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CHROMATOGRAPHIC ANALYSIS OF ETHANOL OBTAINED FROM TOPINAMBUR TUBERS (HELIANTHUS TUBEROSUS)

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Abstract. Currently, the use of non-traditional raw materials in alcohol production is one of the important issues. Ethanol is a biotechnology product used as an additive to fuel (gasoline) for internal combustion engines and in the production of alcoholic beverages. About 7% of ethanol is produced by chemical synthesis, and 93% by yeast fermentation, of which 60% is produced from sucrose and the rest from grain. Ethanol production is carried out by adsorption from alcohol fractions contaminated with ethyl alcohol impurities during mash rectification. The ethanol production process is quite energy-intensive, with a continuous-discrete technological process, starting with the acceptance of raw materials and ending with the shipment of the final product. The most pressing tasks are ensuring optimal technological processes, quality control, and monitoring. Modern production processes place completely different demands on the quality of manufactured products, and competitiveness determines a company's survival and its stable position in the market. The aim of this study was to investigate the chemical composition of ethanol obtained from Jerusalem artichoke tubers. The chemical composition of ethanol obtained from Jerusalem artichoke tubers was identified using an Agilent 7890A/5975C gas chromatograph. After the first distillation, the ethanol content is 34.890%, and impurities account for 65.11%. After adsorption with activated carbon, the ethanol content is 74.040%, and impurities account for 25.96%. Upon further processing of this alcohol with calcium oxide, the ethanol content is 99.406%, and impurities account for 0.594%. In this research work, the chemical composition of ethanol obtained from Jerusalem artichoke (Helianthus tuberosus) is examined using chromatographic analysis, highlighting the relevance of utilizing alternative plant-based raw materials in ethanol production. The study describes adsorption methods used to remove impurities formed during the distillation of fermented mash. The high energy consumption of industrial ethanol production and the importance of improving the quality of the final product are also noted. Several technological stages of purifying ethanol derived from Jerusalem artichoke are analyzed, and the contribution of each method to enhancing the purity of the ethanol is evaluated.

Keywords: Ethanol, Helianthus tuberosus, adsorption, impurities, distillation, gas-liquid chromatography

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ТОПИНАМБУР ЖЕМІСІНЕН (HELIANTHUS TUBEROSUS) АЛЫНҒАН ЭТАНОЛДЫҢ ХРОМАТОГРАФИЯЛЫҚ АНАЛИЗІ

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Аннотация. Қазіргі таңда спирт өндірісінде дәстүрлі емес шикізаттарды пайдалану маңызды мәселелердің бірі болып табылады. Этанол - іштен жану қозғалтқыштары үшін отынға (бензинге) және спиртті сусындар өндірісіне қосымша ретінде пайдаланылатын биотехнология өнімі. Этанолдың шамамен 7% -ын химиялық синтез арқылы, ал 93% -ын ашытқы ферментациясы арқылы алады, оның 60% -ы сахарозадан, қалғаны астықтан алынады. Этанол өндіру брагоректификациялау кезінде этил спиртінің ілеспе қоспаларымен ластанған спирттік қосылыстарды адсорбция әдісімен тазалау арқылы жүзеге асырылады. Этанолды өндіру процесі шикізатты таңдаудан бастап түпкілікті өнімді тиеп жөнелтуге дейінгі үздіксіз-дискретті технологиялық процеспен жеткілікті энергия сыйымдылығына ие. Технологиялық процестің оңтайлы барысын қамтамасыз ету, сапаны бақылау және оларды қадағалау неғұрлым өзекті міндеттер болып табылады. Қазіргі заманғы өндірістік процесс шығарылатын өнімнің сапасына жоғары талаптар қояды, ал бәсекеге қабілеттілік деңгейімен кәсіпорынның дамуы, оның рыноктағы орнықты жағдайымен айқындалады. Бұл зерттеу жұмысының мақсаты – топинамбур жемісінен алынған этанолдың химиялық құрамын талдау. Топинамбур жемісінен алынған этанолдың химиялық құрамы Agilent 7890A/5975C хромато-масс-спектрометрінде анықталды. Алғашқы айдаудан кейін этанол құрамы 34.890%, ал қоспалар 65.11% құрады. Активтендірілген көмірмен адсорбцияланғаннан кейін этанол құрамы - 74.040%, ал қоспалар-25.96% құрады. Бұл спиртті одан әрі кальций оксидімен өңдеу кезінде этанол - 99.406%, ал қоспалар - 0.594% екендігі анықталды. Зерттеу жұмысында топинамбурдан (Helianthus tuberosus) алынған этанолдың химиялық құрамы хроматографиялық талдау арқылы қарастырылып, спирт өндірісінде баламалы өсімдік шикізатын қолданудың өзектілігі айқындалады. Ферменттелген сусланы айдау кезінде пайда болатын қоспаларды адсорбциялық әдістермен тазарту жолдары сипатталады. Сондай-ақ өнеркәсіптік этанол өндірудің энергия шығыны жоғары екені және өнім сапасын жетілдірудің маңыздылығы атап өтіледі. Зерттеу барысында топинамбурдан алынған этанолды тазартудың бірнеше технологиялық кезеңдері зерттеліп, әрбір әдістің этанолдың тазалығын жақсартуға қосатын үлесі бағаланған.

Түйін сөздер: Этанол, Helianthus tuberosus, адсорбция, қоспалар, айдау, газ-сұйық хроматография

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ХРОМАТОГРАФИЧЕСКИЙ АНАЛИЗ ЭТАНОЛА ПОЛУЧЕННОГО ИЗ КЛУБНЕЙ ТОПИНАМБУРА (HELIANTHUS TUBEROSUS)

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Аннотация. В настоящее время использование нетрадиционного сырья в производстве спирта является одним из важных вопросов.Этанол – продукт биотехнологии, который используется как добавка к топливу (бензину) для двигателей внутреннего сгорания, и производства спиртных напитков. Около 7% этанола получают путем химического синтеза, а 93% – с помощью дрожжевой ферментации, из них 60% производится из сахарозы, остальное – из зерна. Производство этанола осуществляют методом адсорбции из спиртовых погонов, загрязненных сопутствующими примесями этилового спирта при брагоректификации бражки. Процесс производства этанола достаточно энергоемок с непрерывно-дискретным технологическим процессом, начиная с приемки сырья и заканчивая отгрузкой конечного продукта. Наиболее насущными задачами является обеспечение оптимального хода технологического процесса, контроль качества и их отслеживание. Современный производственный процесс предъявляет совершенно иные требования к качеству выпускаемой продукции, а уровнем конкурентоспособности определяются выживаемость предприятия, его устойчивое положение на рынке. Целью данного исследования была изучение химического состава этанола полученного из клубней топинамбура. Химический состав этанола полученного из клубней топинамбура был идентифицирован на газожидкостном хроматографе Agilent 7890A/5975C. После перегонки бражку состав этанола - 34.890%, примеси - 65.11%. После адсорбции активированным углем содержание этанола - 74.040%, примеси - 25.96%. При дальнейшей обработке этого спирта оксидом кальция содержание этанола -99.406%, примеси-0.594%. В исследовательской работе химический состав этанола, полученного из топинамбура (Helianthus tuberosus), рассматривается с использованием хроматографического анализа, при этом подчеркивается актуальность применения альтернативного растительного сырья в производстве этанола. Описываются методы удаления примесей, образующихся при перегонке ферментированного сусла, с помощью адсорбции. Также отмечаются высокие энергозатраты промышленного производства этанола и важность повышения качества конечного продукта. В ходе исследования изучены несколько технологических этапов очистки этанола, полученного из топинамбура, и оценён вклад каждого метода в улучшение степени его чистоты.

Ключевые слова: Этанол, Helianthus tuberosus, адсорбция, примеси, перегонка, газожидкостная хроматография

Introduction. The paper discusses the technological aspects of ethanol production from non-traditional crops, namely sweet sorghum. A technological scheme for obtaining alcohol and fuel pellets from sweet sorghum is presented. Particular attention is paid to assessing the efficiency of alcohol production from sweet sorghum. The advantage of the sugar content in the stem juice of sweet sorghum compared to other raw materials is described. Presumably, the use of technology for producing alcohol from sweet sorghum allows for resource savings (Kashapov et al., 2016). This study aimed to isolate, and characterizing cellulase-producing fungi from decaying tree trunks, as well as determining the effect of incubation time, moisture content, and initial pH of the medium on cellulase production using untreated corn cobs and sugarcane in solid-state fermentation to saccharify ethanol production. Studies on saccharification optimization showed that an enzyme concentration of 7% (w/w), a substrate concentration of 12% (w/w), and a hydrolysis time of 72 hours were optimal for maximum reducing sugar yield. Total reducing sugar yielded the maximum bioethanol yield within 72 hours when Saccharomyces cerevisiae was used as the fermenting agent (Masinde et al., 2024). The production of cellulosic ethanol from non-detoxified furfural residues obtained under various operating conditions from sugarcane bagasse was investigated. Simultaneous saccharification and fermentation (SSF) and pretreated industrial strains of Saccharomyces cerevisiae were used for fermentation. The highest furfural yield of 69% (11.44 g/100 g dry bagasse) was achieved at 170 °C and 0.5 wt% H_2SO_4 (170-200 °C and 0-1 wt% H_2SO_4), with corresponding ethanol yields of 77-95% (9.57-11.58 g/100 g dry bagasse). The mass of ethanol obtained reflected a conversion of about 50% of the cellulose in the raw biomass due to cellulose decomposition during furfural production. No production conditions were found under which furfural and ethanol yields were maximized, indicating an inevitable trade-off between the two by-products (Ntimbani et al., 2022). This study examines the challenges faced by ethanol plants in Thailand and offers preliminary guidelines for addressing them in the public sector and for ethanol plant operators. This study collected data on identified problems through surveys conducted at 11 of Thailand's 26 ethanol production plants. The study used questionnaires to survey seven aspects of ethanol production, namely: raw materials, production processes, transportation, pricing, government support, engineering, and environmental considerations. Consequently, the data revealed a noticeable correlation between the extraction period and the problems that arose. It was found that all types of ethanol plants experienced the most significant difficulties with obtaining raw materials and pricing, which were the main problems. The production of raw materials such as molasses and cassava varies depending on the season, leading to unstable annual yields. Another moderate problem for ethanol production plants is the government's policy of promoting the use of ethanol fuel (Chatthanon et al., 2025).

Fuel ethanol is the largest liquid biofuel in terms of volume, produced mainly from sugar and starch-based raw materials. The United States and Brazil are the world's largest producers of fuel ethanol. The objective of this study is to increase ethanol production using SuperPro Designer software. Recently, the process of modeling using computerized software has focused considerable attention on increasing ethanol production. In this study, operational control and modeling were developed to increase ethanol production (modeling and operational control). Through perfect control of temperature, pressure, nutrient supply, and molasses using software. The use of software to predict results is a new method. Modeling of a fermentation plant to increase ethanol production, followed by comparison of feedback with actual data from the plant. The simulation model of the process begins with the construction of a temperature-dependent kinetic model using batch fermentation cultures. Then, the continuous ethanol fermentation process was modeled using a kinetic model that matched the experimental measurements. The simulation was based on a process flow chart. Obtaining ethanol after 5 hours of fermentation resulted in an increase in ethanol from 6% to 7%. The fermentation time was reduced to 5 hours. This compares to (9-18) hours in traditional fermentation methods (Widatalla et al., 2025). This study investigates the composition, hydrolysis, fermentation, kinetic studies, and optimization using response surface methodology (RSM) of ten different lignocellulosic materials in ethanol production using enzymatic hydrolysis of isolated Trichoderma reesei and Aspergillus niger and fermentation of Zymomonas mobilis and Saccharomyces cerevisiae. Immediate and final analysis shows that sugarcane and rice husks are ideal raw materials due to their high volatile content, low moisture and ash content, offering more fermentable carbohydrates. The highest glucose concentrations were achieved from sugarcane bagasse (0.5689 g L^{-1}) using T. reesei and from rice husks (0.5803 g L^{-1}) using A. niger. Pretreatment increased glucose yield, with rice husk ash (RHAn) yielding 9.3 g ethanol L^{-1} over 60 hours and sugar bagasse (SBTr) yielding 8.1 g L^{-1} over 48 hours, while reducing particle size to 75 μm increased glucose yield due to increased surface area. Kinetic models, including Monod and Michaelis-Menten models, were used to describe ethanol production, with RHAn demonstrating the highest growth parameters. This study reports on optimized ethanol production, which achieved maximum yields under controlled conditions, further confirming the feasibility of large-scale bioethanol production (Ibrahim et al., 2025). Second-generation ethanol production uses lignocellulosic waste as feedstock, which is abundant and typically considered waste, solving the problem of "competing with humans for food" caused by first-generation fuel ethanol and demonstrating great importance for national energy security and social sustainability. Lignocellulosic waste used in second-generation ethanol production requires pretreatment using biological, physical, or chemical methods to break down its stubborn structure and increase its enzymatic digestibility. The polysaccharide components of pretreated lignocellulose are then broken down by enzymes into fermentable monosaccharides, which can be converted into ethanol by fermentative microorganisms. Currently, many pretreatment methods have been developed, as well as strategies for enzymatic hydrolysis and fermentation for the conversion of biomass. However, the key to developing the cellulosic ethanol industry still lies in figuring out how to effectively break down the lignocellulosic structure at low cost and with low energy consumption. This chapter reviews and evaluates various lignocellulose pretreatment methods developed in recent years, including their advantages and disadvantages, pretreatment mechanisms, and provides a summary of the current state of cellulose ethanol technologies. In addition, this chapter also discusses the processes of enzymatic hydrolysis and fermentation for ethanol production, as well as a detailed analysis of many factors affecting process performance. Furthermore, the bottleneck of lignocellulosic ethanol production and future prospects are discussed (Yuan et al., 2025). This study evaluates the enzymatic hydrolysis of pretreated corn cobs (PCC) using a mixture of commercial enzymes (Cellulase and Viscozyme L enzyme mixture) followed by simultaneous saccharification and fermentation (SSF) with Mucor indicus DSM 2185 for ethanol production. A combination of 2% (w/w) of a mixture of cellulase enzymes and 5.18% (w/v) of Viscose L, corresponding to an enzyme loading of 48.9 FPU/g PCC, allowed almost complete hydrolysis of 40 g L−1 PCC within 6–48 hours, achieving 92.66% total conversion of carbohydrates to fermentable sugars. In SSF experiments conducted in Erlenmeyer flasks, optimal ethanol production in matrix nutrient medium (MNM) reached 14.95 g L^(−1), with a conversion rate of 0.373 g g^(−1) at 30 °C over a 48-hour period. Scaling up the bioprocess in a 1.5 L bioreactor with a stirrer at 30 °C resulted in an ethanol concentration of 16.46 g L^(−1), a total carbohydrate conversion of 86.27%, and a substrate-to-ethanol conversion rate of 0.44 g g^(−1) over 22 hours. Minor secondary metabolites were also detected, including 0.88 g L − 1 xylitol and 0.26 g L − 1 glycerol. Overall, the results demonstrate the potential of M. indicus in combination with commercial enzyme mixtures as a scalable strategy for industrial ethanol production (Mardetko et al., 2025).

In recent years, annual energy consumption from petroleum sources has increased in many cases, leading not only to the continued depletion of limited fossil fuel reserves, but also raising concerns about a safer, better, and greener environment. In addition, high fossil fuel prices have led to an energy crisis in both developing and developed countries that depend on oil. In response to these challenges, it is necessary to find alternative sources of energy production. This study aimed to compare ethanol production from three different tuber crops (Manihot Esculenta, Ipomoea Batata, and Dioscorea SPP). Cassava, sweet potato, and yam peels were collected from the market in the local government area of Jalingo, Taraba State. The collected samples were taken to a convenient location where they were sorted. Cassava, sweet potato, and yam peels were sorted separately so that mainly peels were available for drying. Drying was carried out in the open air and lasted for a week. The well-dried samples were then ground using a hammer mill, mortar, and pestle, which reduced the cassava, sweet potato, and yam peel to very small particle sizes and weighed. Distilled water was added to 10 g of powdered wort, mixed, and filtered. Yeast and malt were added to the filtered wort and left for three (3) days to ferment. After fermentation, the fermented mash was distilled to collect a colorless liquid as distillate. This distillate was neutral to litmus test, soluble in water, and indicated the presence of alcohol by ester, sodium metal, iodoform, and Lucas tests. The results of comparing the three samples showed that cassava peel produced the highest concentration of ethanol (6.25), followed by thread peel (6.13), while the lowest ethanol yield was obtained from sweet potato peel (5.01) at a temperature of 78.40C and a pH of 7.2 after 72 hours of fermentation. This work has shown that cassava, sweet potato, and yam peelings, which are considered worthless waste, are suitable raw materials and can be effectively used for ethanol production (Zakari et al., 2025). Production efficiency and production costs are factors that influence the economic success of sugar and ethanol plants. Ethanol is a highly sought-after product, and during the off-season for sugar cane production, its residual production is insufficient to supply the market. This creates a need for imports and negatively affects Brazil's trade balance. In this context, ethanol produced from corn is a potential alternative for securing market supply, generating income, and diluting plant operating costs by extending its operating period throughout the year. However, access to raw materials and implementation costs may affect the economic viability of this activity. The objective of this study was to assess the feasibility of corn ethanol profitability in the context of a sugarcane-only plant that needs to be adapted to flexible conditions, located in the state of São Paulo. The indicator used was the increase in the sales margin for this fuel and its by-products, taking into account the difference between the costs of raw materials in the two regions. The results show that the market margin for corn ethanol is negative in the state of São Paulo due to its distance from Brazil's main corn supplies. However, when we considered the potential revenue from related products, the loss scenario turned into profitability. Thus, it is concluded that the profitability of corn ethanol production in this scenario depends on the commercialization of its by-products in consumer markets such as pig farming and biodiesel plants (Ferreira et al., 2023). The enormous potential for pineapple production can lead to the generation of significant amounts of waste, approximately 75% (by weight) of the pineapple, which contributes to global environmental problems. For this reason, there is an urgent need for bioprocessing methods to convert pineapple plantation waste into high value-added bioproducts, including bromelain, various sugars, xylooligosaccharide, xylitol, and ethanol. The aim of this study was to investigate the efficiency of converting pineapple plantation waste into bromelain, xylitol, and ethanol. In this study, the activity of the bromelain enzyme was tested in each part of the pineapple plant waste. The configuration of hydrolysis and fermentation processes used to produce ethanol and xylitol from the remaining pineapple plant waste from bromelain extraction was also investigated. Bromelain is a proteolytic enzyme found in pineapple plants and can be extracted from every part of pineapple plant waste. Enzymatic activity under several conditions, such as raw extract, pure extract, and dried extract, was studied to determine the best conditions for the subsequent production process of this enzyme in the future. The purification of bromelain involved the use of a precipitation method followed by dialysis, while the drying process used a lyophilization method. It has been shown that the specific activity of bromelain enzyme is highest in pineapple stems, which is observed in unpurified extract (1.45 ± 0.06 CDU/mg), purified extract (10.38 ± 0.06 CDU/mg), and dried extract (12.05 ± 0.43 CDU/mg). Using pineapple stems to extract bromelain can result in lignocellulosic waste, which consists of 39.47% starch, 19.96% hemicellulose, 36.44% cellulose, and 6.05% lignin. The high starch, cellulose, and hemicellulose content can be used as raw material for ethanol and xylitol fermentation. In this study, ethanol and xylose fermentation was carried out using two methods: separate hydrolysis and fermentation (SHF) and semi-simultaneous saccharification and fermentation (semi-SSF). As a result of fermentation using the semi-SSF method, ethanol with a higher titer and yield (22.12 ± 0.05 g/L and 0.44 ± 0.00 g/g, respectively) was obtained. However, it was found that xylitol formation was insignificant, regardless of whether it was obtained using SHF or semi-SSF. The purification of bromelain involved the use of a precipitation method followed by dialysis, while the drying process used a lyophilization method (Mardawati, et al., 2023). Improving energy efficiency in renewable energy production can contribute to sustainable economic growth with lower fossil fuel consumption, lower greenhouse gas emissions, and greater energy security. The most common biofuel for motor vehicles today is ethanol. Brazil is a major producer of ethanol and uses sucrose from sugar cane, which is currently the most efficient feedstock for bioethanol production. Improving ethanol production at existing plants through thermal integration can lead to significant energy efficiency gains. This article presents diagrams in which the data required for thermal integration is organized in a new way. For the first time, the entire thermal cascade is analyzed through the individual components of ethanol and sugar production, including the boiler, steam turbine, heat exchangers, and technological operations. In standalone plants, the ethanol and electricity produced correspond to approximately 35% and 8% of the input energy, respectively; in combined ethanol-sugar plants, the ethanol, sugar, and electricity produced correspond to approximately 16%, 22%, and 9% of the input energy, respectively. The remaining energy (53-57%) leaves the plant in the form of residues or is released into the environment as heat. The possibilities for improving the plant's energy efficiency by modifying technological operations, heat exchangers, the turbine system, and the boiler have been identified and discussed. Analysis of the plant-wide thermal cascade allows us to understand the relationship between the combustion energy in the boiler, the exergy of gaseous combustion products and high-pressure steam, electricity generation via the turbine, and heat consumption in heat exchangers and process operations. This holistic perspective helps improve energy performance in ethanol and sugar production. Energy transfer diagram (ETD) of the plant-wide heat cascade through ethanol production (Bonhivers et al., 2021).

Materials and methods. There are two ways to produce alcohol: biochemical and chemical or synthetic ones. The biochemical method is fermentation with sugar, the synthetic method is the interaction of ethylene with water in the presence of a catalyst. We used a biochemical method to produce ethyl alcohol. The technology for producing ethyl alcohol includes the following stages: 1) boiling the grain with water 2) cooling of the boiled mass and saccharification of starch with enzymes 3) the fermentation of sugars by yeast in biosport 4) distilling alcohol and its rectification (Yarovenko, et al. 2022). The raw materials are washed and crushed. Besides 1:2, 1:3, 1:4 water is poured, then (TC BY 100104781.010-2005 produced in Belarus, dried alcoholic yeast wort Saccharomyces cerevistal) is filled with pre-prepared yeast, mixed and put on for 2-4 weeks at the room temperature. After two or four weeks, they filtered it out. After weighing the amount of wort, distilled it. The resulting wort was poured into a heat-resistant flask, and an electric stove was used to heat it. The temperature of the first distilled alcohol is 89^0C. Because the concentration of the first distilled alcohol is low. To increase the concentration, alcohol was redistilled. The distilled alcohol contains impurities. To determine their quantity and purify them from the alcohol-containing impurities, it is necessary to adsorb and distill them with activated carbon and calcium oxide (Yarovenko et. al., 2022; Yermakov et al., 2013, Azimbayeva et al., 2013, Kamysbayeva et al., 2022). The composition of ethyl alcohol, obtained by fermentation of dahlia wort, was determined on Agilent 7890A/5975C gas-liquid chromatography.

Results and discussions.

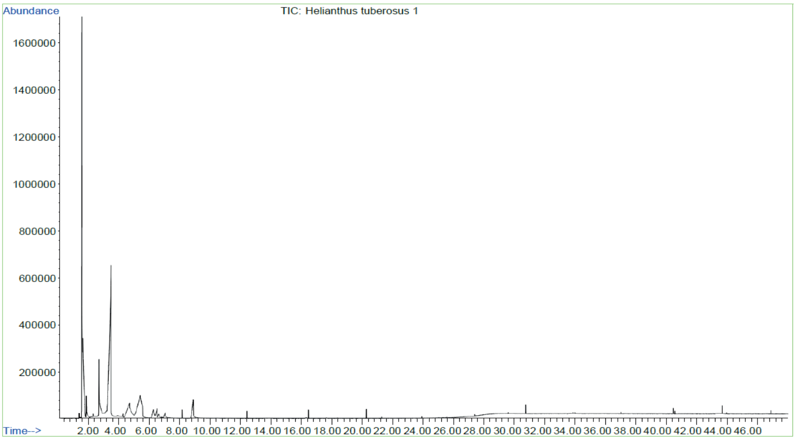

Figure 1- Chromatogram of ethanol obtained from topinambur tubers (Helianthus tuberosus)

The composition of ethanol obtained from topinambur tubers (Helianthus tuberosus) (%): inorganic gases—0.135, organofluorine compounds—0.135, ethanol—34.890, alcohols—8.050, phenolic compounds—0.066, carboxylic acids-56.268, nitrogenous organic compounds-0.182, esters-0.023, aldehydes-0.106, saturated hydrocarbons-0.045, silicon organic compounds-0.056, heterocyclic compounds-0.212.

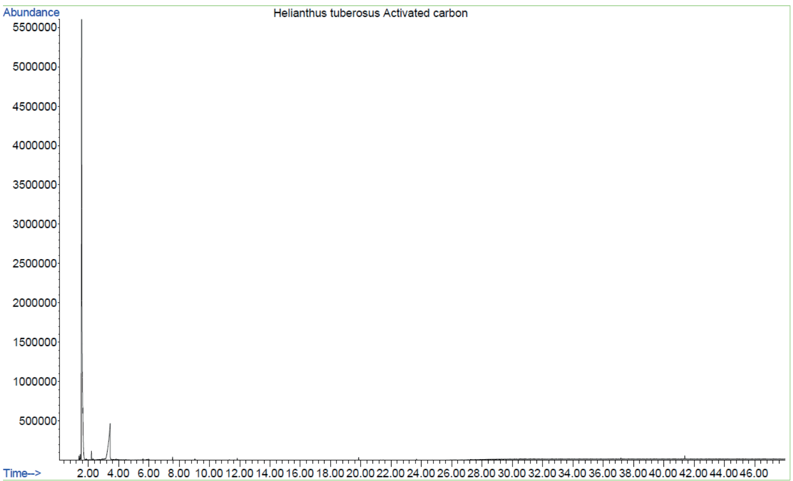

Figure 2- Chromatogram of ethanol obtained from topinambur tubers (Helianthus tuberosus) (after adsorption with activated carbon)

The chemical composition of ethanol obtained from topinambur tubers (after adsorption with activated carbon) (%): inorganic gases-0.276, organofluorine compounds -0.375, ethanol -74.040, alcohols -4.023, esters -0.916, heterocyclic compounds-0.575, monosaccharides - 0.033, carboxylic acids-19.240, organosilicon compounds - 0.404, aldehydes - 0.053, organonitrogen compounds - 0.040.

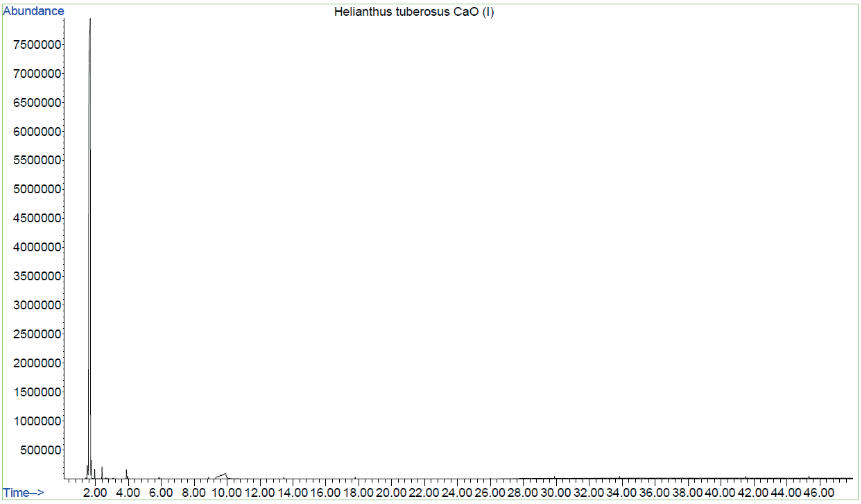

Figure 3- Chromatogram of ethanol from topinambur tubers (Helianthus tuberosus) (CaO adsorption)

Chemical composition of ethanol from topinambur tubers (after adsorption with calcium oxide) (%): inorganic gases—0.070, aldehydes—0.620, ethanol—92.050, alcohols—6.925, esters—0.072, carboxylic acids-0.080, organofluorine compounds-0.105, organosilicon compounds-0.094, phenolic compounds-0.066, organonitrogen compounds-0.082.

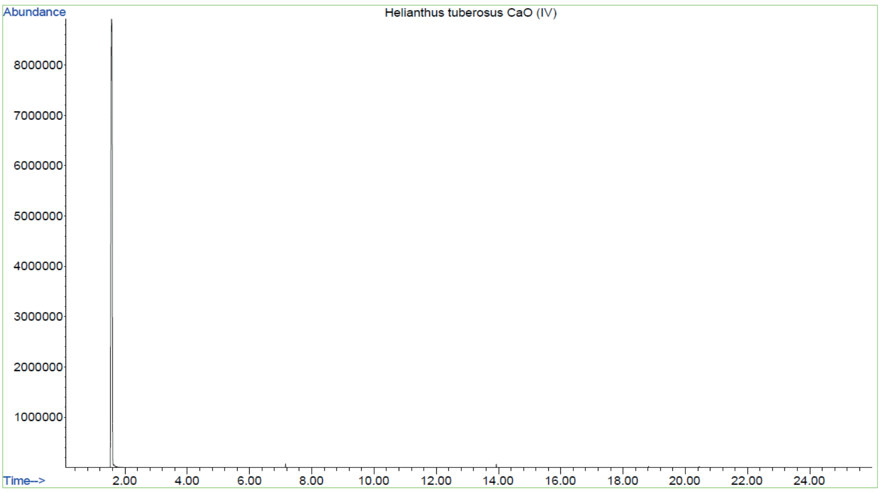

Figure 4- Chromatogram of ethanol from topinambur tubers (Helianthus tuberosus) (CaO adsorption)

Chemical composition of ethyl alcohol from topinambur tubers (after 4-fold adsorption with calcium oxide) (%): ethanol-99.406, alcohols-0.216, nitrogen-containing organic compounds-0.216, heterocyclic compounds-0.040, aldehydes-0.070.

Conclusion. The chemical composition of raw alcohol obtained from topinambur tubers was identified using an Agilent 7890A/5975C gas-liquid chromatograph. After distillation, the mash contains 34.890% ethanol and 65.11% impurities. After adsorption with activated carbon, the raw alcohol content is 74.040%, and impurities account for 25.96%. Upon further processing of this alcohol with calcium oxide, the raw alcohol content is 99.406%, and impurities account for 0.594%.

Thus, based on the above, the technology for producing ethanol from topinambur tubers is effective. This is because this raw material is characterized by a significant content of easily fermentable substances with a high alcohol yield.

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