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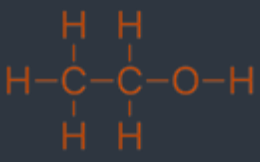
Poison of the month



Ethanol

Ethanol: Between Everyday Use and Toxicological Reassessment – Challenges of Harmonized Classification

Ethanol is among the most widely consumed psychoactive substances globally. In Europe, the use of ethanol is deeply embedded in cultural practices and social traditions. At the same time, ethanol is an essential industrial chemical used in a wide range of applications.

Ethanol acts primarily on the central nervous system by modulating key receptors in the brain, including the gamma-aminobutyric acid type A receptor (GABA, inhibitory), the N-methyl-D-aspartate receptor (NMDA, excitatory), and the 5-hydroxytryptamine receptor (also known as the serotonin receptor). The resulting dose-dependent effects range from calming, anxiolytic, and mood-enhancing to sedation, respiratory depression, and ultimately death. Chronic intake of high amounts of ethanol can lead to liver disease and neurological damage. A carcinogenic effect associated with regular consumption is also well-established, and ethanol has therefore been classified by the International Agency for Research on Cancer (IARC) as Group 1: "carcinogenic to humans" — particularly in relation to cancers of the oral cavity, esophagus, liver, and breast.

The World Health Organization (WHO) emphasizes that there is no safe threshold for ethanol consumption. Despite this clear toxicological assessment, ethanol remains widely present in food and beverages, and, unlike tobacco products, packaging does not carry warning labels indicating its toxicity.

However, a reassessment is currently underway regarding the classification of ethanol as an industrial substance by the European Chemicals Agency (ECHA). Ethanol is currently under review in two parallel

The nomination of ethanol as “Toxin of the Month” for April 2025 was put forward by the Working Group on 3R Practice and Alternative Approaches (AK 3R practices and alternative methods....

...as the current discussion about a possible CMR classification makes the need for evidence-based regulation and the use of alternative, practical assessment methods and strategies particularly clear.

Toxicokinetics

Ethanol is rapidly absorbed via the gastrointestinal tract, primarily in the small intestine. It is metabolized in the liver, mainly by alcohol dehydrogenase (ADH) into acetaldehyde, which is further converted by aldehyde dehydrogenase (ALDH) into acetate. Acetaldehyde is considered a key toxic mediator, especially with respect to carcinogenic and mutagenic effects. Genetic polymorphisms, i.e., individual differences in the enzymes responsible for ethanol metabolism, account for variability in alcohol tolerance, elimination rates, and toxicity. Accordingly, the dose at which intoxication occurs can vary substantially among individuals. Central nervous system effects generally begin to appear at a blood alcohol concentration of around 0.3‰.

Regulation of Ethanol in Food

The European Food Safety Authority (EFSA) is responsible for the risk assessment of ethanol in food, while risk management falls to the European Commission and Member States. Although pure ethanol is discussed to be classified as a Group 1A carcinogen, this classification will

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not be applied to alcoholic beverages, as they are considered ready-to-eat foods and are thus exempt from chemical labeling requirements. EFSA acknowledges the risks posed by alcoholic beverages; however, current EU food law does not mandate warning labels for alcohol. At present, only the alcohol content must be declared if it exceeds 1.2% by volume. Health warnings — such as those regarding cancer risks — have not yet been politically implemented at the EU level, though national initiatives are possible. Ireland has taken a pioneering step by announcing in 2023 that health warnings will be mandatory on alcohol packaging starting in 2026. In Germany, there are currently no such initiatives, despite alcohol consumption per capita remaining significantly above the OECD average, as reported by the Federal Centre for Health Education (BZgA), which is reflected in higher rates of alcohol-related illness and mortality.

Harmonized Classification

In the European Union, all chemical substances with proven hazardous properties must be appropriately classified and labeled to ensure safe handling. Under the CLP Regulation, manufacturers and importers are responsible for assessing and classifying their substances and submitting the data to the European Chemicals Agency (ECHA). For particularly hazardous substances — such as those that are carcinogenic, mutagenic, toxic to reproduction, or respiratory sensitizers — a so-called harmonized classification applies. This ensures that a uniform and legally binding hazard labeling is used throughout the EU. Proposals for harmonized classification can be submitted by regulatory authorities or industry and are reviewed before being adopted into Annex VI of the CLP Regulation. The overarching goal is to ensure consistent protection of human health and the environment across Europe.

processes. Within the biocidal product framework under the Biocidal Products Regulation (BPR), Greece, as the competent evaluating Member State, has proposed classifying ethanol as a substance toxic to reproduction (category 2). Such a classification indicates a suspected risk of adverse effects on reproduction. Furthermore, ethanol has been identified as a potential candidate for substitution under the Biocidal Products Regulation. This means that, for certain product types, authorities are currently evaluating whether safer alternatives exist. A public consultation on the assessment of potential alternatives closed on 28 April 2025. If the evaluation concludes positively, manufacturers would be required to demonstrate the unavailability of suitable alternatives in order to maintain market authorization.

Additionally, the possible classification of ethanol as a CMR substance (carcinogenic, mutagenic, toxic to reproduction) under the CLP Regulation (Classification, Labelling and Packaging) is under discussion. A harmonized classification of ethanol as a CMR substance would have significant implications. Products such as ethanol-based disinfectants, cleaning agents, and technical solvents could no longer be marketed to consumers. Even tightly controlled industrial uses would be subject to additional regulatory burdens. Notably, the toxicological data underpinning the reassessment of ethanol draw heavily from studies involving oral ingestion and recreational misuse. However, this exposure route is irrelevant for most industrial uses of ethanol, particularly as a biocide, where oral intake does not occur. Critics are therefore calling for a differentiated evaluation of ethanol as an industrial substance, with greater emphasis on realistic exposure scenarios, such as dermal contact, which pose significantly lower toxicological risks.

The toxic potential of ethanol, particularly under conditions of chronic misuse, is undisputed. However, if ethanol is included in Annex VI of the CLP Regulation as a CMR substance, it could trigger restrictions across a wide range of applications, including disinfectants and cleaners. Meanwhile, ethanol would remain untouched in food law, allowing continued unrestricted availability in the form of alcoholic beverages and foods, despite significantly higher health risks associated with consumption. This regulatory inconsistency is difficult to justify and may lead to confusion among consumers.

By Ute Haßmann

Literature and links:

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- Foto von Stefan Lehner auf Unsplash