УДК 544.543
DOI: 10.33184/bulletin-bsu-2023.1.19

DETERMINATION OF THE COMPOSITION OF FUSEL OILS IN ALCOHOLIC BEVERAGES BY CHROMATOGRAPHIC METHOD

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In this paper, the analysis of ethanol in moonshine by gas-chromatography method is carried out. The analyzed product was prepared according to a classic recipe: sugar, yeast and water. For the analysis, two samples were taken: the raw alcohol (one stage of distillation) and the final product (two stages of distillation). It is established that if the correct technological process is followed (process was carried out with double distillation), we can obtain a high-quality product. The concentration of harmful components that represent fusel oil is negligible. This study is relevant in our time. It helps to identify counterfeit and defective batches of alcoholic beverages.

Keywords*: gas-chromatography, fusel oils, distillation, raw alcohol, chromatogram.*

Introduction

According to statistics [1], about 25% of all alcohol consumed in the world is counterfeit. Consequently, its consumption can lead to the development of diseases or even to death. Counterfeit alcohol is produced illegally, without complying with the requirements of approved and regulated production processes of legitimate producers. Such alcoholic beverages do not have a trademark and do not meet the quality and safety standards of products. In some countries, small batches of homemade beer from local ingredients are produced and sold bypassing legal production and sales channels. Other prohibited alcoholic beverages are produced on a larger scale; they are exported to the black market, while being bottled in packages counterfeiting well-known brands.

Any alcohol is a specific product of widespread consumption, because it satisfies physiological and some psychological, social, cultural needs of a large number of people. The task of studying the quality of homemade alcohol – moonshine – is urgent due to excessive alcohol consumption in our country and an increase in the number of alcohol poisoning.

In this work, a sample that prepared from sugar, water and compressed yeast was used as the object of study. Determination of the composition of fusel oils in moonshine was carried out by gas-chromatographic method [2]. This study is relevant in our time, because it helps to identify counterfeit and defective batches of alcoholic beverages.

Experimental

A chromatograph “Chromos GC-1000” with a flame ionization detector and a 50 m capillary column were used. The velocity of the carrier gas (nitrogen) was 5 ml/min.

In accordance with the goals and the tasks of this study, we used a moonshine of our own production; it was prepared from sugar (granulated sugar produced by LLC “Rayevsky Sugar Factory”), yeast (“Lux. Extra” produced by LLC “Saf-Neva”, Voronezh) and water. For a more reliable study, two samples were analyzed: the first sample is the raw alcohol; this sample was obtained after the product under study. The second sample is the final sample of a moonshine that is suitable for consumption, which has passed two stages of purification from harmful impurities.

First of all, the retention parameters of all components of fusel oils were studied [3]. The chromatograms for two samples were taken. The first sample was raw alcohol – a mixture that was not subjected to secondary distillation. The second one was the final product that ready for consumption.

As a basis for the preparation of traditional mead, we take water, sugar and yeast. It is a classic recipe, and the proportions have been determined and used in moonshine stills for many years. First of all, we need to determine the proportions and quantity of the initial products. Therefore, we need to take 1 kilograms of sugar, 5 liters of water and 100 grams of pressed yeast (or 20 grams of dry yeast) for obtaining 1–1.2 liters of moonshine with a strength of 40°.

We pour water and sugar into the fermentation tank mixing the liquid intensively. Yeast must be activated by diluting it in warm water for 10 minutes. Then we add this mixture to the dough and mix everything thoroughly again. We put the water seal on the container and set the mead to a secluded dark place at a temperature of 20–30 ℃ for 4–6 days. When the mead stops emitting gases, the top layer becomes lighter compared to the main mass, and sediment precipitates, which means the mead is ready. It acquires a more bitter taste in comparison to the taste in the initial stage of fermentation (unripe mead has a sweet taste). The next step is the purification of the mead from harmful impurities.

One of the most correct ways of distilling moonshine is conducting a double distillation with the separation of harmful impurities. The first stage is the distillation of mead into raw alcohol, and the second involves the separation of heads, bodies and tails [3]. This stage is necessary for maximum purification from harmful impurities and obtaining a high-quality product.

One of the most common methods for quality control of alcoholic beverages is capillary gas-chromatography with a flame ionization detector [2]. The analysis is carried out according to state standards (GOST 32039-2013, GOST 30536-2013, GOST

31684-2012, GOST R 52363-2005, GOST R 52473-2005, GOST R 51698-2000). If there is unknown components or differences in the results, identification of compounds should be carried out by gas chromatography-mass spectrometry [4].

Fig. 1 shows a chromatogram of the raw alcohol. It was found that the first sample contains high concentrations of components that make up fusel oils, as shown in the chromatogram *Fig.* 1. This indicates that non-compliance with the correct technology of distilling moonshine gives us a low-quality product. Therefore, consumption of this sample is dangerous for human health, because it contains a large amount of harmful impurities [5].

The gas-chromatography analysis of the second sample revealed that sample contains some components in negligible concentrations. On the chromatogram (*Fig.* 2), it is noticeable that the sample contains mainly ethanol. This sample was prepared under strictly controlled conditions with double distillation. Therefore, we can see that this sample is safe for consumption.

Conclusions

A method of the determining volatile impurities in moonshine by gas chromatography was used in this scientific experiment. It allows us to determine the composition of volatile impurities with sufficient accuracy and identify counterfeit products [2].

During the gas-chromatography analysis, it was found that raw alcohol has a high concentration of aldehydes, alcohols and esters. The second sample contains ethanol and negligible quantities of other components. This indicates that secondary distillation must be strictly observed in the process because consumption of the sample with a high concentration of fusel oils can lead to negative consequences. The stage of purification of raw alcohol from harmful components (secondary distillation) is not necessary, but it is recommended as we can see in the experiment.

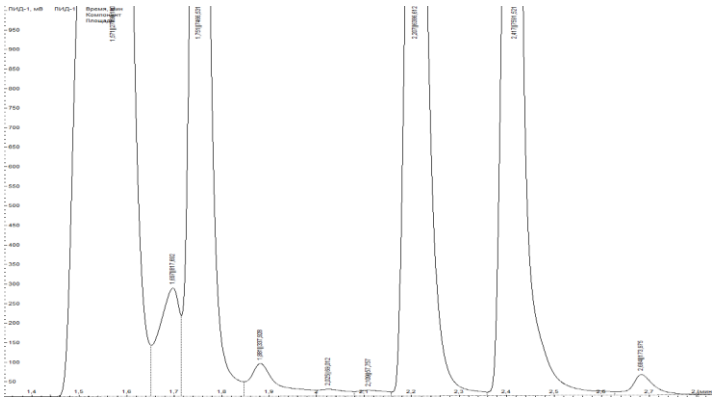

Fig. 1. Chromatogram of the first sample.

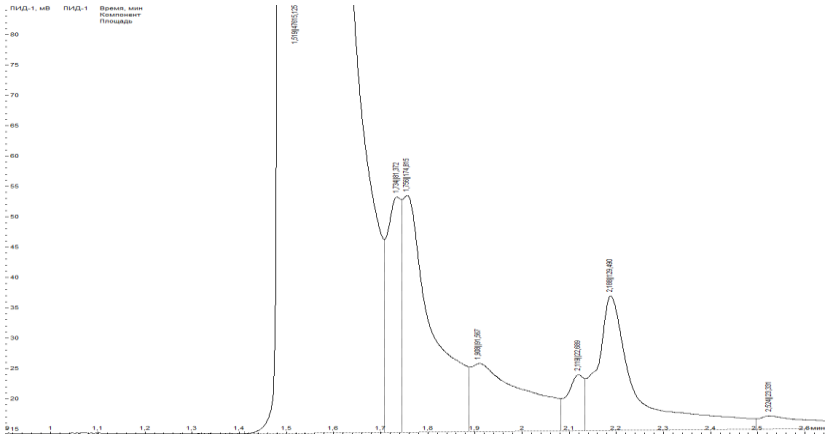

Fig. 2. Chromatogram of the second sample.

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Received 05.02.2023 г.