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APPLE JUICE PRODUCTION TECHNOLOGY
(ТЕХНОЛОГІЯ ВИРОБНИЦТВА СОКУ ЯБЛОЧНОГО)

У статті розкривається поняття, види та технологія виробництва соків, на прикладі яблучного, опис обладнання.

Ключові слова: *сік, концентрат, яблучний сік, технологія виробництва соку.*

The article reveals the concept, types and technology of juice production, using apple juice as an example, and a description of the equipment.

Keywords*: juice, concentrate, apple juice, juice production technology.*

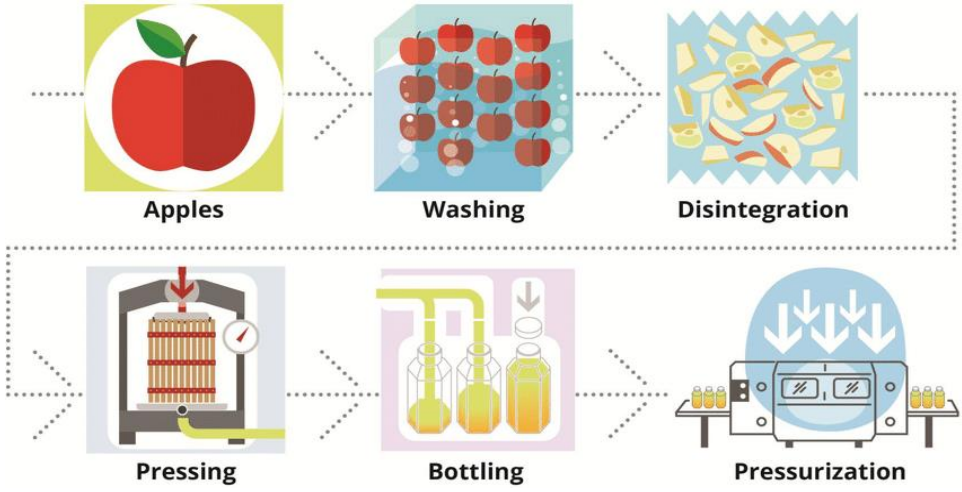
Have you ever wondered how juice in your glass was made?

Juice is a fermentable but non-fermented liquid food product made from several types of unblemished and ripe, fresh or frozen fruits. Juice has the color, aroma and taste characteristic of the relevant fruit.

According to the technology used in processes, juices can be divided into two types:

- juice obtained from fruits and berries by direct pressing;
- juice made from juice concentrate. The same amount of water that was separated during concentration is added to the concentrate and it has the aroma and taste characteristic of restored juice [1].

Production scheme for making apple juice:



[2]

I. Acceptance of raw material

The production process of fruit juice and concentrates begins with raw material purchasing. Fruit is verified in terms of quality before unloading. It should look healthy and be ripe. There are two unloading methods: wet (known as hydro-unloading) and dry.

Hydro-unloading system consists of:

- automatically controlled water cannon used for rinsing fruit from a car;
- operator's rooms with control and pneumatic cabinet for system operation;
- bucket conveyor for vertical transport of raw material and separating water;

- floatable chute with draining devices which accepts raw material from bucket conveyor and the flap system directs it to respective silos.

The delivery scope of dry unloading system includes:

- hydraulic tipper for vehicles. Raw material is unloaded from a car through lifting the front part of the platform and emptying fruit to the hopper;
- operator's cabin;
- spiral sorter - separates impurities such as: leaves, branches, sand and stones;
- diagonal belt conveyor - takes raw material from the hopper;
- unloading belt conveyor - located above silos, directs the accepted raw material to respective storage chambers.

Apples should be stored in small prisms. The producer aims at the fastest processing of the raw material received in order to prevent putrefactive processes and quality deterioration.

Fruits are washed depending on the unloading method applied: in two or in three stages:

- during hydro-transport from silos;
- through water spraying in front of the vertical elevator which transports fruits to the inspection belt;
- at the end of the inspection belt of tables through the system of spray nozzles.

Fruits taken from silos by a sorting unit are transferred to the pulp preparation section.

II. Fruit pulp preparation and processing

Raw materials from pre-production warehouse are transferred to the dosing units (known as sorting units). The task of the sorting unit is to dose apples evenly to the vertical screw feeder (known as elevator). Sorting units have designs individually adjusted to the capacity of elevator and floatable chutes.

Apples transported by a feeder are transferred to the inspection belt or roller table Trained employees carry out inspection and reject raw material which does not satisfy the requirements.

Sorted material falls down to the mill. During pulp milling with the use of a membrane pump, enzyme preparations are added which aid the effectiveness of the pressing process.

In technologically justified cases, fruit pulp from the mill is directed to pulp pipe heater. Pulp flows in the internal module pipe and it is heated by hot water to a set temperature.

Then, fruit pulp is pumped to pulp tanks and it will be taken to the next step in the production of juice and concentrates.

III. Juice yielding.

A correctly performed pressing stage guarantees maximum yield of juice from raw material.

An extrusion process starts with pre-filling of hydraulic piston-cylinder press. Pulp is pumped to a closed cylinder, filling up the pressure chamber space. It is a fully automated process owing to the self-optimising press control system, which determines the level of product extrusion at each process stage.

After completing the press filling-up cycle, pressing takes place. Piston presses the pulp and juice flows out through filtering elements to both juice chambers encased in the resistance board and press-down board. Then, the piston retracts, while the cylinder is rotating, thus, the entire pulp is carefully loosened. This phase is repeated in cycles and each piston feed is a few millimetres longer than the previous one.

Constant cylinder rotation during pressing cycles and expanding ensures the most advantageous loosening of the pulp pressed, thus guaranteeing maximum pressing efficiency.

Pressing cycle is completed. Coat is opened and pressing pomace are discharged. Pressing pomace reach a screw feeder which transports them to their storage site.

Juice pressed in the press flows down to intermediate tanks.

IV. Pasteurisation and dearomatisation

Unclarified juice from presses is directed from intermediate tanks to the section of pasteurisation and aroma recovery in evaporation station. Pasteurisation takes place in the temperature from 95-105°C and it is to inactivate enzymes, obtain juice microbiological stabilisation, starch gelatinisation and protein denaturation.

At the same time, aromatic substances are evaporated in the dearomatization process. One to two hundredfold aroma concentrate is obtained. Evaporation station ensures high process efficiency, rapid evaporation and low steam consumption. Pasteurised juice is pumped to depectinisation tanks.

Fining agent preparation station consists of four tanks. Two tanks are used for preparing bentonite solution and the third one for sol. The fourth tank is designed for mixing and heating gelatin solution.

After dosing the solution, a feeding line is rinsed and fining agent preparation station is automatically switched off. Depectinisation process is finished with pumping of unclarified juice to the batch tank from which is then taken to Ultrafiltration System.

V. Ultrafiltration

Ultrafiltration stage starts with pumping of unclarified juice from depectinisation tanks to the batch tank.

Depectinised unclarified juice reaches the batch tank and a high-efficiency centrifugal pump pumps juice with high velocity through membrane modules. A thin top layer is formed on the surface of membranes and some liquid penetrates through membrane channel as a ready product to the permeate tank. Retentate is condensed to obtain maximum concentration. Then it may undergo diafiltration to obtain extraction. After ultrafiltration process, juice is fed to fined juice tanks and it is taken again to evaporation station in order to condense it.

VI. Concentration

The heart of the line for producing fruit concentrates is multi-staged falling film evaporation station with a dropping juice film used for condensing apple juice and soft fruit (coloured).

During the entire juice production process, raw material reaches the evaporation station twice:

- for the first time, as unclarified juice before ultrafiltration process in order to be pasteurised and dearomatised;
- for the second time, as fined juice in order to be subjected to processes of initial and final condensation, inter-stage filtration and product cooling.

Condensing process consists in feeding fined juice to the heating columns which flows down as a dropping film. Hot steam heats the column from the outside, reaches a boiling point and evaporating point of liquid which is released to the next condensation level. Vapours are directed to the separator and used for further heating. The product goes through subsequent evaporation stages to obtain an appropriate concentration degree. Juice condensed in the evaporation station is cooled down and pumped in pipelines to the equalisation tank and after standardisation to storage tanks.

VII. Standardisation and Storage

Concentrate condensed in the evaporation station is cooled down to the temperature of approx 5-8°C and transported to the warehouse.

Before transferring the concentrate to storage tanks, standardisation takes place. Laboratory tests the extraction, acidity, NTU and colour on the basis of intermediate tank sample.

Concentrates are distributed and dispatched from the warehouse through equalisation tanks. It allows for complete control over the quality and repeatability of load batches.

VIII. Washing equipment and piping in production line

CIP (clean in place) station is used for washing installations, devices and pipelines in the production line in CIP system.

In the production process of juice and concentrates, washing station ensures cleanliness and hygiene in process tanks and storage tanks as well as in pipelines transporting raw material in pipelayers.

Washing products are prepared in the station in the form of working solutions and pumped to the device or installation which is to be cleaned. Then, they circulate in a closed circuit between CIP station and a given device within the time which ensures thorough cleaning at a set temperature. Washing temperature and solution concentration undergoes ongoing verification and automatic adjustment.

A washing procedure consists of the following phases:

- recovery of the products remains from the technological system;
- pre-rinsing of superficial staining;
- washing with the use of cleaning agents (acid washing and alkali washing);
- rinsing with clean water;
- optional disinfection.

Closed circuit washing allows for cleaning agent economy and reduction of sewage discharged. Working solutions are prepared in the CIP station in the concentrations recommended by the manufacturer and in adequate temperatures. Solutions are retained in three tanks insulated with a double coat and fed by a pump as needed [3].

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THE WAR IN UKRAINE, AGRICULTURAL TRADE AND RISKS TO GLOBAL FOOD SECURITY (ВІЙНА В УКРАЇНІ, СІЛЬСЬКОГОСПОДАРСЬКА ТОРГІВЛЯ ТА РИЗИКИ ДЛЯ ГЛОБАЛЬНОЇ ПРОДОВОЛЬЧОЇ БЕЗПЕКИ)

В статті представлені види та якість добрив, які забезпечують посіви необхідними поживними речовинами, завдяки чому посіви ростуть більше, швидше і виробляють більше їжі.

Ключові слова: *сільськогосподарська торгівля, продовольча безпека, зернові культури.*

The article presents the problems of growing and selling agricultural products due to the war, as well as the risks of a global food crisis.

Key words: *agricultural trade, food security, crops*

The ongoing War in Ukraine has had significant impacts on the country's agricultural sector, which is an important contributor to global food security. Ukraine is a major exporter of wheat, corn, and sunflower oil, and disruptions to its agricultural production and exports can have ripple effects on global food markets.

Before the conflict, Ukraine was a major exporter of grains, particularly wheat and corn, accounting for roughly 16% of global wheat exports and 7% of global corn exports in 2013. However, since the conflict began in 2014, exports have declined significantly due to damage to transportation infrastructure and disruptions to supply chains. Additionally, many farmers have been displaced or have lost access to their land, leading to a decline in agricultural output.

The decline in agricultural output in Ukraine has led to higher food prices globally, particularly for wheat and corn. This has put a strain on food security, particularly for vulnerable populations in developing countries that rely on imported food. In addition, the disruption of supply