SUPERIOR CONDITIONING OF THE GRAPE JUICE

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Summary: During conditioning of the table grapes for marketing on the fresh market, produce waste is generated that could be used to produce juice. The process of grape juice clarification with bentonites was studied. Optimal doses of 3 ... 5 g/l were determined that assure superior commercial characteristics to the resulted juice. The study demonstrated the feasibility of using wastes from preparation for the market of table grapes, and the efficiency of bentonites for clarification of the grape juice.

Keywords: wastes, grape juice, juice clarification, bentonites.

Introduction

The fresh table grapes are universal according to their taste and health properties, are appreciated for their unique content with substances useful for the human health, such as sugars, vitamins, organic acids, mineral salts, etc. [1].

The Catalogue of Plant Varieties of the Republic of Moldova for 2015 year [2] includes 90 varieties of table grapes, including 23 varieties with white berries, 12 varieties of black berries, and 7 seedless varieties. The main varieties of table grapes planted in the Republic of Moldova are Moldova, Alb de Suruceni, Chasselas d'ore, Muscat Iantarnîi, etc.

The table grapes intended for marketing on the fresh market are subjected to conditioning - specific operations forming the quality characteristics required by the market. The waste from table grape conditioning - bunches, part of bunches or individual berries that have no commercial value on the fresh market - amount to 20 ... 35% [3,5]. These wastes have no commercial appearance, but are valuable for their content with nutritive substances and can be directed to production of natural grape juices, grape-based soft drinks, dietetic products [5].

The estimated volume of clarified grape juice produced from grapes of Chasselas d'ore variety is 200 ... 253 MT/year (documented information).

The objective of the study: use of waste from conditioning of table grapes for the production of grape juice, optimization of the process clarification of the juice produced from Chasselas d'ore table grapes using natural adsorbents.

Materials and methods

The experimental research was carried out with the grape juice - semi-finished product obtained from Chasselas d'ore grapes, that correspond to the requirements of the standard, but have no commercial value.

For the grape juice the following characteristics were determined:

- dry soluble substances content, titrable acidity, pH, total sugars, total ash, ethylic alcohol (using standardized methods);
- optical density (using photoelectric colorimeter CFC-2);
- viscosity (using glass viscosity meter with diameter of the capillary tube of 0,52 mm);

- polyphenols (using Folin-Ciocalteu reactive and DR 5000spectrophotometer);
- redox potential (using potentiometric method);

The grape juice clarification was carried out with imported bentonites – Bentovin (Romania) and Ascangel (Georgia), prepared according to manufacturer's instructions.

Results and discussions

The clarification of the grape juice doesn't target the total separation of colloids, as a partial reduction by 10 ... 30% is sufficient, especially of hydrophobic colloids [4]. The separation from the juice of macromolecular substances is carried out using different methods, including bentonites. These have sufficient absorbent activity for colloidal substances, improve the commercial characteristics with minimal modifications of sensorial and physical-chemical characteristics. The semi-finished grape juice was treated with various doses of bentonites – 1 ... 10g/l through intense contact of the juice with the bentonites, followed by bentonite separation through centrifuge during 10 minutes and gravitational sedimentation at low temperatures. The degree of juice clarification was evaluated using optical density.

For clearer representation of the effect of Bentovin bentonite on grape juice clarification, the experimental data is presented graphically in Figure 1.

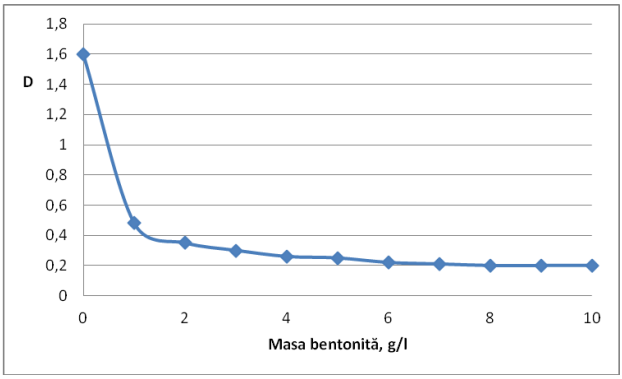

Fig. 1. Relationships between optical density and the dose of Bentovin at clarification of juice from Chasselas d´ore grapes

The graphical information identifies two characteristic phases: initial – with a very rapid completion of the process of clarification and the second sector - that is characterized initially by a certain slope, followed by inclination to abscise. This form of the curve shows that the adsorption of colloidal substances at maximum is carried out at the dose of 1 … 3 g/l. The juice optical density was reduced from 1,6 to 0,25 units. The increase of the bentonite dose leads to significant reduction of optical density due to adsorption of biopolymers from the juice.

At the slow phase of the process of clarification, a small decrease of the angle of inclination of the clarification curve is observed after the dose of 5 g/l. At increased doses of 6 … 10 g/l, the optical density does not change, adsorption of macromolecular substances is at maximal levels. Increases of bentonite doses have marginal effect on juice clarification process, but is undesirable because they reduce the juice nutritional value.

The graphical information from Figure 1 shows that the optical density decreases from 1,6 units to 0,25 … 0,27 or by 84 … 85 %. Through repeated experimentation, and sensorial examinations it was determined that the optical density in the range 0,2 … 0,3 is obtained by processing Chasselas d´ore grape juice with bentonite doses of 3 … 5 g/l and is evaluated as technological clarity – crystal-clear. Increased bentonite doses of 6 … 10 g/l does not intensify the juice clarity, and bring unessential modifications of its characteristics: dry soluble substances, titrable acidity, redox potential and there is loss of juice with big quantities of sediment formed at cold gravitational sedimentation. The effective clarification should be carried out with optimal doses, that do not exceed the levels prescribed by the normative technical documents in force.

For an ampler characterization of the absorption activity of Bentovin and Ascangel bentonites, in the limits of determined optimal doses, their influence on the juice components were studied. The obtained results are presented in Table 1.

Table 1. Influence of optimal bentonite levels on selected physical and chemical characteristics of Chasselas d´ore grape juice

Characteristics		Units of measure	Grapes juice	Bentovin, g/l			Ascangel, g/l		
				3	4	5	3	4	5
Dry soluble substances content		%	18,6	18,3	18,1	18,0	18,4	18,2	18,0
Optical density, D 400		U.s.	1,6	0,30	0,25	0,22	0,28	0,26	0,23
Acidity	titrable	%	0,56	0,53	0,51	0,49	0,54	0,51	0,50
	pH	-	3,28	3,30	3,33	3,38	3,22	3,30	3,40
Total sugars		%	17,8	17,7	17,6	17,6	17,8	17,5	17,5
Ethyl alcohol		%	0,28	0,28	0,30	0,30	0,28	0,30	0,30
Redox potential		mV	197	235	248	255	232	241	253
Polyphenolic substances		Mg/l	6,54	4,98	4,86	4,81	5,84	5,62	5,42
Total ash		%	0,22	0,20	0,20	0,19	0,21	0,20	0,19
Dynamic viscosity, 10^{-3}		$P_a \cdot S$	2,458	2,412	2,386	2,351	2,436	2,401	2,382
Volume sediment		$\frac{cm^3}{250cm^3}$	-	62	72	82	48	58	82
Sensory examination using the scale with 5 points		Points	4,8	4,7	4,9	4,9	4,6	4,8	4,9

The data presented in Table 1 shows that the most marked modification is recorded for juice optical density, that decreases by 1,38 units for Bentovin and 1,37 units with Ascangel. The most evident decrease is recorded at the dose of 5 g/l. These modifications are due to the adsorption of biopolymers – macromolecular substances from the juice, that form the juice turbidity. The grape juice with opticql density in the range 0,2 … 0,3 is characterized by its technological clarity – crystal-clear with shine.

The partial elimination of colloidal substances, especially hydrophobic colloids, leads to the decrease of juice viscosity from $2{,}458 \cdot 10^{-3}$ Pa·s to $2{,}351 \cdot 10^{-3}$ Pa·s for Bentovin and $2{,}382 \cdot 10^{-3}$ Pa·s for Ascangel.

The optimal doses of bentonite-gel lead to the minimal decrease of the dry soluble substances' content by 1,6 … 3,2 % primarily due to the bentonite-gels that contain inflation water.

As result of juice processing with bentonites, the redox potential increases from 197mv to 255 mV for Bentovin and 253 mV for Ascangel due to elimination from the juice of the reducing macromolecular substances – polyphenols, coloring substances, etc. The content of polyphenolic substances decreases from 6,54 mg/l to 4,81 … 5,42 mg/l as result of formation of insoluble compounds – tanning substances, whose sedimentation brings along the substances that cloud the juice. The astringent taste becomes poorly-pronounced; the color obtains a green-yellowish tint.

Bentovin and Ascangel bentonites at doses 3 … 5 g/l do not modify the titrable acidity and the content of mineral substances, total sugars, because the juice-adsorbent contact is of short duration. The intense mixing at short duration of 60 s does not modify the content of ethylic alcohol.

From the information presented in Table 1, of special interest is the volume of sediment formed at self-sedimentation – cold gravitational sedimentation. The value of these characteristics at doses of 3 … 5 g/l is 25 … 33 % for Bentovin and 19 … 33 % for Ascangel bentonite. The sediment formed at processing with Bentovin is compact, and is not deformed at juice decantation from the cylinder. The maximal reduction of juice loss is obtained at sediment centrifugation at 5000 rotations per minute.

The superior conditioning of Chasselas d'ore grape juice is obtained at juice filtration through paper-filter for removal of fine particles from the juice. In the carried out studies, the filtration was used as an index that determine the level of juice clarification – filtration speed. Through repeated experimentation it was determined that the filtration speed is increased by 4 … 5 times in comparison with the cloudy juice.

The juice from grapes of Chasselas d'ore variety clarified with optimal doses of bentonites was subject to sensorial evaluation on a scale of 5 points; the results are presented in Table 1.

The carried out studies, the obtained results have identified the value of processing the waste from the conditioning of grapes of Chasselas d'ore variety for the fresh market, for production of grape juice, superior conditioning of the juice with bentonites, resulting in the final product – clarified grape juice with superior quality characteristics.

Conclusions

1. The studies have determined the value of directing the wastes from the conditioning of the table grapes of Chasselas d'ore variety to the production of clarified grape juice.
2. The experiments have determined the advantage of clarifying the Chasselas d'ore grape juice with effective clarification materials.
3. The adsorption clarification of the grape juice with effective bentonites, at optimal doses, assures a final product with superior quality characteristics.

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