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STABILIZATION OF MELON CLOUDY JUICE WITH BIOPOLYMER AGAR

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In the production of natural fruit juices, the uniform distribution of fruit pulp particles in the volume is of great importance, which determines the aggregate stability of the system. To maintain the aggregate stability of fruit juices, stabilizers are used, which are polymers or surfactants. In this regard, the influence of natural polymer agar on the stability of melon juice containing particles of melon pulp has been studied. The initial melon juice had a pH of 5.78 and a titrated acidity of 970.29 mg of citric acid/L, the content of soluble solids in it corresponded to 10.08 TSS Brix. Samples of melon juice with concentrations of 50, 70 and 90 % were used for research. The study of the stability of melon juice in the presence of agar was carried out for 6 days on the Turbiscan device (France). It is shown that at concentrations of agar introduced into melon juice of 0.005 % and 0.01 %, the system retains its aggregate stability, but when switching to a concentration of 0.02 %, the stability of the system decreases. The size of melon pulp particles changes accordingly. If the addition of agar concentration of 0.05 % and 0.01 % to the melon pulp reduces the particle size of the melon pulp, then an increase in the agar concentration to 0.02 % causes a certain increase in the particle size of the fruit pulp. This effect of agar concentration on the aggregate stability of melon juice is explained by the fact that at low concentrations, polymer macromolecules, covering the surface of melon pulp particles, protect them from sticking. When the polymer concentration increases, melon pulp particles begin to stick together due to the coupling of loops and tails of agar macromolecules adsorbed on their surface

Keywords: cloud melon juice, fruit pulp, agar, stabilization, aggregation, sediment, flocculation

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1. Introduction

Melon is one of the most widely consumed fruits in the world. It contains variable amounts of protein, carbohydrates, and is rich in vitamins, minerals, fiber, oils, and biologically active compounds with functional properties. Melon has a higher calcium level and higher protein content than any other fruit [1–3]. In addition to being an excellent source of various useful components, it has been shown to contain enzymes that help fight diabetes [4]. The low sugar content of melon is suitable for the production of low-calorie juices [5]. On the other hand, the nutritional and anti-fat properties of melon juice make the demand for this product even higher for human consumption. In this regard, the production of juices based on melon pulp is important for the food industry. However, the main disadvantage of juices containing fruit pulp is its precipitation, which accordingly affects the appearance of the product. Therefore, maintaining the stability of melon juice is an urgent problem in the production of natural juices.

2. Literature review and problem statement

To regulate the stability of juices, various types of chemical and physical effects are used on them. In the work [6], the influence of heat treatment on the stability of citrus juice was studied. It is shown that the processing of pulp is effective in heat treatment, since it contains the enzyme pectin methylesterase, which is more heat resistant than even microorganisms. At the same time, according to [7] heating pectin methylesterase increases the cloudity of acidic sour orange juice by inactivating the enzyme. Effect of soybean soluble polysaccharides, calcium chloride and soy protein isolate on the stability and rheology of soursop juice was studied [8]. Interaction soluble polysaccharides soy protein isolate led to increase of Newton viscosity, but interaction of soy protein with calcium chloride led to sediment. Authors suggest, that soybean soluble polysaccharides are effective in stabilizing fibers and proteins in acidic suspensions due to the formation of complexes between polysaccharides and proteins. In work [9], chitosan from shell shrimps was used to lighten passion fruit juice. The results were evaluated in terms of turbidity, color, and total soluble solids (TSS). The result of stabilization of the juice with chitosan was compared with the effect of centrifugation and treatment with an enzyme. It turned out that for the clarification of passion fruit juice, the most convenient treatment is chitosan. The enzymatic treatment was reliable only for viscosity reduction, while the chitosan treatment after a mild centrifugation showed the best result for passion fruit clarification. In the work [10] the possibility of using montmorillonite clay to regulate the stability and appearance of fruit juices is shown. The use of clays is based on the fact that they adsorb anthocyanin molecules from fruits, expanding the inter-layer space in their structure. However, the use of clays does not increase the aggregative stability of juices, since clay particles absorb molecules of substances that pollute the juice, and do not act on large particles of fruit pulp. On the other hand, the production technology will be complicated by the need to remove clay as a spent adsorbent. Therefore, despite the variety of methods for processing fruit juices, there are still unresolved issues related to the regulation of their stability. The reason for this may be objective difficulties in comparing the results of the stability assessment obtained by different methods. Variant for solving the problem can be measures aimed at ensuring an even distribution of fruit pulp particles in a liquid medium. This approach is used in [11], where high pressure homogenization carried out for stabilization of cloudy apple juice. Cloud value, cloudy stability, particle size distribution, ζ-potential and dynamic instability were used as indicator of juice stability. The results showed that, when homogenization at 20 MPa for one time, the apple juice showed lower cloud value, higher cloudy stability, more uniform particle sizes, higher ζ-potential and lower dynamic instability. The considered methods of stabilization of fruit juices are very interesting and diverse, but they do not have unified approaches to the process of stabilization of the system. A more fundamental approach to solving the problem of stabilization of turbid juices is carried out by the authors of [12], in which a colloid chemical interpretation of the issues of stability of juices is undertaken. In this paper, water-soluble polysaccharides – pectins are considered as stabilizers of fermented carrot juice. The stability of juices during storage is explained by the action of soluble polysaccharides, which are adsorbed on the insoluble polysaccharides of the plant cell wall. At the same time, many fruit juices, despite the presence of pectins in them, lose their aggregative stability during storage. This may be due to a lack of enzymes or the predominance of the amount of insoluble polysaccharides over soluble ones. All this suggests that it is appropriate to conduct a study on the stabilization of melon juice using a biopolymer.

3. The aim and objectives of the study

The aim of the study is stabilization of melon juice using a biopolymer agar.

To achieve this aim, it is necessary to:

– determine the effect of agar concentration on the aggregative and sedimentation stability of melon pulp juice;

– search the change in the size of melon pulp particles with varying agar concentration;

– find the optimal conditions for stabilization of melon juice.

4. Materials and method

Melon (Kyrykpa breed) was used from the Kazakhstan plantation. Agar, produced by Sigma-Aldrich Chemie (Portugal), was used as the stabilizer of melon juice.

4. 1. Preparation of melon juice

Melons were washed in running cold water, rinsed with deionized water, and allowed to drain. The rind was removed with a sharp stainless steel knife, seeds and their surrounding section were removed. All cutting tools and dishes were sanitized with 70 % ethanol and allowed to dry before usage [13]. Then, the melons were cut into pieces, and the juice was obtained by using the juicer Scarlet (China) at 20 °C.

4. 2. Measuring of pH of mixture melon pulp-agar

The average pH was determined at 20 °C using a pH electrode (HandyLab/LF12 SET, Germany).

The titratable acidity was determined by titrating 20 ml of the diluted melon juice (initial melon juice/water volumetric ratio 9:1) with a standard solution of 0.1 M sodium hydroxide to a final pH=8.1 using an automatic titrate. The total soluble solids were determined by measuring the °Bx using a digital refractometer Refracto 30px/GS (Mettler Toledo, Japan) at 20 °C. Melon maturity is determined based on the sugar content, more routinely as the °Bx of the pulp.

4. 3. Study of the stability of melon juice

The stabilization of melon juice was carried out with the biopolymer agar, using 0.005 %, 0.01 %, and 0.02 %, agar solutions that were prepared by dissolving the polymer in distilled water at 85 °C in a water bath. To study the effect of concentration of agar on the stability of juice mixture and fresh agar solutions were prepared in volumetric ratios of 9:1; 7:3; 5:5, respectively. The concentration of agar in the mixture was regulated by adding the required amount of water. The resulting mixture was stirred in an ultrasonic shaker (IKA Ultra Turrax Tube drive control, Germany) at 3000 rpm for 5 min. Stability was studied by optical transmittance and backscattering of photons of different samples. These two parameters were measured using special equipment Turbiscan Lab® (Formulaction SA, France). All stability measurements were carried out at a temperature of 25 °C. Turbiscan Lab® has several advantages in comparison with classical approaches. Namely, stability can be measured, and the colloidal dispersions' instability as sedimentation, flocculation and coalescence quantitatively determined.

4. 4. Measurement of the particle size distribution

To determine the particle size of melon pulp in the presence of agar at different concentrations, agar solutions with concentrations of 0.005 %, 0.01 %, and 0.02 % were prepared. Eighteen milliliters of melon pulp was poured into 4 bottles. Two milliliters of distilled water was added into the first bottle, the second – 2 ml of 0.05 % agar solution, into the third one 2 ml of 0.01 % agar solution was added, and the fourth bottle were filled with 2 ml of 0.02 % agar solution. Each bottle content was mixed, and the particle size was measured 24 hours later. Obtained 90 % melon juice was used to determine the particle size. Measurements were carried out by laser diffraction using a Malvern Mastersizer 2000 E (UK). Measurements were carried out in full compliance with ISO 13320–1 [14].

5. Results

5. 1. Physical and chemical characterization of melon juice

Before studying the effect of the polymer on the aggregative stability of melon pulp juice, it was necessary to determine some of its physical and chemical characteristics. The pH, titratable acidity, and the total soluble suspended solids content in the obtained juice are shown in Table 1.

Table 1

Physical and chemical characteristics of the initial melon juice

Characteristics	According to the experiment
pH (25 °C)	5.78
Titratable acidity (mg, citric acid/L)	970.29
TSS (°Brix)	10.08

This information is necessary, on the one hand, to control the quality of the used melon juice as a food product and its compliance with international standards. On the other hand, for the interpretation of data on the stabilization of melon juice by agar, information about its physical and chemical properties is very important.

5. 2. Turbiscan device study of the backscattering curves of melon juice

Fig. 1 shows data on the backscattering of light by colloidal particles of melon pulp obtained on the Turbiscan device. They provide information about the degree of transparency or turbidity of the system, which can be used to judge the stability or instability of the juice. Fig. 1, *a* corresponds to the original melon juice concentration of 90 %, Fig. 1, *b, c* refer to the juice with the addition of agar of different concentrations. Profiles of the intensity of backscattering light of samples (%, *Y*-axis) versus the height of flat-bottom cylindrical glass vial (mm, *X*-axis) as a function of time are shown in Fig. 1, *a–d*.

From the analysis of raw data corresponding to the middle of the sample, it is possible to see that the backscattering decreases, which indicates the aggregation of pulp particles [15]. The delta backscattering signals of pure juice decreased (Fig. 1, *a*). Let's analyze the changes in the backscattering profile according to the principle reported in [16]. The destabilization process was induced by aggregation, which corresponds to $\Delta BS=-5$ % and clarification (migration to the top) of the dispersed pulp particles, which corresponds to the increasing of ΔBS from –5 % to 2 % (which could be detected by the naked eye).

Positive or negative variations of the backscattering profiles of the different samples were not correlated to destabilization processes under the sample height of 2 mm and over that of 30 mm, the values having been determined by enclosed air in the bottom and/or on the top of the cylindrical glass tube, respectively.

The modification of a backscattering signal can occur as a function of time and particle migration and is graphically reported in the form of positive (backscattering increase) or negative peaks (backscattering decrease). Namely, the migration of particles from the bottom to the top of a sample leads to a progressive concentration decrease at the bottom of the sample and, as a consequence a decrease in the backscattering signal (negative peak) and an increase in the intensity of the transmission (positive peak). The opposite is true at the top of the sample.

No variation of particle size occurs when the backscattering profile is within the interval ±2 %. Variations greater than 10 % either as a positive or as a negative value in the graphical scale of backscattering are representative of an unstable formulation. Therefore, the lapse of time necessary for the identification of instability phenomena can be shortened dramatically by using the TurbiscanLab®Expert, due to the early instrumental detection of small changes in transmission and/or backscattering before the appearance of a macroscopic scale physical modification of colloidal suspensions [17].

Backscattering of 90 % melon juice with 0.005 % agar-agar solution changes within 3 % (from +2 % to –1 %), which indicates the instability of the system also (Fig. 1, *b*). Nevertheless, this result is better than that for pure juice, which proves the stabilizing effect of agar. Positive or negative variations of the backscattering profiles of the different samples were not correlated to destabilization processes under the sample height of 2 mm and over that of 18 mm, the values having been determined by enclosed air in the bottom and/or on the top of the cylindrical glass tube, respectively.

Backscattering of 90 % melon juice with 0.01 % agar-agar solution changes about 1.5 % (from +0.5 % to +2 %), which indicates stability of system (Fig. 1, *c*). This result is the best as compared to the case of 0.005 % agar and proves a more stabilizing effect of 0.01 % agar.

However, in the transition to 90 % melon juice with 0.02 % agar-agar solution backscattering changes about 5 % (from +0.5 % to –5 %), which indicates decreasing in the stability of the system (Fig. 1, *d*).

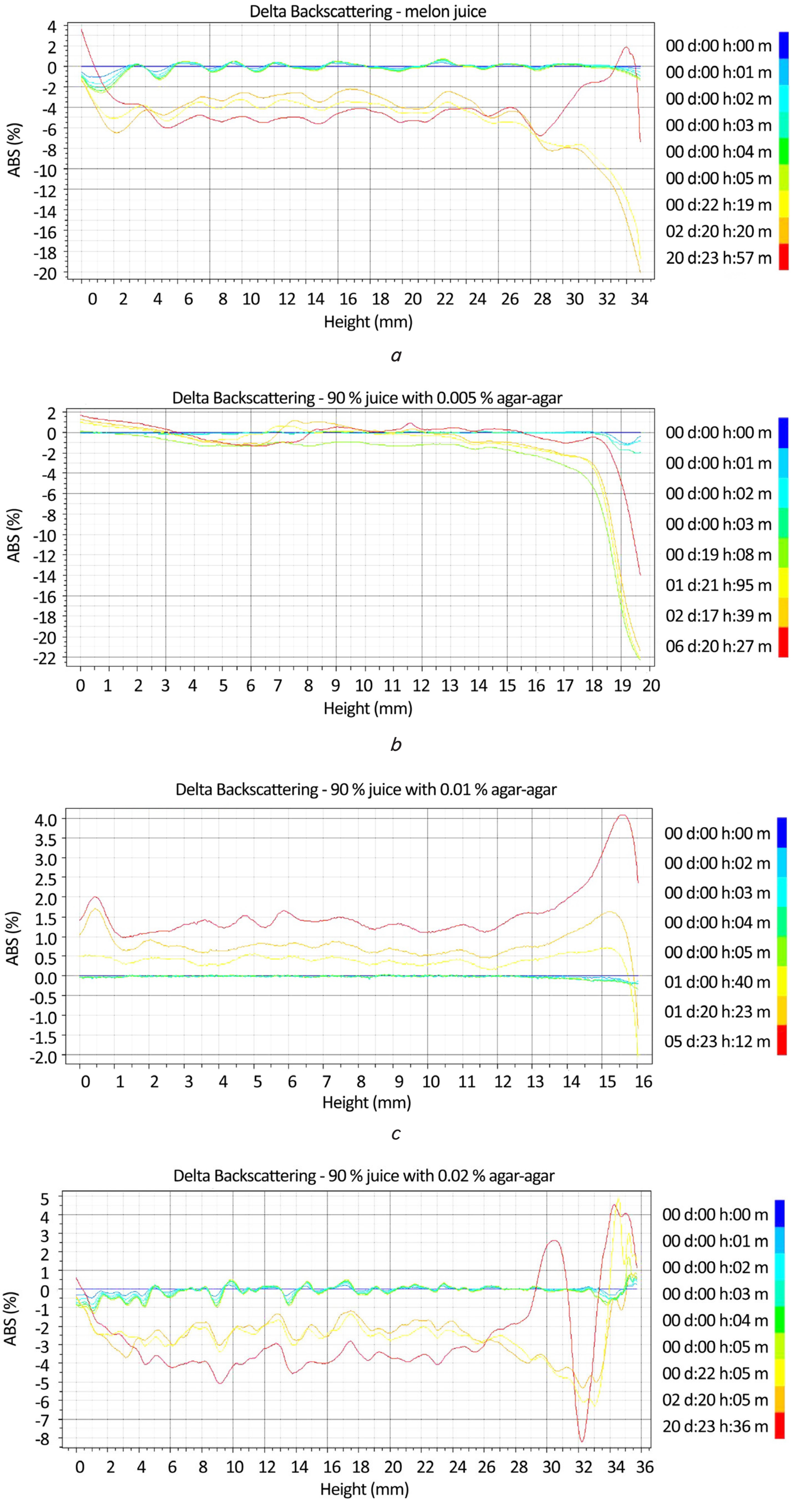
A similar effect of agar on the stability of melon juice has found in the case of 70 % and 50 % juice. These data were used to determine the Turbiscan Stability Indexes (TSI index) of the melon juice–agar system (Fig. 2, *a–c*).

The destabilization index values of 90 %, 70 % and 50 % melon juice obtained by varying the concentration of added agar and measured after 6 days of storage are shown in Table 2. It is shown that in the case of 90 % juice, the lowest value of the destabilization index is found at a concentration of agar 0.01 %.

Table 2

Effect of agar concentration on the destabilization index of 50, 70 and 90 % samples of melon juice after 6 days

Juice concentration	TSI of pure juice	TSI of systems at the concentration of agar		
		0.005 %	0.01 %	0.02 %
90 %	6.5	5.5	1.6	4.5
70 %	6.5	4.8	2.6	4.3
50 %	6.5	4.3	4.5	4.5



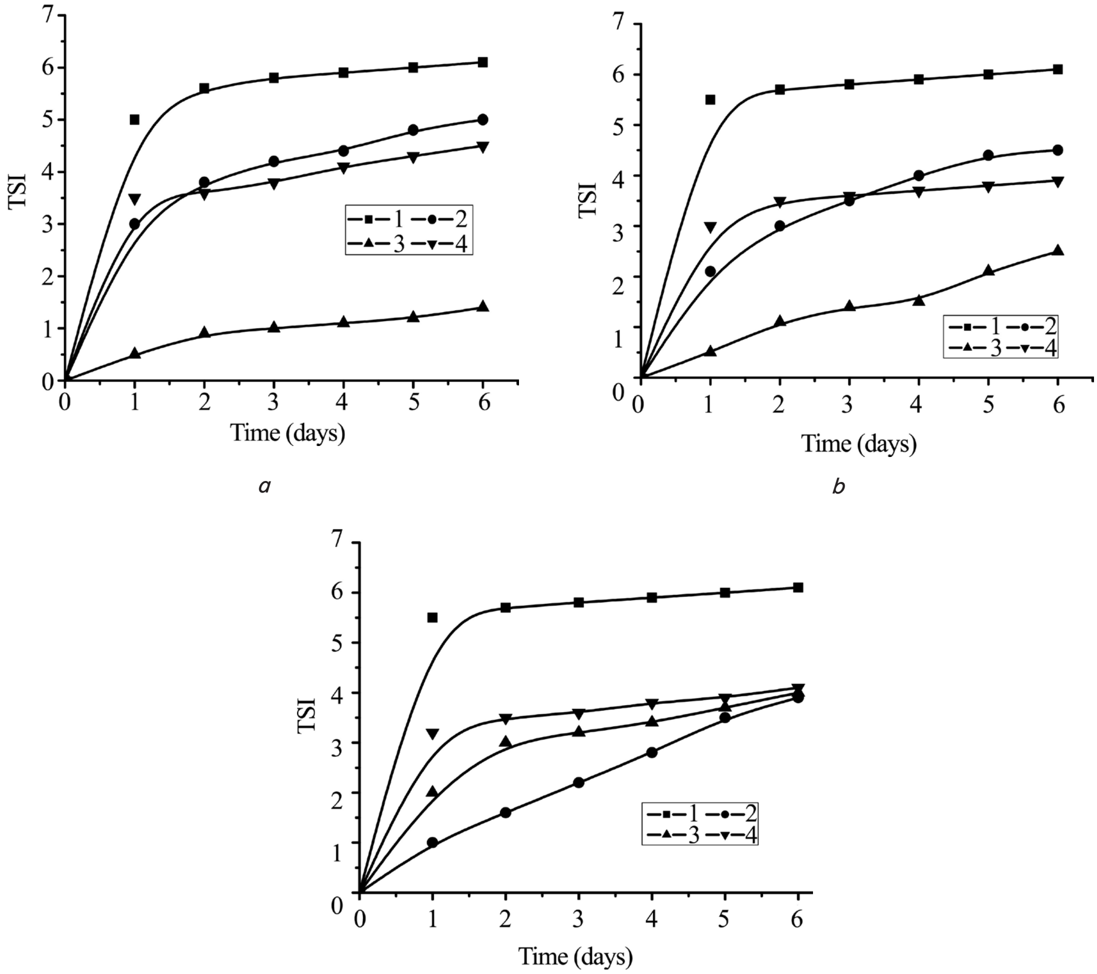
a

b

c

d

Fig. 1. Backscattering signal difference ΔBS of 90 % melon juice at agar concentrations: *a* – 0 % (without agar); *b* – 0.005 %; *c* – 0.01 %; *d* – 0.02 %



a *b*

c

Fig. 2. Destabilization kinetics curves for melon juices of different concentrations: *a* – 90 %; *b* – 70 % and *c* – 50 %. Concentrations of agar: 1 – 0 %; 2 – 0.005 %; 3 – 0.01 % and 4 – 0.02 %

Table 2 also shows that after 6 days of storage, the source melon juice has the highest value of the destabilization index. Moreover, a high TSI value of 6.5 was found for different concentrations: 90 %, 70 % and 50 %. The introduction of a small amount of agar corresponding to a concentration of 0.005 % reduces the TSI value to 5.5, 4.8 and 4.3 for the above concentrations of melon juice. Increasing the agar concentration to 0.01 % sharply reduces the values of the destabilization index, they become equal to 1.6 and 2.6 for 90 % and 70 % of the juice, respectively. For 50 % melon juice, the TSI value increases slightly. However, an increase in agar concentration to 0.02 % leads to an increase in TSI values to 4.5 and 4.3 for 90 % and 70 % of melon juice. In the case of 50 % juice, the TSI value remains equal to 4.5. Comparing the TSI values within a single row clearly demonstrates the effect of agar concentration on the stability of the system. The found regularity is observed within all 3 rows of Table 2, that is, for all 3 concentrations of melon juice used, with the one difference that in the case of 50 % of the juice, stabilization occurs at a lower concentration of agar – 0.01 %. This is due to the fact that less agar is required to cover the surface of the pulp in 50 % of the juice than in 90 % and 70 % of the juice samples.

Thus, the results of the study of the agar influence on the stability of melon juice show that the determining factor is the concentration of biopolymer. Low concentrations of agar have a stabilizing effect on the system, which changes with an increase in its concentration to a flocculating one.

5. 3. Size distribution of melon pulp

Determining the size distribution of melon pulp particles before and after agar addition provides valuable information about the effect of biopolymer and its concentration on the stability of the juice. This is due to the fact that low agar concentrations protect the particles from sticking together and lead to stabilization of the juice suspension. Exceeding the agar concentration of its optimal values for stabilization can lead to destabilization processes – flocculation and sedimentation of melon pulp particles.

The introduction of agar at a concentration of 0.005 % leads to a decrease in the most probable particle size from 901 nm (Fig. 3, *a*) to 466 nm (Fig. 3, *b*). In the case of 0.01 % agar, the particle size is 450 nm (Fig. 3, *c*) and at an agar concentration of 0.02 %, the particle size increases slightly and becomes 555 nm (Fig. 3, *d*).

Analysis of the size distribution curves of melon pulp particles obtained at different agar concentrations shows that the general appearance of the curves is different. In the Fig. 3, *a*, relating to the original melon juice, the curve has two maxima. This is expected for natural fruit juice, which, along with the pulp particles, may contain associates of enzyme, carbohydrates, and antioxidants molecules that are part of the fruit (total soluble solids content is 10.08 °Bx (Table 1). After adding agar to the system (Fig. 3, *b*–*d*) the first low peak on the curves disappears, which may be the result of the interaction of organic substances molecules with biopolymer macromolecules. With increasing concentration of the introduced agar, there is a noticeable tendency to narrow the width of the area located under the curves, which indicates a decrease in the degree of polydispersity of the system. This is probably due to the protective effect of the polymer layer adsorbed on the particles of melon pulp.

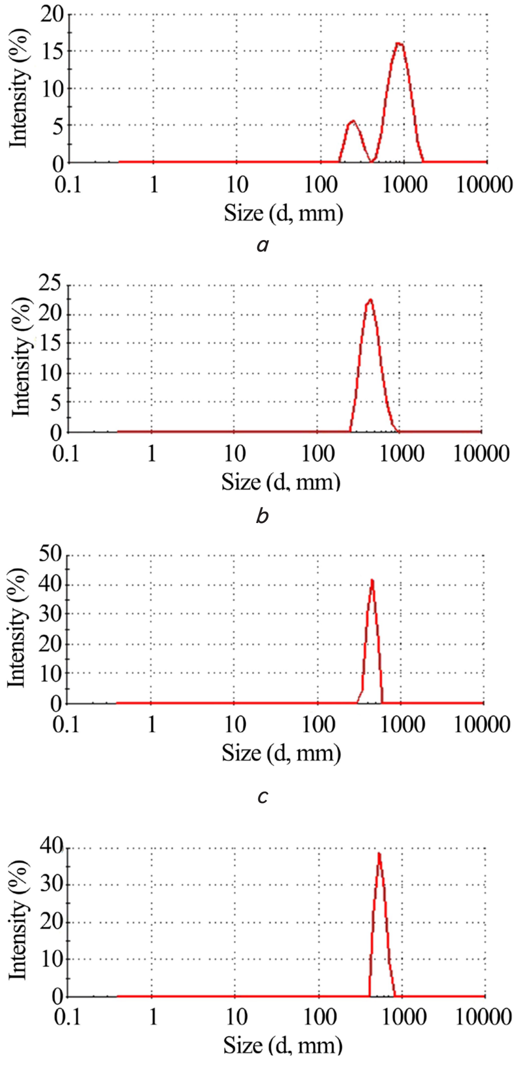


Fig. 3. Effect of agar concentration on particle sizes of 90 % melon juice. Concentration of agar: *a* – 0 % (without agar); *b* – 0.005 %; *c* – 0.01 %; *d* – 0.02 %

6. Discussion of results

6. 1. Effect of agar concentration on the aggregative stability of melon juice

The average pH and titratable acidity values of initial melon juice were 5.78 and 970.29 mg/L, respectively (Table 1). The value of pH is close to the pH value of melon juices described in the literature [18, 19]. This result is a very important indicator since low acidic beverages contribute to dental erosion. According to the study, dental apatite solubility above pH 4.0 is minimal; a drop of 1 unit to 3.0 results in the pH resulted in a 10 – fold increase in apatite solubility [20]. The total soluble solids content was 10.08 ºBx. According to the standard, it should be in the range of 8.6–10.6 ºBx.

One of the main consumer preferences for the properties of natural juices, in addition to taste, is the aggregative and sedimentation stability. If suspended particles of fruit pulp stick together, then they lose aggregative stability. In turn, an increase in the mass of particles as a result of aggregation leads to a loss of their sedimentation stability, which adversely affects their appearance and consumer qualities. By adding polymer solutions to such systems, it is possible to protect the particles of fruit pulp from sticking significantly. However, the food orientation of the products limits the choice of stabilizers used for this purpose. Therefore, in this work, agar, a biopolymer widely used in the food industry, was used as a stabilizer.

By changing the value of ΔBS, which shows the instability of the system, it is possible to judge the changes in the aggregative stability of the juice after the addition of agar (Fig. 1). As can be seen from the data in Fig. 1, the initial juice has a high value of ΔBS, which decreases when the agar is introduced with a concentration of 0.005 % and 0.01 %, but increases when the concentration is 0.02 %.

The instability of the initial melon juice can be explained by its composition. The particles of melon juice are composed of pectin, which gives their surface hydrophilicity, but they also contain a sufficient number of fibers, which provide a tendency to stick together. Besides, the particle sizes are also large enough, which contributes to their subsidence. The introduction of agar into melon juice leads to the adsorption of its macromolecules on the surface of melon pulp particles. As a result, their surface covered by polymer macromolecules and enriched with OH-groups of the polymer facing the aqueous medium, which increases their hydrophilicity; this helps to stabilize the system by creating a barrier to particles joining. However, depending on the concentration, polymers can have both stabilizing and destabilizing effects on colloidal systems.

The effect of agar concentration on the stability of melon juice is more clearly demonstrated by the data on the TSI index over time obtained from backscattering results (Fig. 2, *a*–*c*). Let's note that the higher the TSI, the lower the stability of the system; therefore, the particle settling curves were called the destabilization curves.

The fact that the curves of destabilization of juices in the presence of agar are lower than the curve of destabilization of the initial juice indicates that all used agar concentrations – from 0.005 % to 0.02 % – have a stabilizing effect on this system. As can be seen from Table 2, which shows the values of the indices of destabilization of juices in the presence of agar at various concentrations after 6 days of aging the mixture. In all samples, the TSI values do not reach the value 6.5, which is typical for the initial melon juice.

At the same time, for 90 % and 70 % juices, the minimum TSI, or maximum stability, is observed in the presence of 0.01 % agar (Fig. 2, *a*, *b*).

Probably, in the case of 0.005 % agar, the amount of biopolymer introduced into the juice is not enough to protect suspended pulp particles from sticking together. The stabilizing effect of polymers on dispersed particles depends on their concentration. If all particles of the solid phase are coated with an adsorption layer of the polymer, then the system is stable. In the case when the polymer is not enough for this, particles not coated with polymer macromolecules tend to aggregation and sedimentation. The excess polymer is also undesirable since, in this case, the "loops" and "tails" of the polymer macromolecules that are turned into the solution and bonded due to hydrophobic interactions, which leads to a loss of stability [21].

In this case, the stability of melon juice increases with a change in agar concentration from 0 to 0.01 %; however, with a transition from 0.01 % to 0.02 %, the stability of the juice decreases again. Probably, at a concentration of 0.02 % in the system, destabilization or flocculation processes begin due to an excess of the polymer. However, the level of destabilization does not reach the level of instability of the initial juice.

With a decrease in juice concentration to 50 %, the minimum TSI values are observed in the presence of a 0.05 % agar solution; this can be explained by an increase in the ratio of agar/dispersed particles, i. e., in a more diluted juice, stabilization is achieved even at lower polymer consumption (Fig. 2, *c*).

6. 2. Effect of agar on the size distribution of melon juice

Typically, the introduction of the polymer into the suspension leads to the formation on the surface of the dispersed particles of the protective shell, preventing them from sticking. The protective effect of agar on particles of melon juice is demonstrated by the particle size distribution curves obtained at different agar concentrations (Fig. 3, *a–d*).

In this suspension (90 % juice), agar concentrations of 0.005 % and 0.01 % have a stabilizing effect on the system. Particle size decreases from 901 nm to 406 nm and 450 nm accordingly. A slight increase in particle size at 0.02 % agar concentration to 555 nm explained by the cohesion of some polymer-coated particles. At the same time, a decrease in the width of the areas under the curves is noteworthy; this is a piece of evidence that the particles of the dispersed phase are becoming closer in size, which is also the result of the stabilizing effect of the polymer.

Thus, the influence of agar on the stability of melon juice was determined by the scattering and transmission of light by particles of melon pulp. Agar concentrations of 0.005–0.01 % have a stabilizing effect on the system, at a concentration of 0.02 %, aggregation processes begin. Exceeding this concentration leads to the destabilization of the juice, to the separation of phases.

The fact that the curves of destabilization of juices in the presence of agar are lower than the curve of destabilization of the initial juice indicates that all used agar concentrations - from 0.005 % to 0.02 % – have a stabilizing effect on this system (Fig. 2, *a–c*). As can be seen from Table 2, which shows the values of the indices of destabilization of juices in the presence of agar at various concentrations after 6 days of aging the mixture. In all samples, the TSI values do not reach the value 6.5, which is typical for the initial melon juice.

The peculiarity of the proposed method of regulating the stability of melon juice is as follows. All natural fruit juices are a suspension in which the pulp particles are distributed in an aqueous medium. If the particles surface is hydrophilic, they are evenly distributed in the water environment, if it is hydrophobic, they will have a tendency to stick together. Another reason for the instability of juices can be the large size of the pulp particles, this problem is solved by technologists by grinding the particles, as well as heating the juices or processing them with high pressure and filtration [6, 11, 12], which requires certain costs. At the same time, the nature of the surface of the pulp particles plays a crucial role in regulating the stability of juices, and its change with the agar biopolymer is very convenient and does not require additional costs. In addition, the required mass of agar is small, since it used only to modify the surface of the pulp particles.

The difference between this study and similar works undertaken in the literature [6–10, 18–21] is that the basic concepts of the stability theory of colloid systems were used for juice stabilization. The maintaining of juice turbidity is explained on the basis of preserving the dispersion of the system, and cases of destabilization explained by the joining and aggregation of particles of the pulp.

The advantage of the method is convenience and simplicity of execution. The only drawback that limits its use in juice technology may be the need for strict dosing, since excess of the necessary doses of the polymer can lead to the transition of the stabilizing effect to the flocculating one.

This disadvantage can be eliminated in the future by mathematical modeling of the stabilization process based on the calculation of the ratio between the mass of polymer in the final slurry of juice and pulp weight, number and size of particles per unit volume, and specific surface of the pulp.

The limitation of the study is the lack of data on the stabilization of melon juice for a longer period than 6 days. The time factor is especially important for food products that must maintain a pleasant appearance throughout the entire shelf life.

In addition, the work did not study the effect of the polymer on the charge of pulp particles. Knowledge about the particle charge could provide additional information about the influence of agar on the state of melon pulp particles in suspension and serve as a tool for regulating the forces of electrostatic repulsion and intermolecular attraction between them, which determine the stability of the juice.

7. Conclusion

1. The influence of agar biopolymer on the stability of cloudy melon juice was determined using the method of scattering and transmission of light by melon pulp particles. Agar concentrations of 0.005–0.01 % have a stabilizing effect on the system, and flocculation processes begin at a concentration of 0.02 %. This effect of agar concentration on the stability of turbid melon juice is explained by the adsorption of its macromolecules on the surface of melon pulp particles.

2. Introduction of agar at a concentration of 0.005–0.01 % reduces the size of the pulp particles from 901 nm to 466–450 nm, but at a concentration of 0.02 % agar, the particle size increases to 555 nm. At low concentrations, polymer macromolecules, covering the surface of the particles, protect them from sticking together that leads to stabilization of the system. An increase in the concentration of agar causes the appearance of an excess of polymer on the particles, in which its tails and loops can bind to each other. This leads to flocculation of melon pulp particles, which forms large aggregates of particles that are prone to sediment.

3. For stabilization of 90 % of melon juice, 0.005–0.01 % concentration of agar biopolymer is optimal. Exceeding this concentration leads to the destabilization of the juice, to the separation of phases.

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