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II | GROWING, STORAGE, PROCESSING AND AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

RESEARCH ON THE FOOD SAFETY OF POMEGRANATE JUICE AND CONCENTRATE PRODUCTION TECHNOLOGY

UZAYDULLAEV AKMAL

Head of department, Gulistan State University, Gulistan, Uzbekistan
Phone.: (0897) 277-7553, E-mail.: uzaydullayevakmal@gmail.com

Abstract: To ensure flow and continuity of the juice production process, industry uses continuous presses. In addition, the quality of the juices produced depends, first of all, on the quality and chemical composition of the raw materials, as well as on the features of the production process. More numerous factors for preserving the quality of juices are the following: packaging that allows you to preserve the organoleptic and physicochemical properties of processed vegetables for a certain period of time, etc.

Keywords: electromagnetic fields, ultrahigh frequency, concentrate, pasteurizer, electroflotator, anode, cathode, flavor, extraction, temperature.

Introduction. All over the world, scientific work is being carried out to improve the processing of fruits and vegetables rich in carbohydrates, vitamins, and micro- and macro elements and to create modern equipment and technologies. At the same time, special attention is paid to the creation of highly effective methods and technologies for obtaining fruit and vegetable juices.

Today, there is a high growth in production at pomegranate processing plants around the world, including India, Iran, China, Turkey, the USA, Pakistan, Afghanistan, and Uzbekistan.

The issues of preserving vitamins and proteins in pomegranate juice, ensuring a high level of juice transparency, and creating technological systems aimed at increasing the range of products have not been studied at an insufficient level. Accordingly, the use of the pasteurization process under the influence of ultrahigh-frequency electromagnetic fields in the processing of pomegranate juice is of great scientific and practical importance.

Results and discussion. The study used physical, chemical, and electrophysical methods, preparation of reagents, determination of dry matter, and determination of total and active acidity.

In this work, we [1], to improve the technology for the production of pomegranate juice and concentrate, instead of the existing pasteurizer with a plate heat exchanger in the existing Bertuzzi production line, installed a resonant microwave pasteurizer, and the production process line was improved by replacing the second separator for purifying pomegranate juice with a two-chamber combined electroflotator (Fig. 1).

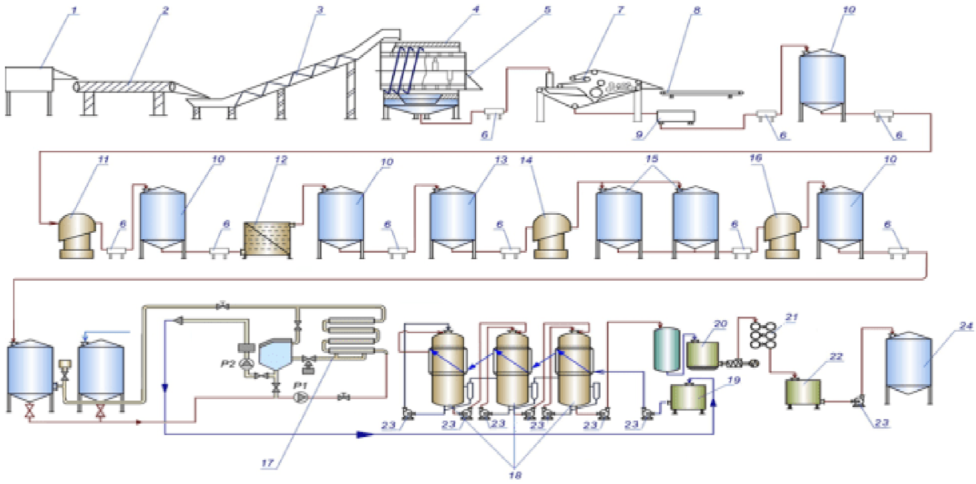

Figure 1. Improved technological line for the production of pomegranate juice and concentrate.

1-administrator desk; 2-conveyor; 3-wash lift; 4-separation machines (“Bertuzzi”); 5-conveyor for pomegranate peel; 6-pump; 7-strip press (“Flottweg”); 8-pomegranate seed conveyor; 9-buffer juice capacity; 10-container for collecting juice; 11-separator (“Nagema”); 12-microwave pasteurizer; 13-anion exchange reactor; 14-separator for selecting anion exchangers; 15-fermentation tank; 16-Two-section electroflotator; 17-ultrafilter "Unipectin AG", BS17-container for ultrafilter-17 juice. BD17-Distillate ultrafiltration tank-17; 18-component vacuum evaporator "Chema"; 19-buffer juice tank; 20-capacity of ready-made concentrates; 21-salt cooler for concentrate; 22 containers for collecting cooled concentrate; 23-vacuum pump; 24-aseptic tank.

Figures 2 and 3 show a schematic diagram of a continuous pasteurizer and a two-chamber electroflotator for pomegranate juice.

The microwave pasteurizer for juice consists of an Oyster EMP energy source, an oyster pasteurizer control device, safety devices and inlet and outlet pipes for juice. Pasteurizers are divided into three groups according to power: small (up to 1.5 kW), medium (1.5-5 kW) and large (more than 5 kW), and according to productivity: small (5-10 kg/h), medium (15-40 kg/hour) and large (more than 50 kg/hour).

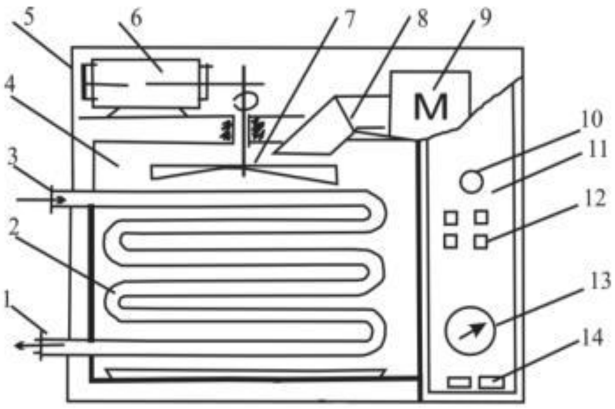

Figure 2. Schematic flow diagram of a continuous pasteurization plant for pomegranate juice.

1;3-juice inlet and outlet pipes; 2-coil tubes for continuous pasteurization of juice in the working chamber; 4-working resonator microwave chamber; 5-device frame; 6-disector electric motor; 7-dissector; 8-EMF wave transmitter; 9-magnetron; 10-signal lamp; 11-control panel; 12-button control panel; 13-rheostat; 14-button to turn the device on and off.

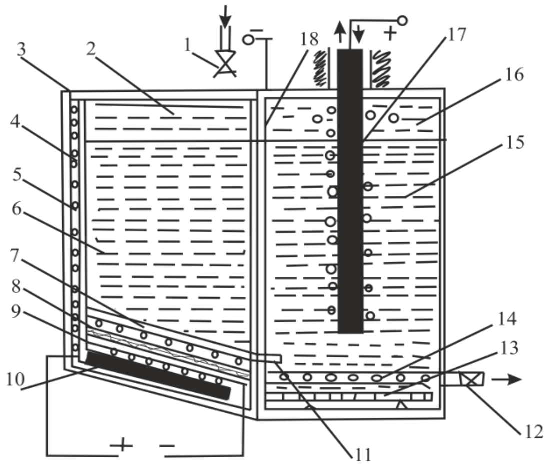

Figure 3. Two-chamber apparatus for electroflotation of pomegranate juice.

1-juice entry point; 2-foam product; 3-frame; 4 – ways to remove oxygen; 5-oxygen bubbles; 6-processed juice; 7 – drainage of pure juice; 8-diaphragm; 9-cathode; 10,17-anode; 11-point of transition of juice to the second section; 12-output of fresh juice; 13-cathode; 14-hydrogen bubbles separating from the cathode; 15-quality purified juice; 16-layer foam; 18-cathode wire.

The electroflotator consists of anode and cathode electrodes installed in the working chamber, product supply, output, DC power supply, control system and other parts. In its two chambers: first, large waste pomegranate juice is purified by a rapid flow of bubbles, allowing the streams to mix, and then by slowing the flow by mixing small colloidal particles with the bubbles.

When assessing the quality of pomegranate juice in accordance with GOST 32102-2013 "Canned food. Juice products. Concentrated fruit juices. General Specifications (with Amendments)" take into account the moisture, color, taste and smell of the product, as well as the appearance of the finished juice [3].

The taste and smell are inherent to pomegranate juice, without foreign odors and tastes; unexpressed smell and taste of concentrated juice are also allowed if natural volatile flavors are not added to it [2].

The color is characteristic and corresponds to the color of the pomegranate grain; slight lightening of the juice from dark fruits is allowed. A slight sediment is allowed at the bottom of the container or package. It is allowed to have crystals that dissolve quickly during reconstitution on the walls or bottom of the container. The consistency can be viscous and thick, but the presence of foreign impurities that are not characteristic of the finished product is not allowed.

To clarify the effect of extraction time on the degree of extraction of target components with increasing process duration under the conditions of a resonant microwave pasteurizer, additional experiments were carried out. Their results are presented in Table 1.

Table 1. Content of water-soluble substances.

Simple sugars	Organic acids	Polyphenols	Vitamin C
Fine fraction, 60 wt. %			
15,05 ± 0,12	1,65 ± 0,01	1,73 ± 0,01	17,60 ± 0,15
Coarse fraction, 40 wt. %			
10,25 ± 0,08	0,850 ± 0,005	1,97 ± 0,02	15,85 ± 0,11
The entire remainder			
12,76 ± 0,10	1,27 ± 0,008	1,840 ± 0,015	16,76 ± 0,13

As can be seen from Table 1, the fine and coarse fractions differed in the content of water-soluble substances.

To ensure flow and continuity of the juice production process, industry uses continuous presses. To obtain grape juice, a screw press is widely used, the working element of which is a pressing screw consisting of two parts, rotating at the same speed in different directions with oppositely directed turns. Both screws are placed in a perforated cylinder equipped with stiffeners.

The juice output is regulated by the size of the gap between the conical moving gate and the body of the perforated cylinder.

The product pressed by pressing contains not only juice in the strict sense of the word but also particles of fruit pulp of different sizes. This juice is a polydisperse system. To obtain a crystal-clear product, the juice must be clarified, i.e., divided into sediment and clear liquid (the juice itself).

The difficulty in obtaining clear juice is explained by the fact that the product is a colloidal solution that contains large particles of pulp, highly dispersed particles, and high molecular weight substances (pectin, proteins, some tannins, colouring substances, and polysaccharides). Large suspended matter can be removed by passing the juice through a stainless steel sieve with a hole diameter of 0.75 mm or using a coarse impurity cleaner type KS-12. However, after such purification, a stable colloidal turbidity remains in the juice, which does not disappear even after long-term storage. The industry produces cloudy, unclarified juices, but they have an unsightly appearance.

To obtain a consistently transparent finished product, it is necessary to partially destroy the colloidal system by removing part of the protein, pectin, and other substances of colloidal dispersion from the juice. Various methods are used for this purpose.

Treatment with enzyme preparations is the predominant method of juice clarification. Juices rich in pectin substances are treated with pectolytic enzyme preparations in an amount of no more than 0.03% by weight of the juice based on a standard pectinase activity of 9 units/g.

The preparations are applied in the form of a suspension in the same way as when treating pulp with enzyme preparations. Moreover, if enzyme preparations were added to the pulp, then re-adding them to the juice is undesirable.

The juice with the enzyme preparation is kept for 1.5-2 hours at a temperature of 45-50 °C. After this, the juice is carefully decanted (removed from the sediment) and sent for further processing.

Instant heating to 80–90 °C are used to clarify some juices (cherry, apple, and pomegranate). In this case, the stability of the colloidal system is disrupted, and some of the colloids precipitate. This method is combined with other lighting methods. After heating and cooling, the juice is separated.

Clarified juices are filtered to separate the sediment and obtain a crystal-clear product.

The juice is filtered at constant low pressure using various filters. The most common in industry is the Progress frame filter press. On its frame, there are 47 aluminium plates with a ribbed surface. Filter cardboard or asbestos plates are placed between the plates and compressed tightly. Unfiltered juice enters the channels of the even-numbered plates, passes through the filter plates under pressure, and through the channels of the odd-numbered plates, clear juice exits the filter into the collection tank. As the filter press operates, the plates become clogged, and its productivity decreases significantly. Therefore, the filter must be recharged with new plates during the shift after stopping work. For the purpose of economical use of filter cardboard, it is recommended to separate the juice before filtering until sediment is reduced and filter the juice through the filter cardboard, first in one direction, then in the opposite direction.

The juice is packaged after deaeration (removing air from the product) and heating into prepared bottles, type I cans with a capacity of up to 3000 cm3, and aluminium tubes with a capacity of 200 cm3. Next, the jars are sent for pasteurisation at a temperature of 85–90 °C in continuous devices or autoclaves. The duration of pasteurisation and sterilisation is from 10 to 60 minutes, depending on the type of juice and container capacity.

Juices are stored in dry rooms at temperatures from 0 to 25 °C and a relative air humidity of no more than 75%. Dark-coloured juices should not be stored in he sun. The juice is stored for 6 months to 2 years.

And so, we carried out an analytical analysis of the technology for processing pomegranate juice in Uzbekistan: we studied the issue of growing pomegranate fruits of local pomological varieties, studied the chemical characteristics of pomegranate juice and ways to improve the quality of pomegranate juice, and improved the technologies for processing pomegranate juice and the quality of the juices produced using electrophysical methods [4–6].

When purifying pomegranate juice by electroflotation, the influence of current density on the process, placement of electrodes in the chamber, foaming properties, juice temperature, and layer height were determined.

During the electroflotation process, there are no significant changes in dry matter, sugar, titratable acid, tannins and dyes, iron, calcium, or vitamins.

The chemical composition of pomegranate juice was studied using ultraviolet and infrared radiation to obtain additional information about the properties of electroflotation processes [4–5].

Table 2. Chemical composition of pomegranate juice before electroflotation(1) and after(2).

Experience Series	Sample number	Height of selected samples, cm	Dry substances, %	Sugar, %	Titrated acid, %	Tannins and dyes, g/l	Acidity, %	pH	Fe, mg/ 100 g	Ca mg/100 g.	Витамины, мг %. Ascorbic acid-C pH 5.0	Thiamine-B1, mg% pH 7.5,	Riboflavin	Pyridoxine
1	1	0	21,0	18,5	1,29	1,12	1,8	3,35	0,15	0,22	12	0,22	0,15	0,4
	2	70	21,0	18,6	1,29	1,11	1,8	3,35	0,15	0,22	11	0,22	0,15	0,4
	3	0	21,0	183	1,29	1,12	1,8	3,35	0,14	0,21	10	0,22	0,15	0,4
	4	20	21,0	18,3	1,29	1,11	1,9	3,3	0,14	0,21	11	0,21	0,14	0,4
	5	60	21,0	18,6	1,29	1,12	1,6	3,3	0,14	0,21	10	0,21	0,15	0,4
	6	70	21,0	18,3	1,29	1,08	1,6	3,3	0,15	0,22	10	0,21	0,14	0,4
2	1	0	18,6	16.6	1,26	1,09	1,5	3,4	0,14	0,21	9	0,21	0,13	0,3
	2	70	18,2	16,3	1,24	1,06	1,4	3,4	0,14	0,22	8	0,20	0,13	0,3
	3	0	18,4	16,3	1,24	1,05	1,5	3,4	0,13	0,21	8	0,19	0,14	0,3
	4	20	18,4	16,3	1,25	1,05	1,3	3,4	0,14	0,21	8	0,20	0,13	0,3
	5	60	18,4	16,3	1,24	1,04	1,3	3,4	0,13	0,21	7	0,19	0,13	0,3
	6	70	18,4	16,3	1,24	1,03	1,2	3,35	0,14	0,22	8	0,20	0,14	0,3

Conclusion. For this purpose, a quartz spectrophotometer of type SF 4 was used in the operating range from 220 to 1100 μm. In this range, the maximum absorption in the ultraviolet part of the spectrum turned out to be maximum. The conducted organoleptic analysis confirmed that the clarity, color and taste of pomegranate juice improved during electro flotation.

The physico-chemical parameters of pomegranate juice during the electroflotation process were determined: dry substances, sugar, tannins and dyes, acid, iron, calcium and vitamins. Confirmed no significant changes and improvement in appearance and taste.

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