

UTILIZATION OF SHUNGITE FOR IMPROVING QUALITY AND SAFETY OF JUICES

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Introduction

Table beet juice is a unique product, because it contains valuable components, which have preventive and healing effect. Among those are fibre, pectines, hemicellulose, organic acids, polyvitamins (A, B1, B2, B6, C, P, U, E), mineral substances, compounds with kalium, ferrum and manganese. Beet juice is rich for iodine, magnesium, calcium, phosphorus. It also contains betaine and saponins, which improve metabolism in human body, bind cholesterine and facilitate the creation of choline [1].

Nevertheless due to the failure to comply with the requirements relating to garbage utilization and because of polluting underground aquifers with household wastes as well as wastes from harmful industrial productions, soil and vegetables are being contaminated with components, which decrease the quality and safety of vegetable juices.

This is a pending task of state importance to find new effective sorbents for the purpose of purifying vegetable juices, and among those one can name shungite.

Shungite contains fullerenes, whose peculiarity is that carbon atoms in molecules are situated at the peaks of regular pentagons and hexagons, covering the surface of the sphere and constituting closed polygons. Shungite carbon has amorphous structure and is resistant against graphitization, it is also known for high reaction capacity in thermal processes, effective sorption characteristics, chemical resistance. Shungite contains approximately 60% of carbon and 40% of rock constituent elements [2]. It is ecologically safe adsorbent [3].

The purpose of the present research is to examine shungite adsorptive capacities with regard to heavy metals and nitrate ions, which diminish the quality and safety of table beet juice.

Experimental

Fresh table beet juice was being mixed at temperature of 60°C (conditions for the production of table beet juice) with shungite with industrial fraction of 1...2 mm and concentration (% mass) of 4.76 during 30 minutes (optimal conditions), filtrated, and the percentage of heavy metals and nitrate ions were measured.

In order to determine the content of heavy metals 50 ml of the juice, processed with shungite, and 25 ml of 6 M HCl were being boiled during 15 minutes, evaporated up to 5 ml of mixture, which was then diluted with distilled water up to 100 ml. Then it was heated and evaporated up to 50 ml, filtrated and consequently the measurements were taken, and through the method of graphical straight calibration the content of heavy metals was determined.

For the purpose of determining the content of nitrate ions in the juice, processed with shungite, the following was done: 50 ml of aluminium potassium sulphate were added to

10 ml of juice and stirred for 5 minutes, then the nitrate parameter pNO_3 was measured and content of nitrate ions was determined in accordance with the calibration schedule, prepared in advance under standard dilution of potassium nitrate. The effect of juice purification was calculated under the formula:

$$E = \frac{100 \cdot (K_1 - K_2)}{K_1}$$

whereas K_1 and K_2 – quantity of nitrate ions in the juice, non-processed and processed with the adsorbent.

Results

The content of heavy metals in table beet juice before and after being processed with shungite is shown in Fig. 1.

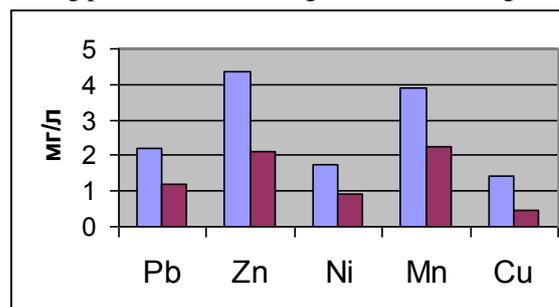


Fig. 1 Content of heavy metals in table beet juice, processed with shungite in comparison with the control sample

Analyzing the data obtained, one can see that shungite adsorbs practically all examined heavy metals, reducing their initial content in 2...3 times.

While adsorbing heavy metals, shungite also adsorbs nitrate ions, which is evidenced by the results, presented in the table below (optimal variant).

Table 1. Content of nitrate ions in table beet juice, being purified by shungite at 60°C for 40 min with the concentration of adsorbent constituting 4.76% mass.

Name	Parameter
Control sample	2694 mgr/kg
Juice processed with shungite	2090 mgr/kg
Purification effect	22.4%

It is evident, that shungite adsorbs nitrate ions from table beet juice, improving the quality and safety of this drink. Beet juice testing showed positive results.

In our opinion, mechanism for adsorbing heavy metals and nitrate ions can be explained due to the existence of physical adsorption in the pores of the adsorbent as well as the fullerenes' capacity to create reactive ion-exchange centers (fullerenes show bipolar characteristics).

The used sorbent can be regenerated and utilized.

Conclusions

Shungite effectively adsorbs heavy metals and nitrate ions from table beet juice. The content of heavy metals is decreased in 2...3 times, the effect of purifying juice from nitrate ions constitutes 22.4%.

The adsorption of heavy metals and nitrate ions from table beet juice by shungite improves its quality parameters and safety.

References

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