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METHODS OF CONCENTRATION OF FRUIT JUICES AND THEIR ANALYSIS

ARIPOVA KAMOLA

PhD student of Namangan Institute of Engineering and Technology, Namangan, Uzbekistan
Phone.: (0888) 854-1050, E-mail.: kamola_aripova@mail.ru

Abstract: The paper considers the process of evaporation of water in multi-body vacuum evaporation plants to optimize the concentration of fruit juices. An analysis of the designs of vacuum evaporation plants for food concentration is given. Based on empirical dependencies and mathematical modeling, the optimal dynamics of the process is determined, which makes it possible to calculate the evaporation parameters to minimize energy consumption, as well as improve the quality of the finished product and reduce oxymethylfurfural. The results of the research can be used to economically optimize the technology, increasing productivity and efficiency of production processes.

Keywords: optimization, concentration, fruit juice, oxymethylfurfurol, optimal dynamics, process, construction, technology, parameter, concentrate.

Introduction. Juices are an important food product because, along with fresh fruits and vegetables, they provide the human body with all physiologically active substances - vitamins, macro- and microelements, polyphenols and many other substances necessary for normal human life [1-3]. The production of concentrated juices is developing widely all over the world. Their storage and transportation allows significant savings in containers, unloading and transportation, which allows to create a reserve for years with low yields. By concentrating, it is possible to increase the content of soluble dry matter in juices to 70-75% and, accordingly, reduce their volume by 5-6 times compared to natural ones. Juices are concentrated to 60-72% for transportation and long-term storage.

In the production of non-alcoholic beverages, juices regenerated by mixing concentrated juices and water in equal amounts are used, while preserving the physico-chemical, microbiological, nutritional and organoleptic properties of the initial raw materials. In this case, the flavor is restored by adding concentrated volatile flavoring agents. Liquid volatile aromatic substances are obtained during the production process of concentrated juice, as well as during the process of dissolving or extracting fruits using solutions (with water, carbon or ethyl alcohol oxide). Due to the low liquid content of concentrated juices, they are characterized by high microbiological resistance during storage.

Methods. Juice concentration is carried out by the following main methods:

1. sublimation (freeze drying);
2. crystallization (freeze concentration);
3. by reverse osmosis;
4. through heat treatment;
5. by vacuum evaporation.

Juice concentration is used to reduce storage and transportation costs.

One of the simplest and classic methods of preserving juices is heat treatment at temperatures below 100°C.

Fresh juices contain significant amounts of ballast substances (pectin, starch, proteins). During storage in natural juices, microorganisms develop from them, as a result of which organic substances in juices can oxidize and decompose. All this causes the quality of the product to decrease and deteriorate.

In the process of pasteurization, the growth and development of microorganisms is stopped, and protein complexes of enzymes, mainly phenolase, are inactivated. In this case, pasteurization temperature of 90°C is the norm, because an increase in temperature causes a decrease in the quality of the juice and the formation of melanoids, which create a specific taste. Juice pasteurization is carried out in heat exchangers: conical bells, plate or tube heat exchangers.

Heat-sensitive yeasts, molds, lactic and acetic acid bacteria develop in fruit juices. In acidic (pH=4.5) juices, yeasts are killed by heat treatment at 62°C for 2 minutes, non-spore-forming bacteria are killed in a few minutes at 65°C, and spore-forming acid-resistant bacteria are killed at temperatures of 87-93°C.

Heat-resistant molds, which are resistant to prolonged heating, have also been identified in fruit juices. Because the Byssochlamus fulva fungi found in apple and monkey juices were able to withstand heat at a temperature of 87°C for 30 minutes and developed under a pressure of 33.6 kPa.

Results. In order to prevent such defects in the production of non-alcoholic beverages, juices are preserved using ethyl alcohol. The main advantage of this method is that juices are cooled due to coagulation of pectin substances. After the addition of alcohol, they are cooled until the amount of pectin in the juice is 0.035%.

Sorbic acid is used to preserve juices; to prepare sorbic acid, it is dissolved in 10 times the amount of juice heated to 80-85°C with constant stirring. mixed, then heated to a temperature of 70-80 °C to stop the activity of lactic acid bacteria resistant to the action of sorbic acid contained in the mixture. After heating, the juice is cooled to 20-30°C and poured into sterilized volumes and hermetically sealed. Sorbic acid is used in the production of semi-finished juices, concentrated juice and drinks.

Thus, considering the main technological processes of production, it can be concluded that the processes are the main factor affecting the quality of juice products.

In the modern canning industry, concentrated juices are produced mainly from apples, grapes and citrus (mandarin) fruits. Such juices contain up to 50-70% dry matter. In the production of concentrated juices, the containers used for packing products are 4-6 times more expensive than ordinary juices, and storage warehouses and transport vehicles for finished products are also used relatively less.

There are three methods of juice production: evaporation (heat method), concentration by freezing and reverse osmosis methods, heat method juice concentration is often not higher than 50°C in high-efficiency film-type vacuum evaporation equipment. carried out at temperatures The juice flows through a thin film (1 mm thick) in the device and evaporates from 10 to 70% in a few seconds. This method works well in producing non-viscous, tempered and clear juices. This method ensures that the appearance, smell and color of the juice are preserved. In order to preserve the volatile specific smell of the product, the aroma retention is carried out. In the concentration of juices, the aromas are released with the first vapor, which vapor is trapped and condensed. Concentrated and cooled flavorings are packaged in bottles. Before preparing the juice for consumption, the concentrate is mixed with water and added to the product.

Unstrained juices are concentrated until 55% dry matter content, in strained juices 55% dry matter remains (with the exception of monkey juice, up to 70%). Mandarin juice is concentrated to 45% dry matter.

Concentrated juices with dry matter up to 70% are packed in pre-prepared containers (40-50°C) after evaporation. If the amount of dry matter in the juice is 55%, it is preserved by treatment with sorbic acid in order to prevent bacterial spoilage.

Separation of wine stone by ion exchange- cation or anion exchange resins are highly effective for processing sulfited grape juice, in which calcium and potassium (+ positive) cations and anions (acidic and sulfated) grapes are separated in one process. after the juice is first cooled and filtered, it is transferred to an ion exchange device. The prepared juice first passes through a cation exchange resin, which cations capture potassium, calcium, magnesium (+positive) heavy metals and separate hydrogen (+positive) ions. In this case, the acidity of the juice increases sharply and is equal to pH - 1. Then the juice passes to the 2nd anion tar filter and the acids are trapped by the absorption method. Sulfate and dyes are transferred to the juice during transport of OH - ions, and the juice has an alkaline reaction.

In the last third filter, the juice again passes through a cationizing filter. In this filter, along with the remaining cations, the acids bound to these cations are separated. Juice increases to pH 3 - 5. The juice purified from compounds of cations and coloring phenols is almost colorless and can be used as grape sugar.

Electrodialysis —with this separation of wine stone - in which electrolytes pass through semi-conductive barriers under the influence of electric current. This method is used to separate potassium ions from grape juice. In electrodialysis, the purified juice is transferred to the separator and cleaned after adding large impurities, then heated in plate heaters to 98°C, then cooled to 35-40°C and transferred to the AOP-1 device. Additives are prepared in special mixers. After their residues are cleaned in the separator, the juice is filtered and transferred to the electrodialysis unit EDU-1. It consists of 4 blocks of electrodialyzers. Between them are intermediate containers, in which water for washing is stored. The concentration of potassium in the electrodialysis juice should not exceed 800 - 900 mg/dm^3.

Separation of wine stone by chemical methods. Chemical detartarization is based on the addition of calcium salts of lactic acid or other organic acids to grape juice, resulting in an exchange between tartar and calcium salts. As a result of the reaction, a moderately soluble calcium salt of tartaric acid is formed, which precipitates in crystalline form. Precipitation of tartar using calcium lactate takes 7-10 days. 10 kg of calcium lactate is used for 1 ton of juice.

Precipitation of tartar using metatartaric acid— metatartaric acid is a polymer of tartaric acid, a tarry yellow substance obtained by heating it with heat. A particular difficulty in using metatartaric acid is that it hydrolyzes when heated to form tartaric acid and reduces the stabilizing properties of metatarnic acid. It increases this property by increasing the pH of the juice.

Conclusion. That is, iron ions, copper and alcohol slow down the action of metatartaric acid sulfite. 2-2.2 times more metatartaric acid is used for the stabilization of tartar in non-tempered juices compared to the pre-tempered juice.

Forms metatartaric acid - soluble compounds with tartar and at the same time eliminates its sedimentation. For rapid sedimentation of wine stone, freshly squeezed juice is cleaned of suspended particles, quenched with pectolytic enzymes, heated to 92oC, cooled to 35-40oC, separated and filtered. Metataric acid 0.05 - 0.06% is added to the strained juice, mixed for 5 - 6 minutes, heated, packaged and sterilized.

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