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«Жанармай, катализ және электрохимия институты» АҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

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THE INFLUENCE OF YEAST RACES ON THE AROMA-FORMING SUBSTANCES OF TABLE WINES

Abstract. Wine is a product of biochemical transformations, compounds present in grape juice, by controlled alcoholic fermentation, that is, effervescence. Grape and yeast enzymes play a key role in the processing of grapes and the preparation of wine, influencing all biotechnological processes of winemaking.

Adding liquid or dry active yeast to the wort allows better control of the fermentation process. Under the influence of these yeasts, sugar is converted mainly into alcohol or carbon dioxide, but the yeast itself during fermentation produces many molecules (higher alcohols, esters) that affect the aroma and taste of wine. These transformations take about two weeks and lead to a significant increase in temperature, which must be regulated, not allowing it to rise above 18-20°C: otherwise, some of the aromatic substances may evaporate and the fermentation process itself will stop.

The amount of yeast that determines the correct and complete fermentation depends both on the quality of the wort itself, and on the more or less prolonged access of air, the ambient temperature. The air, or rather the oxygen of the air, has a beneficial effect on fermentation as long as there are still many nutrients (sugars) in the wort; as the latter are consumed, extremely small yeast cells are formed, which persist for a long time in the form of turbidity. The rapid course of fermentation can be greatly facilitated by the periodic stirring of yeast, which, settling to the bottom, lose direct contact with nutrients — the lower layers almost do not

function. You can mix the wort mechanically or by adding healthy whole grapes to it; in this case, the wort is constantly and automatically mixed: the berries, rising up in the fermenting liquid, carry the yeast with them. In order to speed up the fermentation, the wort is sometimes ventilated, that is, air is introduced into it, by mixing.

This article shows the influence of the yeast race on the fermentation dynamics of white grape must, the composition of organic acids and aroma-forming components. The races that ensure the production of high-quality wine materials are identified.

Key words: Wine yeast, fermentation, enzyme activity, fermentation dynamics, organic acids, aroma-forming substances.

Introduction. One of the most important technological operations in the production of white table wines is the fermentation of wort, carried out by special yeast races. According to scientists [1, 2], it is the yeast races that have a great influence on the dynamics of fermentation, the formation of taste and aroma, and even the bottling resistance of wine materials. With the right selection of the race, you can produce wine material of the predicted quality and chemical composition. The modern domestic market of auxiliary materials has a large number of new yeast races. However, before recommending them for use in production, it is necessary to conduct a set of studies (tests) in order to justify their use for a certain category of wines. The main purpose of the work is to study the influence of yeast races LEVURE IOC BE THIOLS, LEVURE IOC B 2000 and LEVURE IOC B 3000 (produced in France) on the quality indicators of white table wines [5,7].

Materials and methods. As an object of research, the wort from the white grape variety Rkatsiteli was used. For the fermentation of grape must from white grape varieties, new races of active dry yeast were used, having the following characteristics:

LEVURE IOC B 3000 - Emphasizes the aromatic intensity and complexity of the wine with pronounced shades of yellow fruits and flowers, while contributing to the formation of a sense of volume and roundness in the taste. The strain's good fermentation abilities make it an ally of the winemaker in preventing the risks of sulfur compound odors, the so-called "reduction"tones. Ideal yeast for making elegant wines with a rounded, long-lasting taste when using yeast-lees aging technology.

LEVURE IOC B 2000 - promotes the disclosure of fruit aromatic components contained in white and pink wort. It is used for the production of fresh, aromatic wines. It allows you to obtain different aromatic profiles depending on the fermentation temperature and, thus, to harmoniously combine the fermentation tones and varietal flavors. Yeast IOC B 2000 is used in the process of vinification of white wines, for which the main aspect is the aromatic expressiveness. To an even greater extent, it is advisable to use the strain for grape varieties that are poor in the content of flavor precursors.

LEVURE IOC BE THIOLS – Preparation of yeast IOC BE THIOLS - the result of the application of an innovative method of selection using markers. It provides the formation of thiol compounds with fruit flavors in a high concentration, and at the same time is characterized by the lack of the ability to produce SO_2 and H_2S. Therefore, it is a "tool" in the hands of the winemaker who wants to reduce the amount of sulfites in the white and pink wines produced.

The volume of carbon dioxide released was determined using hydraulic locks. Mass concentration of organic acids – by capillary electrophoresis according to GOST R 52841-2007, and aroma-forming compounds-using gas-liquid chromatography by direct sample input (Crystal 2000M).

The results of the study. In grape must from the Rkatsiteli grape variety in the same quantities (2 g/dm^3) reactivated cells of yeast races LEVURE IOC BE THIOLS, LEVURE IOC B 2000, LEVURE IOC B 3000 and control - LEVURE IOC 18-2007, fermentation temperature 18-20ºC were introduced. The initial concentration of sugars in the initial wort is 18.5 g/100 cm³, and the titrated acids are 8 g/dm3. Fermentation was carried out under hermetic conditions [6].

Discussion of the results. The analysis of the obtained data shows a difference in the dynamics of fermentation depending on the yeast race (Fig. 1).

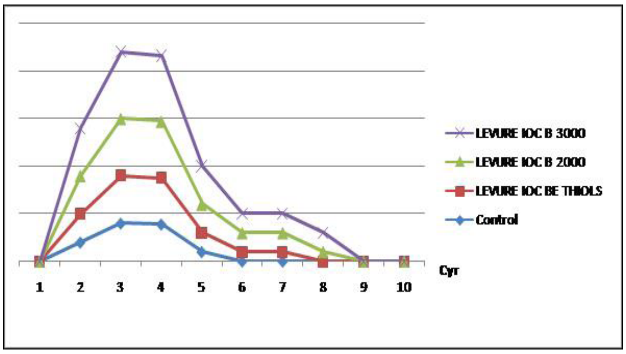

Figure 1. Dynamics of CO_2 release during fermentation of wort by yeast races

The latent period was almost identical for all three experimental yeast races. In the control version, the fermentation was somewhat slower, and the exponential phase was faster. The most active sugar consumption and CO_2 release were observed when using the yeast race LEVURE IOC BE THIOLS and LEVURE IOC B 2000. The least active release of CO_2 was observed in the control sample. According to the data obtained by the fermentation of sugars race LEVURE IOC THIOLS BE ended on the sixth day, other experimental races - on the ninth day, and race LEVURE IOC 18-2007 (control) for 10 days [4].

The results obtained can be explained by the difference in the activity of the enzyme systems of each of the yeast races, which is most likely a genetic feature of the strain. In this regard, it is of interest to study the chemical composition of the obtained wine materials [12]. It was found that the volume fraction of ethyl alcohol varied from 10 % vol. LEVURE IOC BE THIOLS, LEVURE IOC B 2000 and LEVURE IOC 18-2007 in races 10.5 % vol. LEVURE IOC B 3000-9.6 % vol. Organic acids affect the taste and bouquet of wine, determine the direction of biochemical processes. As a result of the conducted studies (Table. 1) it was found that the concentration of titrated acids decreased, especially in the case of the use of the yeast LEVURE IOC B 2000.

Table 1. - Mass concentration of organic acids depending on the yeast race

Indicators	The yeast race			
	Control	LEVURE IOC B 3000	LEVURE IOC B 2000	LEVURE IOC BE THIOLS
Mass concentration of organic acids, g/dm^3				
Wine	2,43	2,20	2,18	2,24
Apple	1,93	1,78	1,85	1,68
Amber	0,32	0,58	0,66	0,45
Lemon	0,32	0,26	0,44	0,18
Acetic acid	0,28	0,25	0,40	0,36
Dairy	no	1,26	0,86	0,47
Tasting score, score	7,6	7,8	7,7	8,1
Mass concentration of titrated acids, g / dm^3	7,2	6,8	7,0	6,7

The content of tartaric acid varied slightly, while its decrease was noted when using the LEVURE IOC B 2000 and LEVURE IOC B 3000 races. During the fermentation process, a decrease in the concentration of malic acid was revealed. Its amount in wine materials varied from 1.68 g / dm^3 when using the LEVURE IOC BE THIOLS race to 1.93 g/dm^3 in the control. The greatest reduction in the concentration of malic acid was provided by the use of the LEVURE IOC BE THIOLS race.

The results obtained allow us to assume that all experimental yeast races have an acid-reducing ability, which is especially important and significant at the present time, when additional technological operations have to be carried out to reduce the concentration of titrated acids. The use of the studied yeast races in the technology makes it possible to regulate the concentration of titrated acids already at the stage of alcoholic fermentation. In comparison with the control, the experimental samples showed the accumulation of succinic acid, especially in the variants obtained using the yeast races LEVURE IOC B 2000 and LEVURE IOC B 3000 (0.58 and 0.66 g/dm^3, respectively). It is known [8] that the presence of succinic acid increases the antioxidant capacity of white table wines and their resistance to oxidation. Consequently, the samples obtained with LEVURE IOC B 2000 and LEVURE IOC B 3000 are more resistant to oxidation in comparison with other wine materials. An increase in lactic acid content was observed in all samples, especially when using the LEVURE IOC B 2000 and LEVURE IOC BE THIOLS strains (0.47 and 0.88 g/dm3, respectively). No lactic acid was detected in the control sample. This indicates that the LEVURE IOC 18-2007 yeast race does not contain enzyme systems that transform malic acid to lactic acid [9].

Acetic acid is rapidly formed at the beginning of fermentation, and by the end of fermentation, its content can drop sharply. Thus, studies [10] have shown that this property of yeast is genetic and can increase or decrease depending on the chemical composition of the wort. Studies have shown that the lowest concentration of acetic acid was found when using the LEVURE IOC 18-2007 and LEVURE IOC B 3000 races. Based on the research of Saenko N.F. [11], it is possible to recommend these yeast races for the treatment of "sick" wines with an increased concentration of acetic acid and acetaldehyde.

Oxalic acid was also detected in three wine materials, which indicates different activity of the Krebs cycle enzyme systems. This fact is confirmed by a large difference in the accumulation of pyruvic acid, through which most of the transformations of organic acids in the tricarboxylic acid cycle occur [16].

Citric acid is a natural by-product of alcoholic fermentation [15] and is involved in the addition of wine taste, redox processes. It is formed in the Krebs cycle from pyruvic acid under the action of acetyl-CoA or from oxalic-acetic acid under the action of decarboxylating enzymes of the Krebs cycle. It was found that the synthesis of citric acid of the studied yeast race can be arranged in a row (in descending order of concentrations) LEVURE IOC B 2000 > LEVURE IOC 18-2007 > LEVURE IOC B 3000 > LEVURE IOC BE THIOLS.

Organic acids are involved in esterification reactions, the product of which are various esters and esters that form the aroma of wine. The activity of esterification is determined by the enzymatic complex of yeast cells. Analysis of research materials (Table. 2) indicates that the most important flavor-forming compounds vary widely depending on the yeast race. It was found that the fermentation of wort by LEVURE IOC B 2000 and LEVURE IOC

B 3000 strains led to an increase in the accumulation of acetaldehyde, which can give excessive sharpness and coarseness to the aroma and taste of the wine.

Table 2. - Accumulation of aroma-forming components, mg/dm^3, depending on the yeast race

Indicators	The name of the yeast			
	LEVURE IOC 18-2007	LEVURE IOC B 3000	LEVURE IOC B 2000	LEVURE IOC BE THIOLS
Acetaldehyde	80,5	121,3	68,7	81,4
Ethyl Formate	0,21	0,22	no	0,18
Ethyl Acetate	23,45	19,78	44,8	36,5
Isoamyl Acetate	0,46	0,51	0,19	0,32
Ethyl Lactate	0,13	0,20	0,22	0,27
Ethyl Acetal	no	0,04	no	0,01
Methanol	20,0	24,1	18,6	21,9
2-butanol	no	0,12	no	0,08
1-propanol	19,4	20,6	15,8	21,2
Isobutanol	59,7	60,1	32,7	41,0
1-butanol	1,12	1,32	no	no
Isoamyl alcohol	168	171	212	186
1-amyl alcohol	0,36	0,38	no	0,12
1-hexanol	18,6	18,5	16,6	18,3
2-phenylethanol	21,6	38,9	32,5	31,2
2,3-butanediol	38,7	58,0	40,4	39,4
Tasting grade, score	7,8	8,2	8,2	8,4

It is known [3, 6] that acetaldehyde is a secondary product of alcoholic fermentation, and its concentration is largely determined by the amount of sulfur dioxide in the initial wort. In our experiments, the initial wort had the same concentration of sulfur dioxide, which was 70 mg/dm^3, therefore, the differences in the concentrations of acetaldehyde in the experimental wine materials are caused by other factors, namely, the specifics of the yeast race. In addition, during fermentation, a constant new formation of acetaldehyde is usually observed due to deamination of amino acids [14], the activity of which is determined by the biosynthetic functions of the corresponding yeast enzyme systems.

A significant accumulation of isoamyl acetate and 2,3-butanediol, which have an adverse effect on the taste and aroma of wine, was found in wine materials prepared using LEVURE IOC B 3000 yeast races. A significant difference between the races was observed in the number of terpene compounds - citral, terpeniol, limonene, and ionone. Perhaps it is their presence that can explain the bright floral aroma of wine materials prepared using the LEVURE IOC BE THIOLS and LEVURE IOC B 2000 strains.

As a result of analyses of wine materials produced using the LEVURE IOC BE THIOLS and LEVURE IOC B 2000 strains, it was found that the concentration of isoamyl alcohol was slightly higher, and ethyl acetal, on the contrary, accumulated a small amount compared to the control sample. According to the concentration of ethyl lactate, the samples of wine materials obtained using the IOC BE THIOLS and LEVURE IOC B 2000 differ favorably from the control.

The most important among the esters is ethyl acetate, which has a light fruity aroma, and ethyl lactate, which softens the taste of table wine material. As a result of the studies, the largest amount of ethyl acetate was found in the wine material obtained by fermentation of the wort with the LEVURE IOC B 2000 yeast race, a slightly smaller accumulation was obtained when using the IOC BE THIOLS race. In the other variants, including the control, the content of ethyl acetate had similar values. The greatest accumulation of ethyl lactate was found in the variants using the IOC BE THIOLS, LEVURE IOC B 2000 and LEVURE IOC B 3000 races.

The mass concentration of isoamyl acetate, which shows floral and bitter-fruit tones depending on the concentration, was the highest when using the IOC BE THIOLS and in the control.

Also presented in table aromaterapia components identified in the wine capric, Caproic aldehyde, ethylbutyrate, ethylmalonic, Edilkamin, ethylcaproic, eticaret, isoamylene, esters of linoleic, linolenic, oleic and myristic acids, isovalerianate, capric, Caproic and Caprylic acids, the concentration of which had similar values for all the studied races of yeast. A comparative analysis of the accumulation of higher alcohols is of interest.

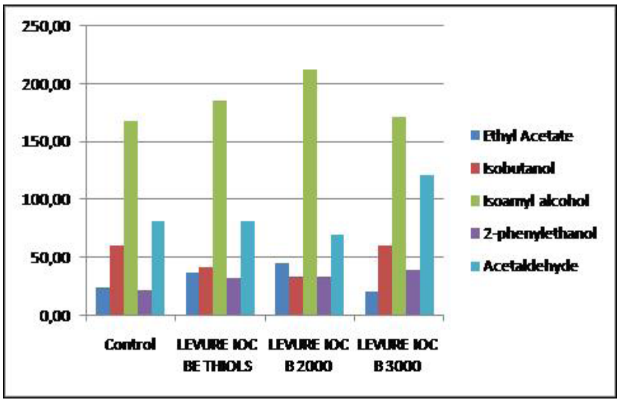

Figure 2. Changes in the concentration of aromatic components depending on the yeast race

They are formed by deamination or transamination of the corresponding amino acids, subsequent decarboxylation of ketoacids, and reduction of aldehydes during alcoholic fermentation [13]. According to [17], higher alcohols are products of alcoholic fermentation, the amount of which is determined by the yeast race, and the synthesis is carried out on the verge of carbohydrate and nitrogen exchange of yeast, i.e., the synthesis of higher alcohols is determined by the genetic characteristics of yeast.

The analysis of the obtained experimental data indicates that under the same fermentation conditions, 2-butanol was detected only when using the IOC BE THIOLS and LEVURE IOC B 3000 races (Fig. 2). Both the experimental and control yeast races were characterized by a low synthesis of 1-propanol and 1-butanol, which is a positive factor.

Of the known higher alcohols of grape processing products, isoamyl alcohol has the most unpleasant aroma. Its accumulation was greatest when using LEVURE IOC B 2000 yeast races, which, however, did not have a negative impact on the quality of the wine material.

Conclusion. Tasting wine materials was successfully carried out, which revealed a correlation between sensory evaluation and the concentration of titratable acids, especially malic and lactic, and higher alcohols. The wine material prepared using the LEVURE IOC BE THIOLS race had the highest tasting score, while the other wine materials had similar organoleptic scores.

Thus, the presented research materials indicate a significant influence of the yeast race on the aromatic complex of white table wine materials.

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АШЫТҚЫ НӘСІЛДЕРІНІҢ ҮСТЕЛ ШАРАПТАРЫНЫҢ ХОШ ИІСТІ ЗАТТАРЫНА ӘСЕРІ

Аннотация. Шарап - бұл бақыланатын алкогольдік ашыту, яғни ашыту арқылы жүзім шырынында болатын қосылыстардың, биохимиялық өзгерістердің өнімі. Жүзім мен ашытқы ферменттері жүзімді өңдеуде және шарап дайындауда шешуші рөл атқарады, шарап жасаудың барлық биотехнологиялық процестеріне әсер етеді.

Сусынға сұйық немесе құрғақ белсенді ашытқыны қосу ашыту процесін жақсы басқаруға мүмкіндік береді. Осы ашытқылардың әсерінен қант негізінен алкогольге немесе көмірқышқыл газына айналады, бірақ ашытқы өзі ашыту кезінде шараптың иісі мен дәміне әсер ететін көптеген молекулаларды (жоғары спирттер, эфирлер) түзеді. Бұл түрлендірулер шамамен екі аптаға созылады және температураның едәуір жоғарылауына әкеледі, оны 18-20°C-тан жоғары көтерілуіне жол бермей, оны реттеу керек: әйтпесе хош иісті заттардың кейбіреулері булануы мүмкін және ашыту процесінің өзі тоқтайды.

Дұрыс және толық ашытуды анықтайтын ашытқының мөлшері сусынның сапасына да, ауаның, қоршаған ортаның температурасына да азды-көпті қол жетімділігіне байланысты. Ауа, дәлірек айтқанда, ауаның оттегі ашытқыларға пайдалы әсер етеді, егер суслада әлі де көптеген қоректік заттар (қанттар) болса; соңғысы тұтынылғандықтан, лайлану түрінде ұзақ уақыт сақталатын өте кішкентай ашытқы жасушалары түзіледі. Ашытудың жылдам дамуына прогресті ашытқыны мезгіл-мезгіл араластыру арқылы едәуір жеңілдетуге болады, ол түбіне дейін түсіп, қоректік заттармен тікелей байланысын жоғалтады - төменгі қабаттар дерлік жұмыс істемейді. Сіз сусланы механикалық түрде немесе оған толық жүзім қосу арқылы араластыра аласыз; сонымен бірге сусла үнемі және автоматты түрде араласады: жидектер ашыту сұйықтығында көтеріліп, өздерімен бірге ашытқыны алып жүреді. Ашытуды тездету үшін сусланы кейде желдетеді, яғни оған араластыру арқылы ауа енгізеді.

Бұл мақалада ашытқы нәсілінің ақ жүзімнің ашыту динамикасына, органикалық қышқылдардың құрамына және хош иістендіргіш компоненттердің әсері көрсетілген. Жоғары сапалы шарап материалдарын ұсынатын жарыстар ерекше атап өтілді.

Түйін сөздер: Шарап ашытқысы, ашыту, ферменттердің белсенділігі, ашыту динамикасы, органикалық қышқылдар, хош иісті заттар.

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ВЛИЯНИЕ РАС ДРОЖЖЕЙ НА АРОМАТООБРАЗУЮЩИЕ ВЕЩЕСТВА СТОЛОВЫХ ВИН

Аннотация. Вино является продуктом биохимических превращений, присутствующих в виноградном соке путем контролируемой алкогольной ферментации, другими словами брожения. Ферменты винограда и дрожжей играют главную роль в обработке винограда и приготовлении вина и влияют на все биотехнологические процессы в виноделии.

Добавление жидких или сухих активных дрожжей в сусло позволяет лучше держать под контролем

процесс ферментации. Под влиянием этих дрожжей сахар превращается в основном в спирт или углекислый газ, но сами дрожжи во время брожения производят множество молекул (высшие спирты, эфиры), которые влияют на аромат и вкус вина. Эти превращения занимают около двух недель и приводят к существенному увеличению температуры, которую необходимо регулировать, не давая ей подняться выше 18-20°C: в противном случае некоторые ароматические вещества могут улетучиться и сам процесс брожения остановится. Число дрожжей, определяющее правильное и полное брожение, зависит как от качества самого сусла, так и от более или менее продолжительного доступа воздуха, температуры окружающей среды.

Воздух, а точнее кислород в воздухе, благотворно влияет на ферментацию, если в сусле еще много питательных веществ (сахаров); по мере употребления последних образуются очень мелкие дрожжевые клетки, которые сохраняются в течение длительного времени в виде помутнения. Быстрому прогрессу брожения в значительной степени способствует периодическое перемешивание дрожжей, которые, оседая вниз, теряют прямой контакт с питательными веществами - нижние слои почти не функционируют. Перемешивать сусло можно механически или добавлением в него здоровых цельных ягод винограда; при этом сусло постоянно и автоматически перемешивается: ягоды, поднимаясь в бродящей жидкости вверх, увлекают за собой дрожжи. С целью ускорения брожения сусло иногда проветривают, то есть вводят в него воздух, путём перемешивания.

В данной статье показано влияние расы дрожжей на динамику брожения белого виноградного сусла, состав органических кислот и ароматобразующих компонентов. Выделены расы, обеспечивающие получение высококачественных виноматериалов.

Ключевые слова: винные дрожжи, брожение, активность ферментов, динамика брожения, органические кислоты, ароматобразующие вещества.

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OXIDATIVE DIMERIZATION OF METHANE TO C_2 HYDROCARBONS

Abstract. The world's oil reserves are decreasing every day due to the continuous production and processing of the most modern technologies. Scientists all over the world are looking for various raw materials and methods to use the vast resources of natural gas as a substitute for petrochemicals. In this regard, great attention is drawn to natural gas as an alternative source of raw materials for petrochemical industries.

The purpose of this work is to study the reaction of methane dehydrogenation on new 20%La-10%Ce-20%Mg-50% glycine catalysts prepared by the SHS method to identify the optimal conditions for their preparation, concentration and ratio of metals, the influence of contact time and process temperature on the direction and mechanism of the reaction.

The results of the study of 20% La-10% Ce-20% Mg-50% glycine catalyst prepared by the SHS method in the process of oxidative dehydrogenation of methane into C_2 hydrocarbons are presented. On the basis of experimental studies, it was found that the composition of the catalyst exhibits high activity in the above reaction under the found optimal conditions.

Thus, the influence of reaction temperature on the developed composition of catalysts for oxidative conversion of methane has been determined that the optimum temperature for the selective formation of ethane and ethylene is T=700°C. It was found that for selective oxidation of a mixture of CH_4: O_2 : Ar in C_2 hydrocarbons the optimal conditions are: T=700°C, CH_4:O_2=2,5:1, 5000 h^{-1}.

Key words: ODM reaction, C_2 hydrocarbons, SHS method, temperature of reaction.

Introduction. The world's oil reserves are decreasing every day due to the continuous production and processing of the most modern technologies. Scientists all over the world are looking for various raw materials and methods to use the vast resources of natural gas as a substitute for petrochemicals. In this regard, great attention is drawn to natural gas as an alternative source of raw materials for petrochemical industries.

According to the annual Statistical Review of World Energy – 2018, published by British Petroleum (BP) at the end of 2017 proven natural gas reserves in the world are estimated at 193.5 trillion cubic meters.

It is known that natural gas is 90% methane. Of interest is the oxidative dimerization of methane into ethylene, which makes it possible to obtain a number of petrochemical products, such as polyethylene, polystyrene and many other chemical products. This is primarily due to the low cost of methane compared to other hydrocarbons [1].

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