

RESEARCHING ANTISEPTIC PROPERTIES OF SHUNGITE WHEN PRODUCING RED BEET JUICE

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Annotation: Researching antiseptic properties of natural adsorbent shungite with regard to harmful microorganisms of red beet juice. Effective correlation between adsorbent and juice has been established which allows high effect of purifying juice from bacteria, yeast, mold fungi.

Keywords: shungite, red beet juice, bacteria, yeasts. Mold fungi.

The problem of searching and developing the ways for decreasing harmful influence of environmental pollution on human health is of global character. The products by foreign firms often do not correspond to the advertised quality and is expensive. Therefore developing domestic food products on the basis of domestic raw materials with high level of safety is currently very important.

Because harmful production wastes get into soil, domestic raw materials, for instance red beet, often contain harmful substances quantity of which exceeds the standard. Polluted raw materials require additional purification. Unfortunately, the available methods for brightening and purifying vegetable juices do not ensure the required level of juice purification from harmful impurities. Thus it is essential to search for new efficient and cheap ways of purifying red beet juice. For this purpose it appears reasonable to use the adsorbent which is easily regenerated and utilized. Prospective adsorbent for purifying red beet juice is natural carbon-bearing mineral shungite.

Because red beet juice contains a lot of sugars, it becomes a favorable environment for different types of microorganisms, including pathogenic ones, to develop.

In liquid nourishing medium with large amount of hydrocarbons, microorganisms occupy all volume of the product, and spores speed up their development and multiplication.

Lactic acid bacteria, such as *Bacillus Subtilis* and *Bacillus Cereus* decompose carbons to organic acids and transform them into carbon dioxide. In juice one can observe the process of aerobic and anaerobic fermentation which results in deacidification of juice, its deterioration and to the formation of resistant sediments.

Mold fungi such as *Aspergillus Niger*, *Penicillium*, *Monilla*, when getting into red beet juice actively multiply; as the result of their activity carcinogenic substances accumulate in the product, bringing not only juice spoilage but also negative effect on human organism by causing toxic poisoning.

Yeasts such as *Saccharomyces Cerevisia*, *Hanceniaspora*, *Candida* also deteriorate juice quality and cause different diseases.

Cells of various microorganisms actively multiply in invigorating environment, forming colonies which can be seen with the naked eye.

Nowadays in order to disinfect juice from microorganisms pasteurization, sterilization and expensive disinfecting agents are used.

Experimental part.

To increase ecological safety of red beet juice the authors have researched adsorptive capacity of shungite with regard to various types of microorganisms following the methodology: freshly squeezed red beet juice has been heated to $t=50...60^{\circ}\text{C}$ and mixed with shungite in the quantity 2.44...9.09 % mass., the obtained mixture has been mixed during 25...30 minutes and filtrated (temperature and duration of juice processing by adsorbent had been established as reasonable parameters in preliminary research).

Determination of total microbial number of mesophilic aerobic, facultative anaerobic and anaerobic microorganisms in red beet juice has been performed by seeding products, without dilution in Petri (double) dish, with nourishing medium of BEA (beef-extract agar) and stilled in thermostat for 3 days with constant temperature at 37°C . The proportion of mold fungi and yeasts has been determined by seeding in nourishing medium of WA (wort agar) and in Czapek's medium in Petri (double) dish 0,1 cm³ of juice, diluted three times, and then by stilling it in thermostat at $t=28...30^{\circ}\text{C}$ for five days. Control sample of red beet juice, not processed by adsorbent, has been stilled under the experiment conditions and then quantity of microorganisms has been determined.

The effect of purification of juice from microorganisms has been calculated under the formula:

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

whereas K_1 and K_2 – quantity of microorganisms in juice, processed and not processed by adsorbent.

The research results are presented in tables 1...4.

Table 1. Microbiological parameters of red beet juice before and after its processing by shungite with concentration of 9.09% mass. (adsorbent : juice correlation 1:10) at temperature 60°C with duration of 25...30 minutes.

Names of microorganisms	Control sample of juice	Juice sample processed with shungite	Purification effect, %
Mesophilic aerobic, facultative anaerobic and anaerobic bacteria, colony-forming units (CFU) in 1 ml	more than 50	14	71
Yeasts and their spores, CFU in 1 ml	more than 45	9	80
Mold fungi and their spores, CFU in 1 ml	5	2	60

When analyzing data presented in table 1, one can see that shungite with concentration of 9.09 % mass., effectively adsorbs all researched types of microorganisms, decreasing their initial proportion by 60...80% .

When using lower (4.76%) concentration of shungite (table 2), the authors have received good results of adsorbent antiseptic properties with regard to harmful microorganisms from red beet juice. Purification effect differs insignificantly from the previous results while the quantity of adsorbent is decreased twofold.

Table 2. Microbiological parameters of red beet juice before and after its processing by shungite with concentration of 4.76% mass. (adsorbent : juice correlation 1:20) at temperature 60°C with duration of 25...30 minutes.

Names of microorganisms	Control sample of juice	Juice sample processed with shungite	Purification effect, %
Mesophilic aerobic, facultative anaerobic and anaerobic bacteria, CFU in 1 ml	more than 50	16	68
Yeasts and their spores, CFU in 1 ml	more than 45	12	73
Mold fungi and their spores, CFU in 1 ml	5	2	60

Table 3. Microbiological parameters of red beet juice before and after its processing by shungite with concentration of 3.23% mass. (adsorbent : juice correlation 1:30) at temperature 60°C with duration of 25...30 minutes.

Names of microorganisms	Control sample of juice	Juice sample processed with shungite	Purification effect, %
Mesophilic aerobic, facultative anaerobic and anaerobic bacteria, CFU in 1 ml	more than 50	25	50
Yeasts and their spores, CFU in 1 ml	more than 45	23	50
Mold fungi and their spores, CFU in 1 ml	5	2	60

The results of experiments (table 3) shows that shungite with concentration of 3.25% mass., purifies red beet juice from bacteria and yeasts by 50%, and from mold fungi – by 60%, which is good marker of shungite’s adsorptive properties.

The next phase of the research has been to determine antiseptic properties of shungite with concentration of 2.44% mass. Such experiments have been conducted and their results are presented in table 4.

Table 4. Microbiological parameters of red beet juice before and after its processing by shungite with concentration of 2.44% mass. (adsorbent : juice correlation 1:40) at temperature 60°C with duration of 25...30 minutes.

Names of microorganisms	Control sample of juice	Juice sample processed with shungite	Purification effect, %
Mesophilic aerobic, facultative anaerobic and anaerobic bacteria, CFU in 1 ml	more than 50	38	24
Yeasts and their spores, CFU in 1 ml	more than 45	32	28
Mold fungi and their spores, CFU in 1 ml	5	3	40

As one can see from the obtained results, shungite with concentration of 2.44% mass. Adsorbs mold fungi better than bacteria and yeasts. Purification effect for mold fungi constitutes 40%, for bacteria – 24% and for yeasts -28%.

Mechanism of adsorption of harmful microorganisms, especially those which die at higher temperatures, exceeding 60°C, can be explained by existence of uncompensated changes in adsorbent's pores and fullerenes' capacity to form reaction centers; as the result compounds with different types of chemical bond are formed.

It is likely that due to temperature (60°C) partial coagulation of microorganisms protein takes place and because of this water net envelop changes and ξ – potential disappears from a cell. Having lost their charge microorganisms interact with adsorbent due to London-Van der Waals force.

Conclusions.

Using shungite for processing red beet juice increases juice safety parameters.

It has been established that effect from purification of red beet juice from harmful microorganisms by shungite with concentrations of 9.09 and 4.76% mass. are practically the same. Therefore it is reasonable to recommend adsorbent concentration of 4.76% mass. for the purpose of practical usage in technology of producing not only red beet juice, but food dyes from red beet juice which is produced by using preserving agents.

Efficient technological parameters for processing red beet juice by shungite are temperature of 60°C and duration of 25...30 minutes.

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