

# Studying the Effects of Essential Oil Bearing Plants on the Physico-Chemical Characteristics of Vodka

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**Abstract.** Ancient vodka was an alcoholic tincture made of herbs and berries, where ethyl alcohol was modified by the many complex combinations of healthy substances. The ancient vodka makers preserved the preparation principle based on using an alcohol purified of harmful impurities in combination with herbal components; subsequent processing was what distinguished alcoholic drinks from medications. Thus, Russia finally invented and popularized aromatic vodkas, tinctures, liqueurs, and rataphias, which then became popular worldwide. Essential oil bearing plants have been known to human since long ago; they boast a high content of biologically active agents and minerals. They are broadly used in perfumery, cosmetics, confectionary, paint and liqueur production. When used in making alcohol, the beverage is infused with the biologically active components of such plants. Modern use of plants for vodka aromatization is mainly due to strong competition in the market, the producers' marketing policy, or the need to achieve a desired taste or aroma. There are very few publications that describe the effects of biologically active agents on the human body, whereby drinking vodka has a hepatoprotective effect. In our quest for new vodka formulations, we added the total aromatic alcohol produced from essential oil bearing plants and found out that such vodka was less toxic while having unquestionable organoleptic advantages. It was found out that the use of aromatic alcohols based on aromatic plants did not cause any accumulation of harmful substances in special vodkas. We have developed new formulations for vodkas we named Zemlyanichnaya (Strawberry), Brusnichnaya (Cowberry), and Chernichnaya (Blueberry) based on total aromatic alcohols produced from aromatic plants growing in RNO-Alania; we found out that the use of aromatic alcohols based on aromatic plants did not cause any accumulation of harmful substances in special vodkas.

## 1. Introduction

Relevance. The current situation in the Russian and worldwide alcohol market imposes stricter requirements to vodka quality and price. To meet the ever greater demands on the part of the consumer, alcohol makers make significant investments in the development of new formulations and techniques to expand the range they can offer. In this regard, it is imperative to develop and use new formulations. Literature proves the feasibility and efficiency of using essential oil bearing plants and berries to that end. [1-2]

*Research goal* is to develop new formulations for special vodkas.

To that end, we set forth the following objectives:

1. Produce aromatic alcohols from aromatic plants and determine their composition.
2. Study the effects of total aromatic spirits produced from plants on the physico-chemical and organoleptic characteristics of vodka.



As part of this research, we made several different compositions to produce prototypes of special vodkas based on aromatic alcohols produced from aromatic plants growing in RNO-Alania. Prototypes were made using Extra-grade rectified ethyl alcohol.

It is known that oregano has a strong antioxidant effect. [3-6] It has also been found that such effects of the aqueous extracts of oregano are attributable to the glycosides of protocatechuic acid [7-10]. The essential oils of *Achillaea millefolium* have antioxidant effects [11-14] that are not only therapeutic, but also help preserve the beverage quality by preventing the oxidation of biologically active agents. *Urtica dioica* has been used for healing since ancient times thanks to its bactericidal, choleric, and immunosuppressive effects. [15] *Urtica* tinctures have antioxidant effects. [16]

To produce special vodkas, we used the aromatic alcohols of our making, the Extra-grade rectified ethyl alcohol, and purified drinking water.

By subjecting the analyzed plant tinctures to a single distillation, we produced aromatic alcohols that were added to the batch as follows: the total aromatic alcohol was added to the 40% water-alcohol solution of the Extra alcohol (4 cm<sup>3</sup> of aromatic alcohols per 1,000 cm<sup>3</sup> of the batch).

The total aromatic spirit had the following composition for *Zemlyanichnaya*: 50% *Origanum vulgare*, 50% *Fragaria vesca*; for *Brusnichnaya*: 50% *Vaccinium vitis-idaea*, 50% *Achillaea millefolium*; for *Chernichnaya*: 50% *Vaccinium myrtillus*, 50% *Urtica dioica*. The quantitative ratio of added aromatic alcohols was adjusted by organoleptic analysis per GOST R 51355-99.

As expected, we managed to produce vodkas with better organoleptic qualities. The optimum formulation was the one with a aqueous-alcoholic liquid, a total aromatic alcohol produced from aromatic plants with the following content of ingredients, 1l/1,000 dal of finished vodka:

- 40 liters of 70% total aromatic alcohol produced from essential oil bearing plants;
- aqueous-alcoholic liquid for the rest of the volume.

In the aromatic alcohols obtained, we found the volumetric fraction of ethyl alcohol and the mass concentration of essential oils pursuant to TU 9181-452-00008064-01.[17]. Results are shown in *Table 1*.

**Table 1.** Physico-chemical properties of aromatic alcohols

| Source plant                 | Volume fraction of ethyl alcohol, % | Mass concentration of essential oil per dm <sup>3</sup> of anhydrous alcohol, mg |
|------------------------------|-------------------------------------|--|
| <i>Origanum vulgare</i>      | 70.4 ± 0.12                         | 7.1 ± 0.13   |
| <i>Achillaea millefolium</i> | 67.5 ± 0.27                         | 3.4 ± 0.02   |
| <i>Vaccinium myrtillus</i>   | 71.2 ± 0.19                         | 7.1 ± 0.30   |
| <i>Fragaria vesca</i>        | 66.1 ± 0.38                         | 10.06 ± 0.06   |
| <i>Urtica dioica</i>         | 68.8 ± 0.13                         | 7.9 ± 0.02   |
| <i>Vaccinium vitis-idaea</i> | 69.3 ± 0.14                         | 6.03 ± 0.07  |

As can be seen from the physico-chemical properties shown in Table 1, the content of ethyl alcohol in the aromatic alcohols ranged from 66.1% (*Fragaria vesca*) to 71.2% (*Vaccinium myrtillus*).

Essential oil content was at max in the aromatic alcohol produced from *Fragaria vesca* (10.05 mg/dm<sup>3</sup>), and at min in the *Achillaea millefolium* alcohol (3.4 mg/dm<sup>3</sup>).

As we prove feasible producing vodkas from special aromatic alcohols, we designed a process for making the vodkas *Zemlyanichnaya*, *Brusnichnaya*, and *Chernichnaya* based on total aromatic alcohols based on essential oil bearing plants. Vodka making process was based on the 3rd St. Petersburg Technology. Our innovation consisted in adding total aromatic alcohols produced from essential oil bearing plants to the batch.

The proposed technology for making special vodkas does not require any considerable overhead costs; it mainly consists of two stages, (i) producing aromatic alcohols from essential oil bearing plants, and (ii) making vodka.

We used our technology to develop the recipe shown in *Table 2*.

**Table 2** — Formulation of special vodkas based on aromatic alcohols

| Special vodka  | Aromatic alcohol source plant | Content of aromatic alcohols, l/1,000 dal |
|----------------|-------------------------------|---|
| Zemlyanichnaya | Origanum vulgare              | 5   |
|                | Fragaria vesca                | 20  |
| Brusnichnaya   | Vaccinium vitis-idaea         | 25  |
|                | Achillea millefolium          | 5   |
| Chernichnaya   | Urtica dioica                 | 10  |
|                | Vaccinium myrtillus           | 15  |

Our research into the physico-chemical characteristics of these vodkas proved them compliant with the vodka standards, see *Table 3*.

**Table 3.** Physico-chemical characteristics of vodkas

| Indicator  | Impurities     |              |              | Method of analysis |
|--|----------------|--------------|--------------|--------------------|
|  | Zemlyanichnaya | Brusnichnaya | Chernichnaya |                    |
| Alkalinity, cm <sup>3</sup>  | 2.0            | 2.0          | 2.0          | GOST 5363-93       |
| Alcohol vol.,%   | 40.0           | 40.0         | 40.0         | GOST 5363-93       |
| Mass concentration of fusel oil per dm <sup>3</sup> of anhydrous alcohol, mg | 3.7            | 3.5          | 3.2          | GOST 30536         |
| Mass concentration of esters per dm <sup>3</sup> of anhydrous alcohol, mg    | 5.7            | 5.0          | 5.3          | GOST 30536         |
| Mass concentration of aldehydes per dm <sup>3</sup> of anhydrous alcohol, mg | 3.5            | 3.4          | 3.0          | GOST 30536         |

The safety of Zemlyanichnaya, Brusnichnaya, and Chernichnaya vodkas was verified in accordance with SanPin 2.3.2.1078-01[20], which identified no toxic residues in the vodkas of our making.

According to the GOST, organoleptic tests must identify the vodka's crystal-clear transparency, a characteristic specific aroma, and a soft taste peculiar to the ingredients used. Organoleptic test produces a reasonably accurate vodka quality assessment. The appearance (transparency) and color of vodka is analyzed by comparing such vodka against distilled water in a forward-scattered light. Taste and smell analysis consists in organoleptic assessment of taste and smell.

**Table 4** — Organoleptic parameters of special vodkas

| Indicator       | Zemlyanichnaya   | Brusnichnaya   | Chernichnaya   |
|-----------------|--|--|--|
| Appearance      | Transparent liquid without impurities or residue                   | Transparent liquid without impurities or residue     | Transparent liquid without impurities or residue       |
| Color           | Colorless liquid   | Colorless liquid                                     | Colorless liquid                                       |
| Taste and aroma | Soft, typical of vodka, with light tones of strawberry and oregano | Soft, typical of vodka, with light tones of cowberry | Soft, typical of vodka, with light tones of blueberry. |

We thus found the samples of Zemlyanichnaya, Brusnichnaya, and Chernichnaya to have the flavor of the total alcohols. Shelf life for these special vodkas is not limited.

### Conclusion

The alcohol industry is now making use of new technologies for making alcoholic and non-alcoholic drinks based on biologically active agents contained in different plants, which favorably affects the

quality and taste of products; for this reason, we developed formulations for special vodkas named Zemlyanichnaya, Brusnichnaya, and Chernichnaya, based on the total aromatic alcohols produced from aromatic plants growing in RNO-Alania. All these vodkas featured refined tones matching the total aromatic alcohols used in production.

The produced vodkas were alcoholic beverages of reduced toxicity and better organoleptic qualities. It was found out that the use of aromatic alcohols based on aromatic plants did not cause any accumulation of harmful substances in special vodkas.

The results of these study enable us to recommend the alcoholic extracts of aromatic plants, rich in biologically active compounds, for making special vodkas.

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