InnoVationInfo

International
Journal of Food and Bioscience

Int J Food Biosci 2018
Volume 1: 1

The New Method of Juice Concentration

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Abstract

At present time, the concentrates of juice produce by the separation of the water from fresh juice. For producing of the concentrates of juice is used one of the following methods: the evaporation either the freezing water or the diaphragm method. In the evaporation method the juice is heated in the vacuum in the special trays, but this heat is not led to the boiling point, since during the process of boiling all useful substances will be destroyed. The mass, obtained after evaporation, is similar to more viscous the jam, to the honey or the thick syrup. The process of the freezing water completely repeats evaporation, with exception of temperature parameters. The water is moved away under the action of cold. In the diaphragm method the juices pass through the membrane with the smallest membrane 's holes. The water infiltrates, and the large molecules of other substances of juice remain. All these methods are connected with the high expenditures. The paper represents the use of a new developed method for producing of the concentrate of the juice, where the water was not moved away, but the water by itself provides the producing of the high concentrate of juice, which permits to produce of the high-quality concentrates by simple, fast and economically advantageous (it does not require the application of evaporation, freezing and membranes) method.

Keywords: Separation, Concentrates of juice, Many phase systems, Electric field influence on the water solutions, Hydrogen electrolysis gas bubbles.

Introduction

The fresh juice with all important components inside presents the water that compounds the valuable microscopic particles of sucrose, sugar and acid. Therefore, the primary task of juice concentration reduced to the separation of the microscopic of these components from the fresh juice and collection their high concentrate in the special receiver. At present time, this task is solved by the separation of the water from fresh juice. There are three following methods of producing of the concentrated juice: the evaporation of water, the freezing of water or the diaphragm concentration. In the evaporation of water method, described in [1-4], the juice is heated in the vacuum in the special trays, but this heat is not led to the boiling point, since during the boiling all useful substances will be destroyed. The mass, obtained after evaporation, is similar to more viscous the jam, to the honey or the thick syrup. The method of freezing of water, considered in [5,6], completely repeats evaporation, with exception of temperature parameters. The water is moved away under the action of cold. The diaphragm method, considered in [1-4], uses the juices pass through the membrane with the smallest membranes holes. The water infiltrates, and the large molecules of other substances of juice remain. All these methods are connected with the high expenditures. In [7] a new method of separation of the smallest solid particles from

Article Information

Article Type: Research
Article Number: IJFB102
Received Date: 16 April, 2018
Accepted Date: 27 April, 2018
Published Date: 04 May, 2018

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Citation: Shoikhedbrod M (2018) The New Method of Juice Concentration. Int J Food Biosci Vol: 1, Issu: 1 (03-06).

the water solutions and of the collection of these particles as high concentrate in the special receiver was represented. The developed method permits to concentrate of the smallest particles by such manner that the water was not moved away, but the water by itself provides the collection (concentration) of these particles. The paper demonstrates the use of the developed method for the fast and profitable concentration of juice. Besides, the use of developed method showed the high efficiency of the purification of waste water of the juice producing technologies.

Materials

The method has been tested at the plant ***Ganir*** (Israel). The different juices productions of this plant: orange, apples, and mango, were used.

Method and Developed Devices

The fresh juice with all important components inside presents the water that compounds the valuable microscopic particles of sucrose, sugar and acid. Therefore, the primary task of juice concentration reduced to the separation of the microscopic particles of these components from the fresh juice and collection their high concentrate in the special receiver. The completely new technological process of juice concentration, which uses the action of DC (direct current) on the fresh juice, was developed [7]. The essence of the method consists in the fact that under the action of electric field on the fresh juice during electrolysis, between two electrodes the negatively charged bubbles of hydrogen are formed on the cathode. The size of formed negatively charged hydrogen bubbles can be controlled and can be as small, as this requires the technological process of juice concentration.

The use of negatively charged with calculated dispersiveness of hydrogen bubbles permits to solve the primary task of the technological process of juice concentration, connected to the separation of microscopic particles from fresh juice, - the creation of strong complex of the hydrogen bubbles + valuable microscopic particles of the solid component of fresh juice in the process of the elementary act of floatation.

After formation and detachment from the surface of cathode, the charged negatively bubbles of hydrogen, rising up in the fresh juice; meet on its way the microscopic particles of the valuable solid component of the fresh juice by the dimensions of considerably larger than single bubble and bubbles induce the positive charge on the area of the microscopic particle of solid material.

As a result of the attraction of opposite charges, the bubbles stick to the microscopic particle, forming strong contact, and volume of formed complex of microscopic particles + hydrogen bubbles strongly increases, and under the action of the considerably increased Archimedes force, the complexes of microscopic particles + hydrogen bubbles with the increased speed float upward.

For practical using of the developed method of juice concentration, the special laboratory electroflotator was developed, whose common form is presented on the (Figure 1).

The special laboratory electroflotator presents the cylindrical container from the organic glass with inside diameter of 2.0 cm, by height 11 cm, whose bottom (with square S=3.8cm^2) is made from the stainless steel and serves as the cathode. The anode, made in the form of ring from the stainless steel, was fixed at a distance by 0.5 cm from the cathode.

Electroflotator was supplied by the manual separator in the upper part of electroflotator for the collection of the juice concentrate, obtained during the process of the fresh juice concentration, in the receiver collector.

The volume, which fills electroflotator by fresh juice, was about 40 cm^3. Thus, the construction of electroflotator of this form is electroflotator of discrete action. The tests were conducted in the discrete, discontinuous regime. The fresh juice, in the process of juice concentration, was filled from top of the electroflotator.

During the process of the test, the juice concentrate, using manual separator, was collected in the receiver collector, and remained juice water was derived through the pin valve of electroflotator, located on the bottom of electroflotator. For the realization of juice concentration of continuous action, the following electroflotator was constructed (Figure 2).

Structurally developed electroflotator of continuous action for the juice concentration has floatation camera **- 7**, fulfilled in the form of the rectangular capacity, whose angles are supplied by the special inserts, in consequence of which, the internal part of the camera acquires the form of cylinder, and rear upper wall is supplied by the reflector.

In the process of juice concentration, the fresh juice is entered to the floatation camera - ***7*** through the branch pipe with crane ***1***, pocket ***2*** and gap ***4***, for the realization of separation of the valuable microscopic particles from the fresh juice.

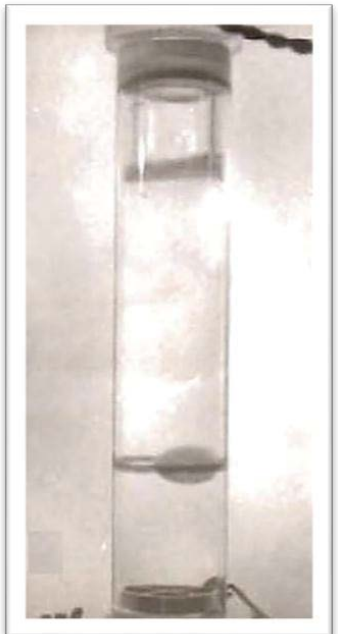

Figure 1: The common form of laboratory electroflotator.

The remained juice water, after passing through the camera -*8* of additional cleaning, is moved away from electroflotator through the pocket and the drain branch pipe with crane -*6*.

The basic element of electroflotator is electrolytic base -***5***, fulfilled in the form of plug and of special mechanism that permits simply to regulate by inter electrode gap size.

The cathode was produced from the stainless and is mounted on the bottom of camera. The anode was produced from the corrosion-resistant metallic lattice uses the special construction, which is located on the cathode that simply regulates the size of gap between anode and cathode.

After completion of works for washing of electroflotator and output of the entire remained water the branch pipe with crane - ***9*** is provided. Crane, during the process of the work of electroflotator, is closed.

The floated microscopic valuable solid particles of juice are collected in the foam layer in the upper part of the camera and are moved away by paddle device - ***3*** to the special receiver capsule.

Results

The tests were conducted at the plant ***Ganir*** (Israel). The tests were conducted on the special constructed laboratory electroflotator of discrete action (Figure 1).

During the tests on the electrodes of electroflotator the direct current voltage was given. The operating range of direct current voltage composed *60-90V*. The results of tests are represented in the (Table 1) (I.R.D Laboratories).

It can be seen from the Table 1 that the greatest results in the obtaining of the high-quality concentrates of juice are achieved by direct current voltage on the electrodes of *90V*. It should be noted that obtained concentrate is the concentrated foam of juice that can be used for producing of the hydrogen cocktail with different juice fruit additives. For determination of the changes of the parameters of concentrate, shown in the Table 1, it was decided to use the developed method for the purification of waste water, obtained after general technological process at the plant.

Table 2 presents the results of purification of waste water, obtained after the completion of general technological process at the plant *Ganir* (*I.R.D laboratories*).

It can be seen from the Table 2 that °*Brix* decreased from *0.4* to *0.1*, and *pulp* from *2.5%* to *0*. The decrease of these parameters is explained by an increase of their content in the juice concentrate after the cleaning. It should be focused attention on the parameter *COD*, which is the basic index of the pollution of water by organic matter.

As follows from Table 2 that after cleaning, the *COD* decreased from *7100 mg/L* to *80 mg/L*, which indicates of the high efficiency of the application of the developed method for the purification of waste water of this plant.

Conclusion

Thus, the tests of the developed method of processing of the concentrates of juices showed its high efficiency for producing of the high-quality concentrates. Method is simple, fast and economically advantageous (it does not require the application of evaporation, freezing and membranes). The developed method showed the high efficiency of the purification of waste water of the juice producing technologies. The developed electroflotators permit to produce the high-quality concentrates of juices and to clean of waste water with high efficiency in industrial practice.

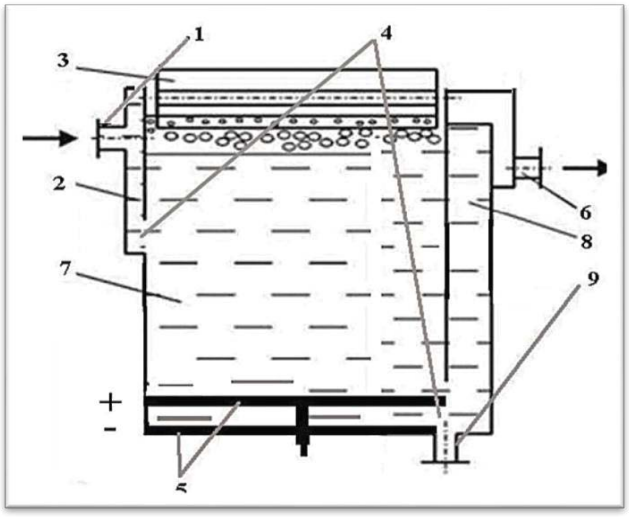

Figure 2: Electroflotator of continuous action for the juice concentration.

Table 1: Results of the tests of the method of processing of the concentrates of juice in the electroflotator. The time of the process- 18 seconds, Brix-measure for the mass relation the dissolved sucrose in the water to the liquid, Ratio-relationship sugar and acids in the concentrate.

U(V)	°Brix	Ratio	Ascorbic acid, Mg/L	Pulp, %
60	64.0	17.5	11	5
75	65	18	11.2	8
90	65.5	19.2	11.4	10

Table 2: Results of the purification of waste water of the plant *Ganir*. *COD* (chemical oxygen demand)-determines a quantity of organic pollutants in the water.

	°Brix	Pulp, %	COD, мг/л
Before cleaning	0.4	2.5	7100
After cleaning	0.1	0	80

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