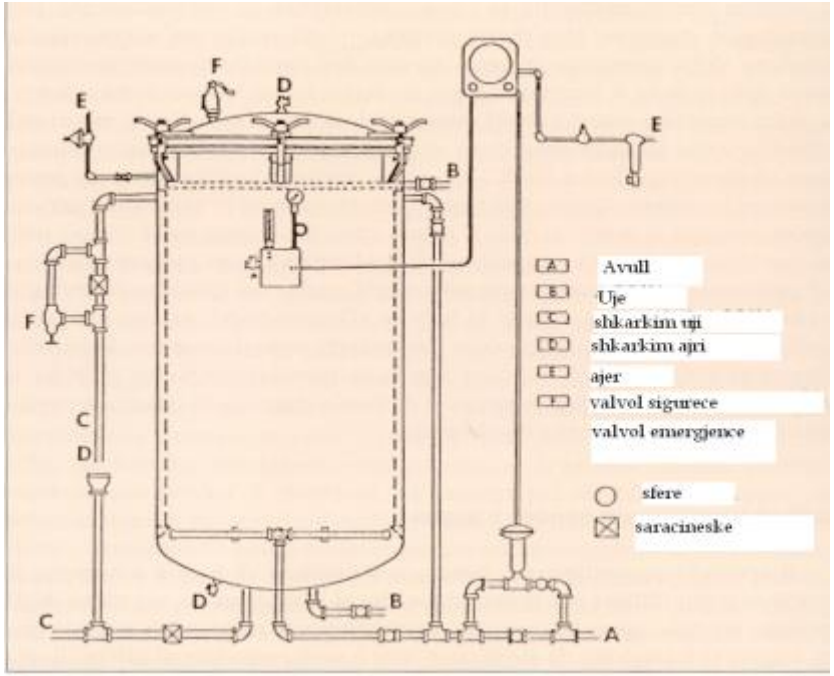
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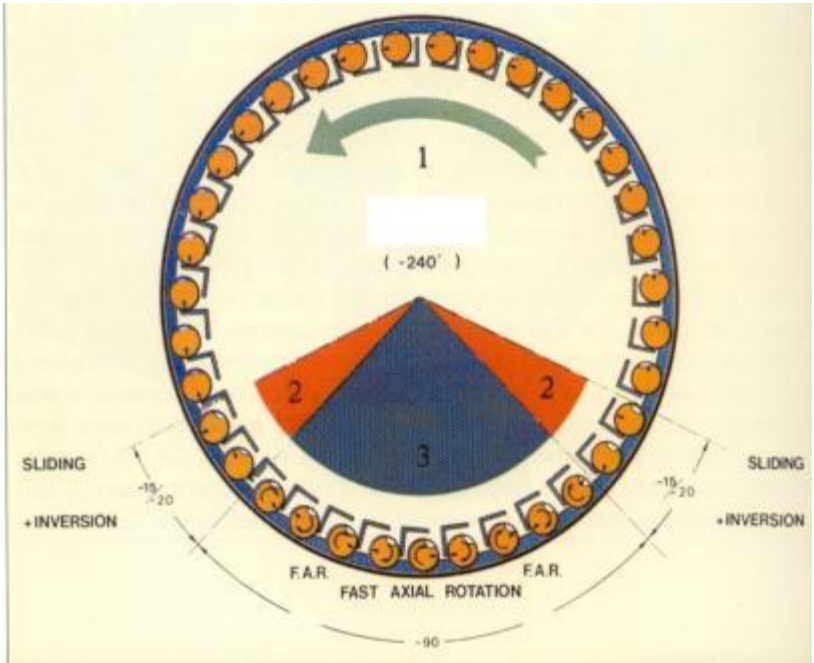
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F.A.R.
FAST AXIAL ROTATION
-90
SLIDING
+INVERSION
-15/-20

Radiation pasteurization

- Radiation pasteurization uses quantities of ionizing radiation
- 0.8-1 kg to reduce the survival probability of non-sporogenic pathogenic bacteria, at such levels that they are not visible in treated foods when examined by normal bacteriological methods.
- In this way many parasites are also fought.
- Radiation pasteurization is also used to fight MOs that cause food decay. With radiation amount from 0.4-10 kilograms.
- Radiation sterilization is used to destroy MO pathogens (putrefaction) that are present in food products.
- The amounts of radiation used for this purpose are 10-60 kilograms.

COMBINED CANNING TECHNOLOGIES FOR FRUITS & VEGETABLES

- The great nutritional & economic value of fruits & vegetables is well known.
- They are the bearers of:
- vitamins,
- trace elements,
- fibers,
- phenolic antioxidants as well
- and other bioactive substances
- carbohydrates
- protein
- calories.
- All these ingredients improve the physical condition of the human body and reduce the risk of various diseases.

- Fruits and vegetables are quite volatile products & break down quickly.
- Up to 23% of the most volatile fruits and vegetables are lost throughout the agri-food process by:
- their destruction,
- physiological dissolution,
- moisture loss,
- mechanical damage during harvesting,
- packaging and transportation.
- These losses are estimated to be more than 40% -50% in tropical and subtropical countries.
- Losses also occur during the storage and preparation of food, at home.

- In the following, some very simple and inexpensive techniques for obtaining fruit products will be described, with:

- high and environmentally stable humidity (LLQM) and intermediate moisture fruit products (LNQM).

- Strawberries, peaches, pineapples are canned uncut, sliced and / or mashed, using combined preservation factors (Hurdle technology).

Combined technology in the sustainability of fruit & vegetable products

- Blanching
- Bleaching, ie exposing pieces of fruit to high temperatures, for a few minutes, is a critical control process in their processing, to increase consistency.
- In traditional canning methods, the main function of this heat treatment is to destroy enzymes that could damage fruits and vegetables.
- But in these minimal processing techniques, blanching has another important role: to reduce the initial microbial load, by inactivating heat-sensitive microorganisms.

The role of solid, soluble materials

- Increasing the concentration of dissolved compounds or solid, soluble materials, reduces aw.
- Their choice depends on several factors, such as: their ability to reduce aw, cost, solubility and organo-sensory characteristics of the final product.
- Salt and sugar solutions have traditionally been used as solids, soluble in food conversion, with intermediate moisture.
- Recently, new foods with intermediate moisture, use other ingredients such as: glycerin, glucose, fructose, cereal syrup, sorbitol, dextrose, lactose, etc.
- For fruits, the choice is reduced mainly to sugars, such as: glucose, fructose and sucrose and some polyols such as: glycerol.

Antimicrobial substances

- The most commonly used antimicrobials are sorbic and benzoic acids and sulfite compounds
- They are mainly used to inhibit the growth of yeasts and molds.
- The action of these preservatives is highly dependent on pH, becoming more active against microorganisms in acidic foods.
- Sorbic acid decomposes highly in function of time, temperature and pH, during the preservation of canned fruits, losing its effectiveness as a combined canning technique.
- For example, after 4 months of storage at 27 ° C, the destruction of sorbic acid is approximately 40% in pineapple and peach.

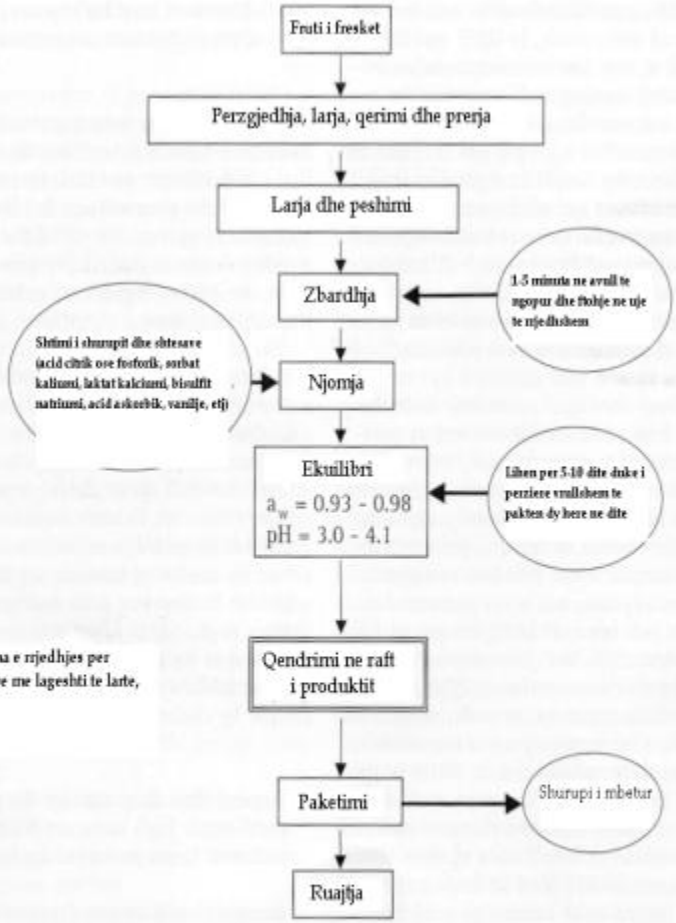


Figura 11.7.1.1: Diagrama e rrjedhjes për prodhimin e produkteve me lageshti te larte, me baze frute.

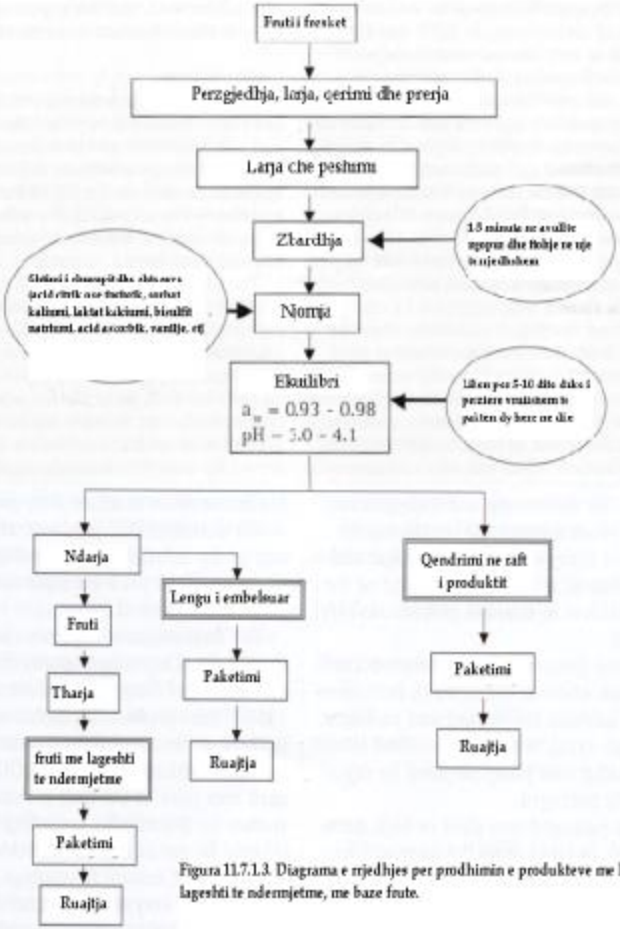


Figura 11.7.1.3. Diagrama e rrjedhjes per prodhimin e produkteve me lageshti te larte dhe lageshti te ndermjetme, me baze frute.

Key preliminary operations include

- Washing: The root vegetables are washed first to remove all impurities and to allow inspection.
- Inspection: Vegetables are inspected for their quality, if they meet the requirements of the consumer.
- Selection: Vegetables are selected on the basis of hardness, purity, size, weight, color, shape, roasting, mechanical damage, foreign matter present, diseases and insects.
- This operation can be performed manually, or using a number of selective separator machines, to isolate and remove the unsuitable product.

Further processes

- Peeling, slicing and chopping: A procedure used for peeled and sliced potatoes is presented below:
- Raw material: A suitable variety should be selected, using a rapid storage test, of a sample prepared at room temperature.
- Attention should be paid to possible darkening.
- Pre-treatment: A careful, good-quality water wash is required before peeling
- Peeling: Peeling in one stage: knife machine; Two-stage peeling: Light peeling with carburetor initially, followed by knife peeling.
- Washing: Washing is done immediately after peeling.
- The temperature and amount of washing water should be 4-5˚C

Use of chemical products in canning food products

- Food products may undergo rot or chemical and biological changes;
- in chemical decay we mention browning, lipid oxidation with rancidation
- To inhibit or slow down chemical changes, antioxidant or antifouling substances are used.
- To avoid microbiological ones, antimicrobials are used.
- In choosing a specific preservative for a particular food product, the following should be considered:
- chemical and physical properties of antimicrobial agents,
- food composition,
- treatments other than chemical ones, in which the product is to be placed,
- characteristics and number of microorganisms present,
- the cost
- toxicity of the substances to be used.

WATER IN THE CANNING INDUSTRY

- Water is used for:
- technological needs of the equipment itself
- boiler feed water,
- cooling water,
- continuous use washing water etc.
- in meeting with treated foods
- constitutes one of the key elements of the finished product
- dilution water
- of solutions used during production cycles,
- washing or boiling water of food products themselves,
- washing water of metal or glass boxes,
- washing water of production lines.
- Due to the variety of products treated by this industry, water with specific bacteriological composition and quality for each product and for each use can not be used.

Water hardness

- The property that water has to boil fruits and vegetables depends on its hardness, ie the amount of calcium and magnesium salts in the solution.
- Water hardness is mainly due to calcium bicarbonate, calcium sulfate and magnesium, calcium chloride and nitrate.
- The degree of hardness indicates the complex of calcium and magnesium salts contained in water, calculated as:
- grams of calcium carbonate (French grade) or
- calcium oxide (German grade) per 100 liters of water.

- It is called:

- "Overall strength" is the strength due to all the calcium and magnesium salts dissolved in water;

- "Stable hardness" means the hardness due to the above-mentioned salts, which remain dissolved even after boiling water;

- "Temporary hardness", which owes to the above-mentioned salts, which precipitate from boiling water, previously dissolved in bicarbonate form.

Physical and chemical characteristics of water

Substance in mg / l	Pure water	Drinking water
Nitrite	0	0
Nitrate as HNO3	trace	<10
Total ammonia	trace	<1
Organic substances	<1	<3
Chloride and NaCl	<30	<50
Phosphoric acid	0	0
French degrees	5-15	<30

Microbiological characteristics

- Microbiological control of water is above all important for the detection of pathogenic microbes.
- Knowledge of bacteria present in water and detection of coliform bacteria are sufficient to determine whether a water is drinkable or not from a microbiological point of view.
- Cholesterol bacteria are always present in water, and their presence in high quantities is an indication of the presence of other pathogenic microbes.
- In the canning industry storage liquids and products are then sterilized at temperatures that lead to the destruction of all pathogens so they may appear uninteresting that may be present in drinking water.

Water chlorination

- The most commonly used chlorine compounds
- Chlorination with gaseous chlorine is commonly used to treat large amounts of water.
- The initial cost of the plants is relatively high, but gaseous chlorine is the most economical compound for disinfection.
- Hypochlorites are used to treat small amounts of water.

Sweeteners: Sugar

- Sugar is the conventional name for sucrose.
- In the physical state, it appears granular and in the form of laminates.
- In the processing of fruits and vegetables, sugar is used only in its granular state; this shape is presented in the form of uniform crystals, white, bright and completely soluble in water.
- The solubility of sugar in water depends on the temperature;
- The water should be as soft as possible, because calcium salts can precipitate during boiling.

Corn syrup (liquid glucose)

- Cereal syrup, industrially, is obtained by acidic or enzymatic hydrolysis of starch, using corn or potato as raw material.
- In fruit processing, mainly in the production of marmalade, cereal syrup can be used.
- In the ratio of 10-20% to sucrose, the addition of cereal syrup has several advantages:
- Improves the shine and texture of the jam;
- Prevents sugaring and,
- Reduces the incredibly sweet taste of the final product, obtained only with sugar.

Packaging materials

- Requirements and functions of food packaging
- should not be toxic and be comparable to the specific food for which they will be used;
- Must have:
- health protection;
- moisture protection;
- protection from unpleasant winds;
- light protection;
- shock resistance;

- transparency;
- ease of opening;
- ease of consumption of the product contained in them;
- ease of disposal after use;
- low cost;
- appearance;
- size, shape, weight they should carry;
- images, the ability to stamp words on them;
- other special qualities.

Hermetic sealing

- Two conditions of great importance for packaging are:
- hermetic closure and non-hermetic closure.
- The term hermetic means a packaging container, which is completely impermeable to gases and vapors in its entirety, including the side closures.
- Such packaging, as long as it stays pristine, is impermeable and resistant to bacteria, yeasts, molds and impurities from dust or other sources, as all of these are relatively larger than gas or vapor molecules.
- Papers made from wood brick are bleached, coated and impregnated with materials such as wax, resin, varnish, plastic and aluminum coatings.

Tin / tin dishes

- Tin sheet is a tough and impermeable material.
- Tin is not completely resistant to corrosion, but its rate of action, with many nutrients, is lower than steel.
- High tin effectiveness depends on:
- Thickness, which ranges from about 0.5 to 2.0 (m (20 to 80 x 10 (-6) in.);
- Thickness uniformity;
- Method of using tin, with electrolytic plate;
- Composition of the base steel coating;
- Food product type and other factors.
- The sheet thickness varies from 0.14 mm to 0.49 mm.
- After production, the metal surface of the cans is varnished, in order to provide a suitable protective coating, to avoid the interaction of the food product with the metal and corrosion of the can

PLANT CANNED

- Canned changes of plant origin
- Food cans in storage, after a while, start to change and break down;
- changes occur mainly in the color and taste of the food product,
- which over time becomes increasingly unpopular
- and more harmful to human health.
- The most severe are the microbiological changes, as a result of:
- of insufficient sterilization or
- closing not in the void of the boxes.
- Color and taste changes
- Chemical and corrosive box bombing
- Chemical decay and damage to boxes
- Corrosion of the tin layer

Color and taste changes

- When sterilization or cooling is not carried out properly, fruits and vegetables acquire a very sensitive taste of the boiled product.
- Apricots turn more or less pink as a result of very slow cooling.
- The color change is also noticed in the sugary products of the invitation.
- Avoid making immediate cooling of the cans to 40 C, after the sterilization process.

- The green color changes at F&P come from the conversion of chlorophyll to pheophytin.
- Fruits red or purple should be packed in boxes painted inside with varnish;
- the color changes come as a result of the formation of complexes that form anthocyanins with metal salts.
- The presence of tin in trace levels, acids in the case of fruit, iron and copper, in the form of citrates and malates, cause the color to change to black to green.
- Extraction of the products and the inner walls of the box often occurs as a result of the formation of iron and tin sulfide.
- Sulfur can come from plant products themselves, but also as a simple organic compound, from the breakdown of proteins, which contain sulfurized amino acids such as cysteine.

- Pea-rich, protein-containing peas and beans release significant amounts of sulfur especially when they have reached a very high degree of maturity.
- Prolonged sterilization and inadequate cooling increase this phenomenon.
- Placing the resin on the tin part is enough to protect the box from the corrosive action of H2S, due to the gas permeability to most industrial resins.
- Under normal conditions, the following phenomena occur:
- Immediately after the onset of corrosion a return of electrolytic potential is observed and the anodic tin passes into the solution;
- The formation of tin ions stops the corrosion of iron;
- Tin digestion decreases considerably if the air contained in the boxes and the product is removed during preheating.

BIOLOGICAL BOMBARDMENT

- Biological bombardment occurs when sterilization is insufficient, or microorganisms redo the product after thermal treatment.

- When the box closures are made under high pressure, a vacuum is created inside it, both during cooling and during their automatic transport.

- To prevent microorganisms from reaching the product through these temporary gaps, it is necessary to use chlorinated water for cooling and drying the boxes immediately after cooling.

- Insufficient sterilization may result from:

- very low sterilization temperature;
- insufficient sterilization time;
- misuse of sterilizers;
- when the initial temperature of the product is too low.

- Biological bombardment is caused by microorganisms, which produce gases.

CANNED FRUITS: FRUITS IN SYRUP AND WATER

- Fruit production in water and syrup is the most important sector in the canned fruit industry.

- The products intended for the preparation of this type of canned food must be processed to such a degree of ripeness that the fruits, not fully ripe but not unripe, have attained a satisfactory composition and taste characteristics after heat treatment.

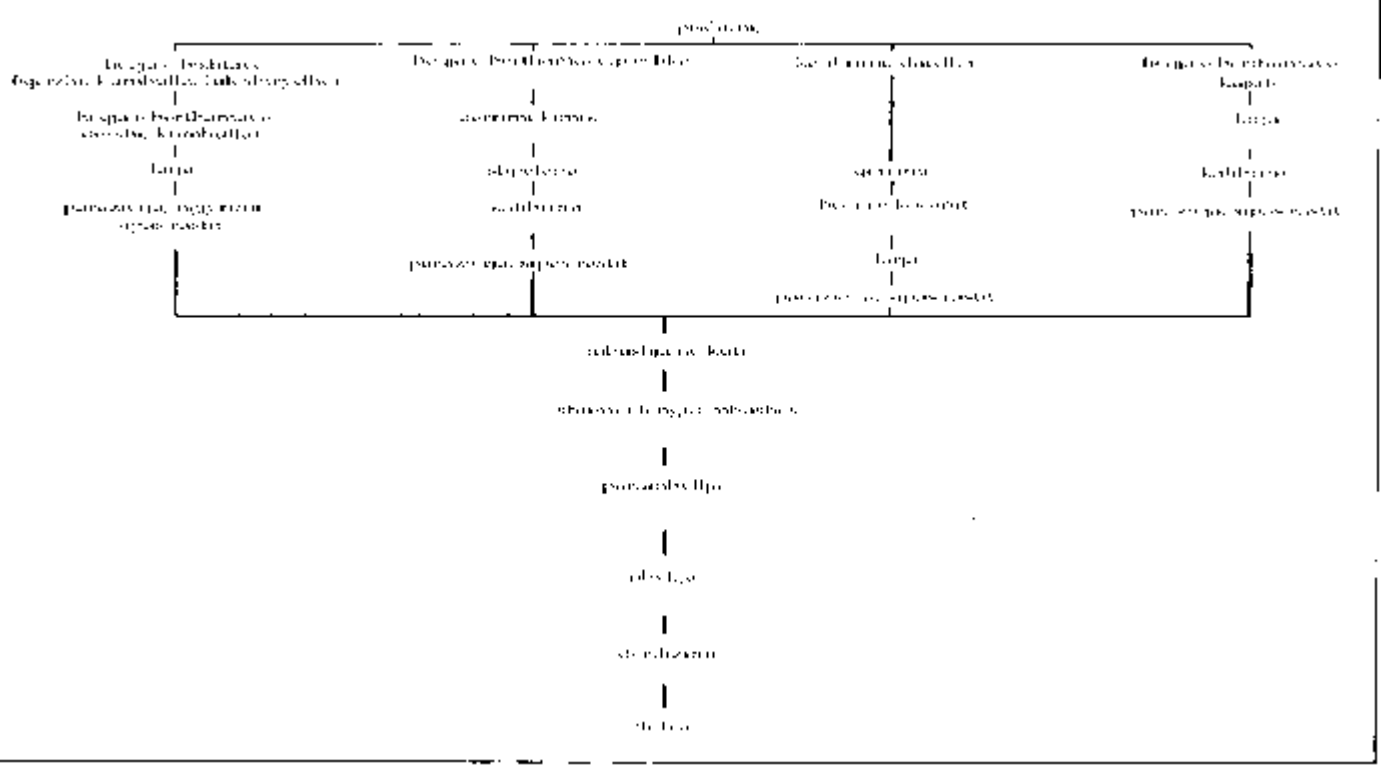
- The assessment of the degree of maturity is performed with special devices that measure the resistance provided by the fruit tube during the penetration of the piercing needle, knife, etc., or by changes in skin color.

- Collection and transportation to the factory should avoid damage.

- For their transportation it is necessary to use separate boxes for each type of fruit;

- for fruits with soft pulp like strawberries, canisters give more satisfactory results,

- pears, peaches can be transported by means of open crates, built in order to create complete space for air circulation.



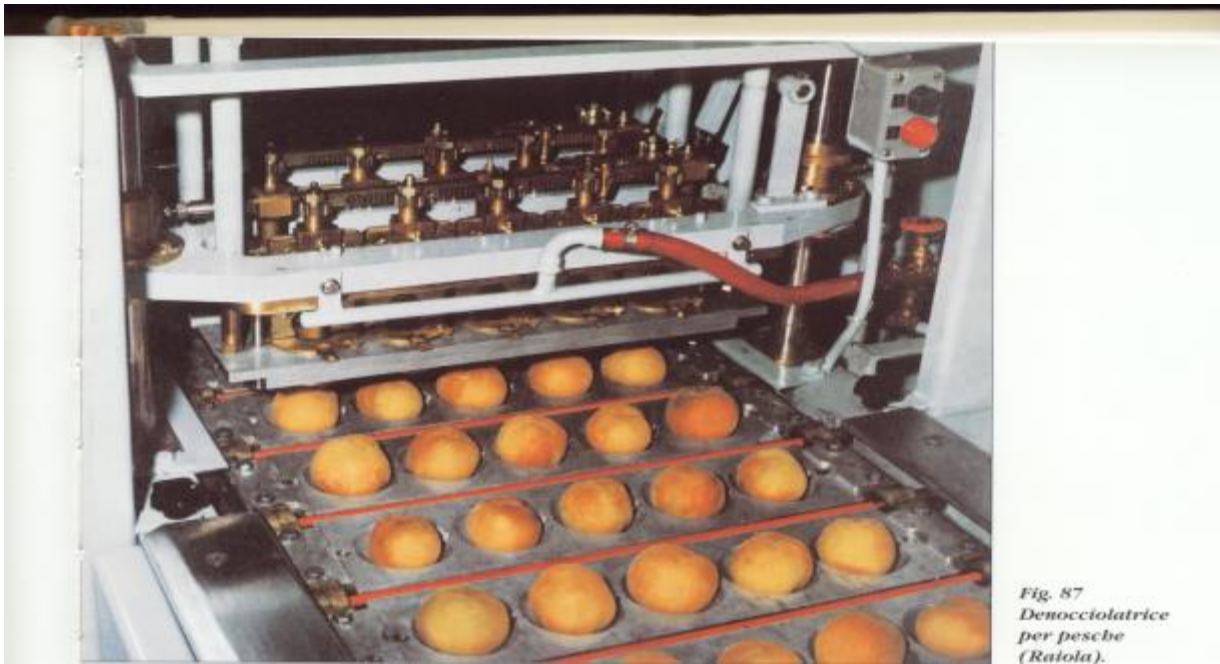


Fig. 87
Denocciolatrice per pesche (Raiola).

Jams, marmalades, and gelatins

- These three products consist of fruit and sugar, organic acid and pectin.
- Jams are mainly produced from citrus fruits.
- Preparation of juice, puree and tulle
- The preparation of clear juice is performed with the procedures used for the production of fruit juices.
- Like juices, tulle or puree is often used and preserved through pasteurization, freezing, or the addition of SO2.

- Pectin
- Industrial preparation of pectin
- The gelling ability of pectins
- Practical use of pectin
- Sugar
- Jams, jams, gelatins contain a high% of sugar.
- During the boiling process sugar is inverted, forming glucose & fructose.
- Inversion speed depends on:
- hydrogen ion concentration,
- (pH) of the mixture;
- boiling temperature;
- duration of boiling.

Preparation of jams

- The restaurant for the preparation of jams should be:
- open,
- well ventilated with caps in which an absorbing current is created to remove the steam released during cooking and SO2 used for the preparation of the raw material.
- The cap is placed on top of the boiling pot.
- Bins used for the production of jams and jams should be wide open and equipped with a discharge tube; the open shape of the boiler allows rapid evaporation and removal of sulfur dioxide.
- Mechanical mixers are also used inside the boiler.
- Marmalades and jams are prepared as follows:

- boiling and concentrating in steam heating boilers;
- the concentration of purees and tulle in the cauldron in the void and the boiling in the cauldron;
- concentrate and boil in the container in the void.
- Filling: After cooking, the product:
- cooled before filling;
- put in the box;
- pasteurized if filling is performed in the cold;
- cools after refilling.

Preparation of gelatins

- For cooking these products as for jams, the same procedures for preparing jams apply.
- The amount of pectin to be used is always higher than that used in jams due to the fact that in the juice are present cellulosic substances of the fruit, which participate in the phenomenon of gelling.
- Boiling time is shorter, while evaporation is faster.
- Gelatins are usually filled into glass jars.
- Gelatins are prepared with natural citrus juices (oranges, lemons, tangerines), but gelatins are also prepared with a small addition of skins in thin strips, pre-boiled with water, sugar, in order to undergo a partial sweetening.
- <u>Disadvantages of jams, jams and gelatins</u>
- Synergy process
- Mold
- Crystallization

- Sugared fruits
- Preliminary fruit treatments
- Sugaring by slow methods
- Sugaring by quick methods
- A temperature of 60-65 C is applied to accelerate the osmotic exchanges between the fruit & the syrup in the tubs.
- The absorption of the syrup is completed within a few days.
- Boiled fruits dipped in syrup (30%), heated to 65 C, in an air dryer.
- During their stay in the dryer syrup is added (40%); water evaporation increases the syrup concentration which within 24 hours reaches 68 Brix.
- The fruits in the syrup are left to rest for a few days in environmental conditions until the osmotic balance is established.

Coloring of the fruits

- The coloring of the fruit is done in the water used for cooking or during the initial stages of the sugaring process.
- The pH of the environment is of great importance in this operation; dyes used are stable at pH 3.6-3.9.
- The exception is erythrosine, which is soluble at pH above 4-4.4 . (in this case the fruits are kept for coloring for two days).

Fruit drying

- The sugared fruits after meeting the last syrup, have refractometric indicators around 70 □Brix.
- They appear swollen & consistent when extracted from the syrup.
- They are then immersed for a short time in hot water, to remove the syrup on their surface.
- Then set to dry on nylon nets.
- Drying is performed in a room with low humidity & temperature 25-30 □C, or in an air dryer 50-55 .C.
- Very high temperatures dry the syrup into unpleasant forms.

Freezing

- The candied fruits are covered with a soft layer of sugar that comes from the drying of the syrup on their surface.
- The action is performed in small baths using sucrose and glucose syrup (2/3 and 1/3).
- Sugar and glucose syrup are dissolved in water and boiled rapidly in cauldrons, up to 80-82 Brix.
- The syrup is cooled to 90 C, the dried fruits are immersed in the syrup for a few minutes and dried up to 50 C.
- Freezing is done by letting them pass into a conveyor, which releases the syrup, which is collected in a collection container.

FRUIT JUICES

- DEFINITIONS
- Fruit juice is the product, which is obtained from fruits by mechanical process, which can be fermented, but which is not fermented, which has the characteristic color, aroma and taste of the fruit from which it comes.
- In the case of citrus juice is the product that comes from the endocarp.
- The product can also be obtained with concentrated fruit juice, by adding water extracted from the juice, at the moment of concentration.
- With the addition of water, the liquid has the right chemical, microbiological and taste characteristics.
- The main qualities of the juice are also guaranteed through the resuscitation of the aroma with aromatic substances, which are recovered at the moment of concentration of the same fruit juice or fruit juices of the same type.
- Such a product must have the same taste and analytical characteristics as those of fruit juice obtained from fruits of the same species.

- Concentrated fruit juice is called the product obtained from fruit juice, through the physical removal of a portion of the constituent water.

- For the product to be intended for direct consumption, the concentration must be at least 50%.

- Dehydrated fruit juice is called the product in powder form, obtained from fruit juice through the dehydration process.

- Fruit nectar is a non-fermented but fermentable product obtained by adding water or sugars to concentrated fruit juice, concentrated fruit puree, or a mixture of these products.

- Fruit picking and transportation
- Washing and selection
- Prepare the fruit by extracting the juice
- pressing
- Tile press:
- Horizontal press:
- Pneumatic press:
- Continued press:
- Separation of large particles
- Vibrating sieves: Fluctuating sieves perform filtration through a horizontal site that fluctuates.
- Centrifugal separators: Use centrifugal force to separate both suspended particles as well as liquids of different densities from fruit juice.
- Filters:
- Clearing: Clearing agents: There are three types:
- Adding a small amount of protein like gelatin
- Soluble casein
- Bentonites,

- Homogenization:
- Sterilization:
- Filter sterilization:
- Sulfur anhydride and sulfite:
- Concentration of fruit juices:

- Concentrators are classified:
- forced circulation evaporators:
- drop film evaporator:
- turbulent membrane evaporators:
- plate evaporators:

- Xhelification:
- Collection of floral aromatic substances:
- Liquid packaging:

CANNED TOMATO

- Concentrates are derivatives of the juice obtained from the fruit:
- by chopping or grinding,
- separation of skins and seeds,
- partial removal of water of the composition.
- Concentrates are distinguished based on the degree of concentration obtained (based on the amount of dry matter residue);

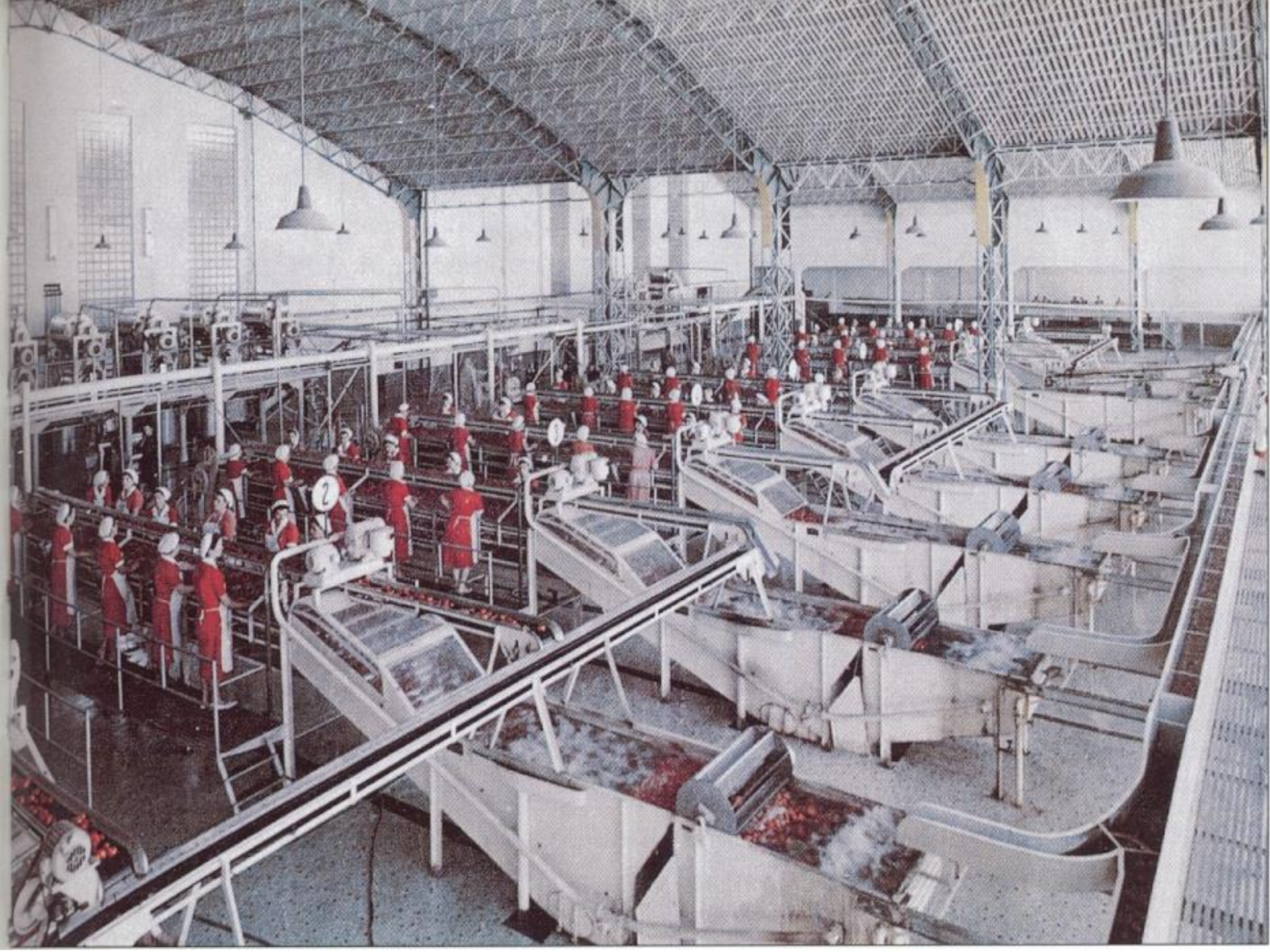
- In the market are:
- semi-concentrates,
- tomato concentrates,
- double concentrates,
- triple concentrates,
- hexadecimal concentrates
- with dry residue values not lower than 12, 18, 28, 36, 56%.
- Yield in the liquid depends on:
- Variety, shape and size of grains, ripening conditions and preparation technique;

- Shredding process
- Pre-minced mincing: Cold Break Method
- The heaters keep the heating temperature constant and to avoid overheating in cases of stopping or resting;
- They are horizontal with tubes with bandages and open heads for easy cleaning and control.
- Extraction of the liquid from the minced mass, heated to a temperature of 65 ° C in the process "Cold break" guarantees proper storage of colorants as well as substances that change in the composition of the liquid (Vitamin C) with temperature.
- The greater or lesser presence of pectic substances in tomato juice depends on the fact that during grinding the pectolytic enzymes released by the cells immediately begin their decomposing action on other substances, changing the composition of the juice.
- The enzymes that act most in such a case are: pectin methyl esterase (PE) and polygalacturonase (PG).

"HOT BREAK" Technique

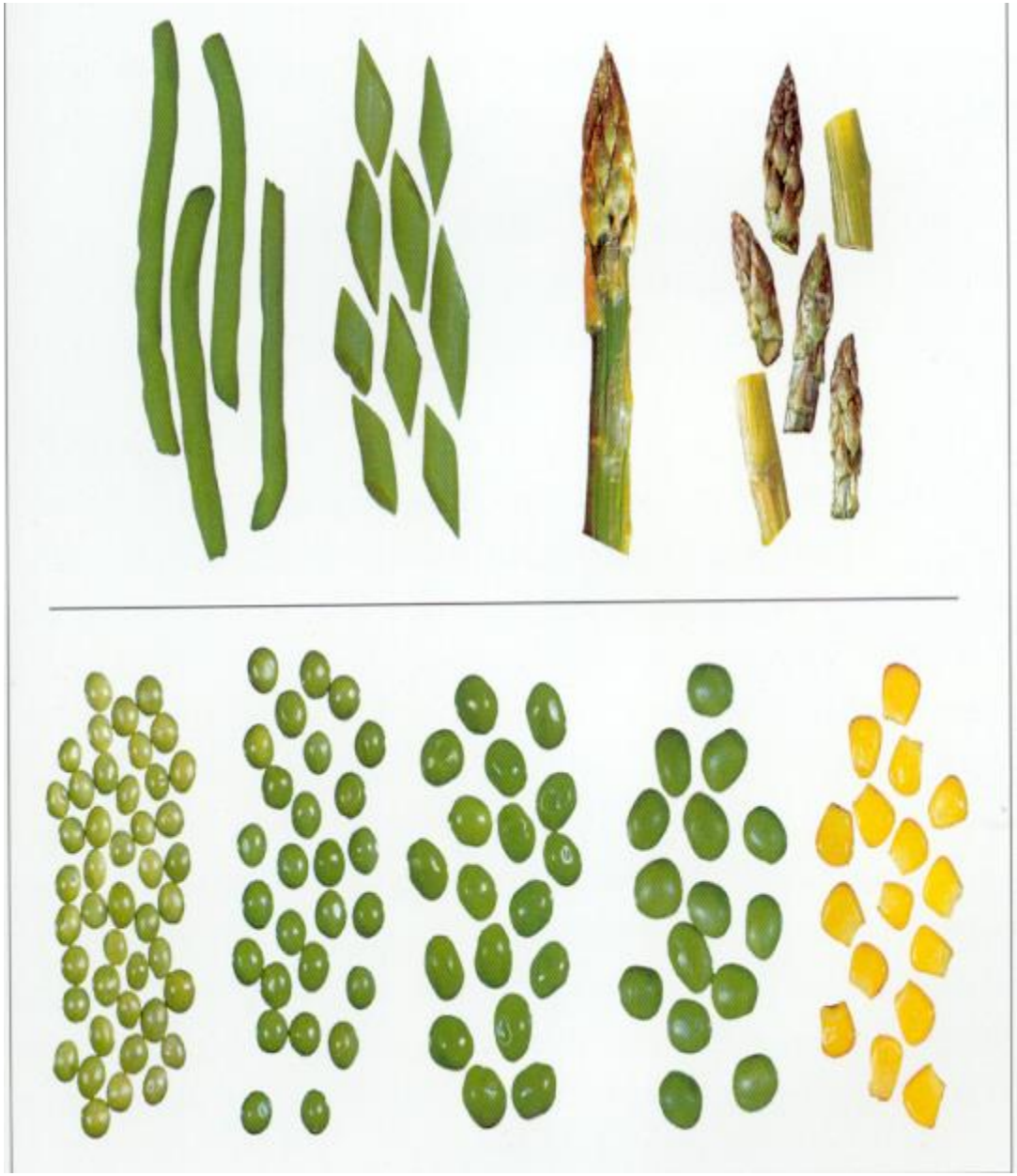
- Pectinmethylesterase acts on pectinic acids
- (polygalacturonic acid methyl esters) and produces:
- pectic or polygalacturonic acids;
- these in turn are put under the action of polygalacturonase, which performs its depolymerizing activity.
- With the "Hot break" technique,
- rapid heating to temperatures above 88 ° C of grated tomatoes,
- pekinmethylesterase is inactivated
- polygalacturonase can not perform its activity
- from lack of proper subject matter
- (non-esterified pectic or polygalacto-uronic acid).
- Products obtained with this technique present high consistency.

- Removal of seeds and skins
- focus
- Sterilization and packaging
- Tomato sauces
- Consist of partially concentrated tomato juice, with a dry residue above 6 ° Brix.
- The technique of use is similar to that of tomato concentrates, therefore the required characteristics are the same as those shown for tomato concentrates.
- To carry out thermal treatments at lower temperatures, it is better to use fruits with low pH.
- Peeled tomatoes
- Peeling tomatoes
- SCREENING
- Putting in the box
- Use of add-ons



- OTHER CANNED ORGANIC CANNED

- Canning peas
- A good variety of peas should have the main characteristics:
- production,
- green grains even after sterilization
- simultaneous maturity
- good taste characteristics.



- Harvesting, peeling, peeling
- Cleaning, Washing
- Dividing by density, Calibration
- Pre-mixing or bleaching
- Washing and cooling
- Screening
- Fill in the box
- Sterilization and cooling
- The product should be pre-heated to 70 C, before filling, treated at a temperature of 116 C for:
- Box 1 kg 45 min
- Box ½ kg 40 min
- Box 5 kg 60 min
- Cooling of the boxes is carried out under pressure and at the outlet they should have a temperature of 35 - 38 C.

- Canned legumes
- Conservation of artichokes
- Artichokes in oil
- Canning asparagus
- Spinach preservation
- Preservation of mushrooms
- Mushrooms in oil

Conservation of artichokes

- Medium-sized fleshy varieties.
- Divided by size with suitable machines, the artichokes are turned to remove hard outer parts (thorns) and peeled to remove them.
- Place in a solution of citric acid and salt (1% citric acid and 1% salt)
- for long enough to remove excess color
- Transfer to a 2% salt and citric acid solution.
- Bleaching can be carried out in the cold, by immersing the artichokes in a 1.25% citric acid solution and placing the product at high vacuum for 30 seconds.

- In this way the air is removed as in the pre-cooking process.
- Washing, calibrating and inserting through boxes.
- Addition of boiling filler,
- consisting of a solution of 2% sodium chloride and 0.2-0.3% citric acid.
- In this way a pH of 4.2-4.3 is reached in the product and sterilization can be performed at a temperature of 100 .C.
- Sterilization lasts:
- Box ½ kg, 40 minutes
- Box 1 kg, 45 minutes

Canning asparagus

- White and green asparagus are used for industrial conservation.
- White asparagus is one that grows almost completely, while green ones develop above ground.
- Washing, parasitization and sterilization should be performed immediately after their collection.
- It is necessary to remove asparagus which has passed a long period of rest and which then become firm and undergo taste changes; the changes are metabolic to glucosides and above all the enzymatic breakdown of protein substances which give off unpleasant odors.

- Asparagus in the cold at a temperature of 4-5 C.
- Wash with water to remove dirt
- Selected to remove unsuitable ones, too small or too large.
- They are divided by size and classified into different categories depending on their diameter.
- They are cut so that they have a length corresponding to that of the boxes.
- This operation can be performed manually or with automatic machines.
- Asparagus is cut into the strongest parts and washed.
- Their heating can be carried out continuously with stainless steel conveyors which bring the asparagus to a boiling water bath

- Mucilaginous and bitter substances are removed by parasitization;
- the duration of this action fluctuates with the size of the asparagus and lasts 2-4 min.
- After parazieries the asparagus is washed and cooled with water then put into boxes
- Add filler (2-2.2% sodium chloride) to very hot water or filler should be added.
- First the boxes are pre-steamed for 5 minutes, especially large format boxes.
- After closing, the boxes are sterilized at 116 .C.
- Box format ½ kg sterilization duration 25 min
- Box format 1 kg sterilization duration 35 min

- PLANT PRODUCTS
- IN SOLUTIONS SALTS AND VINEGAR
- Salt and vinegar have been used since ancient times for the preservation of food products;
- until recently the preparation of these types of cans was done masterfully at home,
- today most of them are prepared industrially.

The action of salt

- Sodium chloride has not been given antiseptic qualities in the true sense of the word;
- There are microorganisms that can live even in concentrated sodium chloride solutions.
- Its conservative action depends on the fact that it reduces through the phenomenon of ion hydration the predisposition of water to the product, ie the coefficient of water activity in the product
- Sa më i lartë është përqëndrimi i kripës aq më i madh është numri i molekulave të ujit që nevojiten për të hidratuar jonet
- Koeficienti i veprimtarisë së ujit mund të jetë shumë i ulët sa të mos lejojë zhvillimin e mikroorganizmave dhe veprimtarinë e enzimave.
- Veprimi dehidratues i klorurit të natriumit ndodh nëpërmjet dukurisë së osmozës.

The action of vinegar

- Wine vinegar should contain at least 6% acetic acid produced by oxidizing alcohol by acetic bacteria.
- Acetic acid like other acids inhibits the growth of microorganisms, through the inhibition of enzymes.
- As with other preservatives, only the non-dissolved molecule exerts a broad bacteriostatic action, so in this form it penetrates easily through the cell membrane.
- At pH lower than 5 (condition for all products treated with vinegar), 95% of acetic acid is in non-dissolved form.
- Regarding the persistence of bacteria in vinegar, it has been observed that some species endure in concentrations of about 11%.
- The preservative action of vinegar is enhanced by the simultaneous presence of salt and lactic acid.

- Cucumber in vinegar
- Salting and fermentation
- Salt 5% of dry matter
- Salt solutions 10-11%
- Softened and slippery cucumbers (mistletoe)
- Softening of cucumbers in salt solutions is an indication of the use of highly dilute solutions, the concentration of which should never be reduced below 8%, to avoid the development of Bacillus vulgatus
- Formation of gaseous sacs coliform bacteria
- Cucumber rot (bacillus Nigrificans)
- Calibration of fermented cucumbers
- Remove the salt
- Cucumber in vinegar
- Cucumber in sweet juice

CHEMICAL COMPOSITION AND CHEMICAL-TECHNOLOGICAL EVALUATION OF FRUITS AND VEGETABLES.

- The chemical composition of fruits and vegetables
- Moisture content. Dry matter
- Carbohydrates or carbohydrates
- Pectic substances
- Organic acids
- Active acidity or pH
- The role of acids in the processing of fruits and vegetables
- Nitrogenous substances, proteins
- Importance of proteins for processing fruits and vegetables
- fats
- Tannins
- Glycosides
- Dyes, Anthocyanins, Chlorophylls:.
- Aromatic substances
- Vitamins, Minerals, ferments

Other canning techniques

- Biotechnology and the degree of decay reduction
- Membrane Filtering Techniques
- High intensity light
- ultrasounds
- Packaging with controlled atmosphere
- Pulsed electric fields
- High hydrostatic pressure

Filter membrane techniques

- Separation of bacterial cells from process currents
- Concentrating
- **High intensity light**
- Broad-spectrum white light, not ionized (1-20 flashes per second).
- Rapid inactivation of microorganisms on the surface of food packaging materials.
- Destruction of insects, pests, parasites, viruses.

Modified atmosphere packaging

- Prolonging shelf life of food products by slowing down the rate of decay.
- Lack of oxygen delays aerobic microorganisms.
- Carbon dioxide has a strong bacteriostatic effect on aerobic microorganisms and inhibitory effects on some enzymes.
- Nitrogen used to replace oxygen in the empty space in the gas filler in the packaging line.
- Experimental successes achieved with the use of CO, SO2, N2O, NO, He, H2, Ar, Cl2, ethylene oxide propylene oxide for specific applications.

Pulsed electric fields

- Operation at low and moderate temperatures below 50 deg. C
- Applying short electric pulses (1-20µs) with a high field strength (15-80kV per cm) to samples placed between two electrodes.
- Microbial cell undergoes reversible membrane permeabilization.
- MP is correlated to microbial inactivation caused by breakdown of cell membrane locally.
- Sudden local ohmic heating of the cell membranes also contributes to the breakdown