EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
UIF = 8.1 | SJIF = 5.685 www.in-academy.uz

NATURAL ALCOHOLS, POLYHYDRIC ALCOHOLS AND PHENOLS

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https://www.doi.org/10.5281/zenodo.10638130

ARTICLE INFO

Received: 02nd February 2024
Accepted: 08th February 2024
Online: 09th February 2024

KEY WORDS

Healing effect, human body, chemistry, biology, positive effects, ethyl alcohol, potato tubers, biochemical processes, hydrolysis, physical process.

ABSTRACT

The relevance of this topic is undeniable. Monohydric alcohols are used in various fields of work, especially widely in medicine. For example, if you ask yourself how to give an injection correctly, it turns out that it is simply impossible to do them without alcohol, and alcohols are the main base for the production of many medicines. Purpose of the article is to systematize the acquired knowledge about natural alcohols, polyhydric alcohols, and also to consider various areas of application.

Once upon a time, there was only the fact that fruit and berry “products” fermented from the heat made people happy, dulled pain, and suppressed fear.

Over time, alchemists studied fermentation processes, then invented special apparatus for distilling grape wine. From this moment, a long period of its improvement begins, in which the most outstanding minds of that time take part [1].

Of course, much is currently known about alcohols, but perhaps in a few centuries more discoveries will be summarized.

Alcohol is a xenobiotic - substances not found in the human body, but affecting its vital functions. It all depends on the dose.

Alcohol is a poison that disrupts natural biological processes, destroys internal organs and the psyche, and leads to death if consumed in excess. Its 60-70% solution has an inhibitory effect on microorganisms, partially destroying them or killing them. If the concentration of the solution is above 20%, it causes dehydration and coagulation of protein substances and protoplasm of the cell [2].

It is also believed that alcohols have a healing effect on the human body, but the authors of numerous works on medicine, chemistry, and biology are trying to confirm or refute various speculations about the healing effect of alcohol, and most importantly, explain in detail the mechanisms of its positive effects. However, it would not be amiss to remind you that moderation should be observed with alcohol, sometimes even for medicinal purposes [3].

For a long time, alcohol was obtained exclusively from wine. Then a way to ferment grain was found, and as potatoes spread, so did he. Currently, potatoes are considered the most common and economical raw material for producing alcohol. Potato starch is easily boiled, in addition, potatoes differ from grains in their increased yield - from a unit of potato

sown area you can get 2-3 times more alcohol than from the same area of grain. ethyl alcohol biochemical oxidation [4].

The production of ethyl alcohol from potato tubers is based on two biochemical processes:

- Hydrolysis
- The physical process of separating liquids by boiling points [5].

Therefore, potatoes are currently recognized as the best type of plant raw material for the alcohol industry. In modern production, high-yielding technical varieties of potatoes are used, which have high starch content and are stable during storage.

These raw materials are also used in foreign production. For example, in Poland, most vodka is made from potatoes, which is honestly stated on the label. Potato alcohol is indispensable in the pharmaceutical, perfume and alcoholic beverage industries.

Alcohols have a variety of transformations. They are neutral substances, that is, in an aqueous solution they do not change the color of the indicator - they exhibit weakly acidic properties.

They are characterized by reactions involving the breaking of O-H and C-O bonds [6].

The polarity of the O-H bond determines its propensity for heterolytic cleavage. The hydrogen atom of the hydroxyl group becomes mobile, capable of being removed in the form of a proton. Therefore, alcohols can act as OH-acids. At the same time, the presence of an oxygen atom in the alcohol molecule, which has a lone pair of electrons, predetermines the manifestation of the properties of bases by alcohols.

Due to its polarity, the C-O bond is capable of heterolytic cleavage. The carbon atom associated with the hydroxyl group carries a partial positive charge and can act as an electrophilic center, and therefore is subject to attack by a nucleophilic reagent [7]. This means that for alcohols, nucleophilic substitution reactions of the hydroxyl group can occur.

Due to the presence of an oxygen atom with a lone pair of electrons in the alcohol molecule, alcohols are able to act as nucleophilic reagents in reactions with other compounds.

Acid-base properties.

Alcohols are amphoteric compounds, that is, they can exhibit both the properties of acids and the properties of bases [8].

1. Acid properties.

Alcohols as acids react with sodium metal to form alcoholates.

2. Basic properties

The main center in the alcohol molecule is an oxygen heteroatom, which has a lone pair of electrons. When alcohols are exposed to strong acids, protons are added to the oxygen atom of the hydroxyl group and an unstable alkyloxonium ion is formed.

Nucleophilic substitution reactions.

When alcohols are exposed to mineral or organic acids, esters are formed, otherwise called the esterification reaction.

An alcohol molecule acts as a nucleophile, attacking the carbon atom of the carboxyl group of the acid, which carries a partial positive charge. A distinctive feature of this reaction is that the substitution occurs at the carbon atom that is in a state of sp2 hybridization [9].

Intermolecular dehydration of alcohols. When alcohol is heated in the presence of catalytic quantities of a strong acid, a water molecule is separated from two sulfate molecules and an ether is formed.

The role of the proton is to activate the electrophilic center of the alcohol molecule and convert a bad leaving group - hydroxyl - into a good leaving group - a water molecule. Thus, the first stage of the reaction is to convert an ethanol molecule into an ethyloxonium ion. The latter is attacked by a second alcohol molecule acting as a nucleophile. The resulting new alkyloxonium ion is stabilized by the release of a proton (catalyst return) and converted to an ether.

Oxidation reactions [10].

Primary alcohols are oxidized to aldehydes

Secondary alcohols are oxidized to ketones

Tertiary alcohols are more resistant to oxidation. When they are exposed to strong oxidizing agents, the carbon skeleton of the tertiary alcohol molecule can split to form carboxylic acids and ketones with a smaller number of carbon atoms than in the molecule of the original tertiary alcohol.

Methanol (CH3OH) is a colorless liquid with an odor similar to ethanol, lighter than water (density 0.79), and highly flammable [15]. Very poisonous. In the body it is oxidized into formic aldehyde and formic acid. Ingestion of even small (5-10g) amounts of methanol causes blindness, large doses (30g) lead to death. It is widely used as a raw material in industrial organic synthesis. It is used as a solvent, as well as in the production of formaldehyde, used to produce phenol-formaldehyde resins; methanol has recently been considered as a promising motor fuel. Large volumes of methanol are used in the production and transportation of natural gas. Methanol is the most toxic compound among all alcohols [14].

Ethanol (C2H5OH) is a colorless liquid with a faint odor and is highly flammable [11]. Mixes with water in all proportions. The starting compound for the production of acetaldehyde, acetic acid, as well as for the production of carboxylic acid esters used as solvents. In addition, ethanol is the main component of all alcoholic beverages; it is widely used in medicine as a disinfectant and in pharmacy for the preparation of tinctures and extracts.

Butanol is used as a solvent for fats and resins; in addition, it serves as a raw material for the production of fragrant substances (butyl acetate, butyl salicylate, etc.). In shampoos it is used as a component that increases the transparency of solutions.

Benzyl alcohol (C6H5-CH2-OH) is found in the free state (and in the form of esters) in the essential oils of jasmine and hyacinth. It has antiseptic (disinfecting) properties; in cosmetics it is used as a preservative for creams, lotions, dental elixirs, and in perfumery as a fragrant substance [12].

Phenethyl alcohol (C6H5-CH2-CH2-OH) has a rose scent, is found in rose oil, and is used in perfumery.

Although phenols are similar in structure to alcohols, they are much stronger acids than alcohols. At the same time, charge delocalization in the phenoxide ion occurs to a lesser extent than in the carboxylate ion; accordingly, phenols are weaker acids compared to carboxylic

acids. Phenols dissolve in aqueous sodium hydroxide, but they do not react with sodium bicarbonate. This is the simplest, although not very reliable test, by which one can distinguish between phenols and carboxylic acids that react with sodium bicarbonate to release carbon dioxide. The effect of a substituent on the benzene ring on the acidity of phenols is consistent with the idea of their electronic effects. Electron-donating substituents reduce, and electron-withdrawing substituents increase, the acidic properties of phenols. Phenols dissociate in aqueous solutions to form phenolate ions and hydrogen ions [13]:

Unlike alcohols, phenols react not only with alkali and alkaline earth metals, but also with alkali solutions, forming phenolates:

As the length of the hydrocarbon radical increases, the rate of this reaction slows down. In the presence of traces of moisture, the resulting alcoholates decompose to the original alcohols.

The role of phenols in human life is very great. Currently, the largest amount of phenol is used to produce phenol-formaldehyde resins, which are used in the production of phenol plastics. Diatomic phenols and their derivatives are included in tanning agents for leather and fur, modifiers and stabilizers for rubbers, and are used for processing film and photographic materials. In medicine, phenols and their derivatives are used as antimicrobial (phenol, resorcinol), anti-inflammatory (salol, osarsol), antispasmodic (adrenaline, papaverine), antipyretic (aspirin, salicylic acid), adrenolytic (mesaton), astringent (tannins) and other medicines, as well as vitamins E and P.

In conclusion, we can say the words of A.M. Butlerov: “A fact that today seems petty, isolated and unimportant tomorrow in connection with new discoveries, can become the seed of a new fruitful branch of knowledge.” Indeed, once upon a time there was only the fact that fruit and berry “products” fermented from the heat brought joy, dulled pain, and suppressed fear. And now we know almost everything about alcohols.

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