Did you know the worst liver destroyer and killer is a chemical byproduct compound called Acetaldehyde? It is naturally formed in the body during the metabolism of alcoholic beverages. 2 shots of hard liquor (spirits) are enough to damage your liver when excessively consumed on a daily basis!

https://youtube.com/shorts/dUZGvF4dvb8?si=XKyNERgJVqg1dPYJ

What is Acetaldehyde?

Acetaldehyde (CH_3CHO) is a colorless, flammable liquid with a pungent, fruity odor, produced both naturally in the body from alcohol metabolism and industrially as a chemical intermediate. Known to be a probable human carcinogen, it is a reactive compound found in cigarette smoke, foods, and various consumer products, and exposure can cause irritation, burns, and respiratory problems. [1, 2, 3, 4]

Properties and Occurrence

• Appearance: Acetaldehyde is a colorless liquid that can become a gas above 69°F (20°C). [2]
• Odor: It has a pungent, fruity odor. [2]
• Natural Occurrence: It is formed in the body during the metabolism of alcohol and is also found in small amounts in foods like yogurt, green tea, and certain fruits. [1, 3]
• Industrial Production: It is primarily used as an intermediate in the synthesis of other chemicals, such as acetic acid. [1, 5]

Uses and Sources

• Industrial Intermediate: It is a crucial chemical building block for the production of various other chemicals. [1, 5]
• Found in Products: Acetaldehyde can be found in building materials, adhesives, coatings, and other common consumer products. [6]
• Cigarette Smoke: It is a significant component of cigarette smoke. [4]
• Natural Breakdown: It can also be an emission from cooking certain foods. [6]

Health and Safety

• Irritant: Acetaldehyde is an irritant that can cause eye, skin, and respiratory tract irritation, leading to conjunctivitis and burns. [1, 2]
• Carcinogen: It is classified as a probable human carcinogen, with animal studies showing nasal and laryngeal tumors. [1, 4]
• Flammable: It is a highly flammable liquid and can easily polymerize or form explosive peroxides when in contact with air. [2, 7]
• Toxicity: Acute exposure can lead to central nervous system depression, while chronic exposure can mimic symptoms of alcoholism. [1]

Resources:
[1] https://www.epa.gov/sites/default/files/2016-09/documents/acetaldehyde.pdf
[2] https://www.cdc.gov/niosh/npg/npgd0001.html
[3] https://zbiotics.com/blogs/journal/what-is-acetaldehyde-and-its-link-to-alcohol
[4] https://www.rivm.nl/en/tobacco/harmful-substances-in-tobacco-smoke/acetaldehyde
[5] https://www.youtube.com/watch?v=ggx7af2etSw
[6] https://www.dcceew.gov.au/environment/protection/npi/substances/fact-sheets/acetaldehyde
[7] https://www.youtube.com/watch?v=kSbfFcV9xkY

How do I get rid of acetaldehyde in my body? AI Overview

To reduce acetaldehyde in the body, the most effective approach is to support your liver's natural detoxification process by staying hydrated, consuming foods rich in L-cysteine like eggs, and taking supplements such as N-acetylcysteine (NAC), glutathione, and Quercetin that help break down the toxic by-product.
Probiotics can also help, as can certain teas like black and green tea.

Support Your Liver's Natural Process.
Hydration: Drink plenty of water to help your body flush out toxins, including acetaldehyde.
Diet: L-cysteine: Eggs, poultry, beef, and whole grains are good sources of L-cysteine, an amino acid that helps break down acetaldehyde.
Probiotic Foods: Consume probiotic-rich foods to support the gut's ability to process acetaldehyde.

Supplements:
N-Acetylcysteine (NAC): A powerful supplement to help break down acetaldehyde.

Glutathione: Found to significantly reduce acetaldehyde levels and help with hangover symptoms.
Quercetin: A supplement that supports the enzymes that break down acetaldehyde.
DHMs: Dihydromyricin (DHM) can speed up the body's processing of acetaldehyde, removing it faster.

Other Supportive Measures:
Herbal Teas: Both black tea and green tea have shown benefits in reducing acetaldehyde levels, with black tea stimulating the enzyme that breaks down acetaldehyde.
Eat a Balanced Meal: Eating before and during alcohol consumption can slow alcohol absorption, giving your body more time to process it.
Physical Activity: Incorporating physical activity can help optimize your body's processes.
Get Enough Sleep: Adequate sleep is essential for supporting your body's overall detoxification and recovery.

Acetaldehyde is contained in beverages such as tea and soft drinks (0.2-0.6 ppm), beer (0.6-24 ppm), wine (0.7-290 ppm) and spirits (0.5-104 ppm) [2].

Spirits, particularly fortified wines and certain liqueurs like grappa and Calvados, tend to have the highest acetaldehyde content among alcoholic beverages. The amount of acetaldehyde varies significantly depending on the type of beverage, with spirits generally containing more than wine, and wine generally containing more than beer. [1, 2, 3, 4]

Beverage Types and Acetaldehyde Content:

• Fortified Wines and Spirits: These beverages often show the highest acetaldehyde concentrations. Grappa, a type of brandy, was found to have extremely high levels in one study. [1, 3]
• Liquors and Spirits: Fruit-based liqueurs and Spirits also showed high levels of acetaldehyde in one study. [3]
• Wine: Red wine and other wines contain higher concentrations of acetaldehyde than beer. [1, 2]
• Beer: Beer generally contains the least amount of acetaldehyde among the three categories of alcoholic beverages. [1, 4]
• Vodka and Gin: These spirits typically contain the lowest acetaldehyde concentrations among different types of alcoholic drinks. [3, 4]

Factors Influencing Acetaldehyde Levels
[5, 6, 7]

• Congeners: Acetaldehyde is a type of congener, which are substances produced during the fermentation process that contribute to the

taste and aroma of alcoholic beverages.
• Beverage Type and Processing: The specific fermentation processes, distillation methods, and aging processes all influence the amount of congeners, including acetaldehyde, in a given beverage.

Importance of Acetaldehyde

• Carcinogen: Acetaldehyde is a naturally occurring compound considered a carcinogen. [3]
• Hangovers: Elevated levels of acetaldehyde in beer, for instance, have been linked to increased hangover severity. [8]
• Oral Cavity Exposure: The acetaldehyde from drinks can also be a source of exposure in the oral cavity, potentially leading to DNA damage. [9]

AI responses may include mistakes.

[1] https://www.sciencedirect.com/science/article/abs/pii/S0278691508002834
[2] https://pubmed.ncbi.nlm.nih.gov/18616675/
[3] https://www.sciencedirect.com/science/article/abs/pii/S0308814613019791
[4] https://pmc.ncbi.nlm.nih.gov/articles/PMC5789370/
[5] https://en.wikipedia.org/wiki/Congener_(beverages)
[6] https://www.foodnetwork.com/healthyeats/healthy-tips/how-color-alcohol-affects-hangovers-congeners
[7] https://felenevodka.com/the-truth-about-hangovers-can-certain-spirits-really-prevent-them/
[8] https://brewingscience.com/acetaldehyde-in-beer-understanding-its-role-and-how-to-minimize-it/
[9] https://www.researchgate.net/figure/Acetaldehyde-levels-measured-in-alcoholic-beverages_tbl1_322510905

Acetaldehyde levels measured in alcoholic beverages.

Type of Alcoholic Beverage	Subcategory (If Present)	Acetaldehyde (μM) [1]	*n* [2]	Ref.
Apple wine/cider		1123 ± 932	11	[100]
		2529	1	[23]
Beer		140	1	[22]
		120	1	[23]
		205 ± 150	364	[100]
		233 ± 281	6	[101]
		172 ± 67	3	[102]
		192	12	[40] [8]
Fortified wines		586	7	[40] [8]
		2686 ± 2728	133	[100]
		2231 ± 2450	53	[100]
	Cherry spirit	8522	1	[23]
	Port	1909 ± 3306	27	[100]
	Sherry	2583	1	[23]
		3537 ± 2482	53	[100]
Liquors and spirits	Raki	1014 ± 1570	12	[101]
		1541 ± 2344	834	[100]
		972	61	[40] [8]
	Bacanora [3]	7711 ± 5061	13	[100]

Type of Alcoholic Beverage	Subcategory (If Present)	Acetaldehyde (μM) [1]	*n* [2]	Ref.
	Brandy/Cognac	1704 ± 1096	82	[100]
	Cachaça [4]	1149 ± 491	21	[100]
	Calvados	1781 ± 861	25	[101]
		600	1	[22]
		753 ± 342	2	[23]
		870 ± 334	27	[100]
	Chinese spirits	7419 ± 3955	30	[100]
	Fruit-based	1953 ± 2704	315	[100]
		1414	17	[40] [8]
	Gin	21	3	[40] [8]
	Grape mark spirit	12,903 ± 2697	4	[23]
	Grappa [5]	11,327	13	[40] [8]
	Herb and spice-based	638	11	[40] [8]
	Mezcal	2103 ± 2024	10	[100]
	Rum	3110	3	[40] [8]
		403 ± 321	38	[100]
	Sake	717 ± 359	5	[102]
	Shochu [6]	600	1	[22]
	Sotol [7]	1876 ± 1346	16	[100]
	Tequila	530	1	[23]
		1371 ± 1960	70	[100]

Type of Alcoholic Beverage	Subcategory (If Present)	Acetaldehyde (μM) [1]	*n* [2]	Ref.
	Vodka	48	3	[40] [8]
		61 ± 70	72	[100]
	Whiskey	1746	3	[40] [8]
	Bourbon	1410 ± 715	3	[102]
		627 ± 448	37	[100]
Wine		275 ± 236	6	[101]
		474	1	[23]
		773 ± 760	213	[100]
		1140 ± 308	3	[102]
		1544	60	[40] [8]
	Red wine	1267	21	[40] [8]
		250	1	[22]
	Rose wine	1855	3	[40] [8]
	Sparkling wine	2792	15	[40] [8]
	White wine	1521	21	[40] [8]
Pure alcohol		56	1	[40] [8]

[1] Amounts (ppm, mg/L, etc.) were converted to concentrations and reported in μM. They correspond to the average and standard deviation resulting from measurement of replicate samples; μM is the symbol for micromolar, a unit of concentration in chemistry and biology. It represents a concentration of one-millionth of a mole of a substance per liter of solution. The breakdown of μM μ (micro-): The Greek letter mu (μ) is the official SI prefix for micro, which means one-millionth (\(10^{-6}\)).M (-molar): The letter M stands for molar, which is a unit of molar concentration,

specifically moles per liter (mol/L). Therefore, 1 µM = \(1\times 10^{-6}\) mol/L. Example of micromolar concentration If a solution has a concentration of 50 µM, it contains 50 micromoles of the solute for every one liter of the solvent. This is a common unit for measuring the concentrations of substances in low quantities, such as in laboratory experiments with proteins, enzymes, or pharmaceutical drugs.
[2] *n* corresponds to the number of samples used to derive average and standard deviation values;
[3] Bacanora is an agave-derived liquor made in the Mexican state of Sonora.
[4] Grappa is a grape-based alcoholic beverage of Italian origin that contains 35% to 60% alcohol by volume;
[5] Cachaça is a distilled spirit made from fermented sugarcane juice;
[6] Shochu is a Japanese distilled beverage with less than 45% alcohol by volume typically distilled from rice, barley, sweet potatoes, buckwheat, or brown sugar;
[7] Sotol is a distilled spirit made from the *Dasylirion wheeleri, Asparagaceae*, a plant that grows in Northern Mexico, New Mexico, west Texas, and the Texas Hill Country;
[8] Values reported from reference [40] correspond to the medians calculated from replicate samples.

Acetaldehyde content in Turkish Rakı

Scientific studies show the acetaldehyde content in Turkish rakı varies significantly, typically ranging from 12 to 116.11 milligrams per 100 milliliters of pure alcohol (mg% mL p.a.). This wide range is common due to differences in production methods and ingredients. [1, 2, 3, 4]

Factors influencing acetaldehyde levels in rakı • Production process: As a fermented and distilled beverage, rakı naturally contains acetaldehyde, which is a byproduct of yeast fermentation. The distillation process can impact the final concentration.

• Raw materials: Whether the rakı is made from grape suma (distillate) or a blend of suma and agricultural ethyl alcohol can affect its chemical profile. One study found that acetaldehyde levels were a key "chemical fingerprint" for distinguishing between rakı made from grape versus raisin suma.
• Distillation control: The amount of acetaldehyde remaining in the final product can depend on how carefully the distiller removes the initial, low-boiling-point fraction during distillation.
• European limits: Despite the variation, all legally produced Turkish rakı must adhere to European regulations, which set the

maximum acetaldehyde concentration for certain spirits. [2, 3, 5, 6, 7]

Acetaldehyde in other spirits:
To put rakı's acetaldehyde content in perspective, a study on volatile organic compounds in alcoholic beverages reported the following ranges:

- Beer: 0–63 mg/L
- Wine: 0–211 mg/L
- Spirits: 0–1159 mg/L
- Fortified wines: 12–800 mg/L [8, 9]

[1] https://www.researchgate.net/publication/235732757_Determination_of_the_Principal_Volatile_Compounds_of_Turkish_Raki
[2] https://onlinelibrary.wiley.com/doi/pdf/10.1002/j.2050-0416.2007.tb00290.x
[3] https://onlinelibrary.wiley.com/doi/abs/10.1002/j.2050-0416.2011.tb00449.x
[4] https://www.researchgate.net/figure/Derekot-processing-flow-chart-by-limit-methods_fig7_365996223
[5] https://onlinelibrary.wiley.com/doi/full/10.1002/jib.75
[6] https://en.wikipedia.org/wiki/Rak%C4%B1
[7] https://www.researchgate.net/publication/264225033_Chemical_fingerprints_of_Raki_A_traditional_distilled_alcoholic_beverage
[8] https://applbiolchem.springeropen.com/articles/10.1007/s13765-015-0059-1
[9] https://applbiolchem.springeropen.com/articles/10.1007/s13765-015-0059-1

Turkish Raki is the traditional anise flavored distillate beverage produced mainly from a grape distillate called suma.
Two types of Raki are produced in Turkey according to the distillate source.
They are Type I — a fresh grape Raki produced only from suma
and Type II — a Raki produced from a blended distillate of suma and alcohol of agricultural origin (mainly molasses).

In this study the content of ethanol, methanol, distillate based major volatile compounds (aldehydes, esters, higher alcohols), aniseed based anethole and estragole, volatile acid and sugar values in two types of commercial Raki samples (40 samples) was determined and the effect of distillate source on the composition was examined.
The distillate and the aniseed based major compounds of the Raki samples were analyzed by direct injection with a GC-MS-FID according to the European Commission Reference Method.
The results of variance analysis and PCA showed that there was a significant difference between the two types of Raki samples. Total volatiles (esters and higher alcohols), methanol, trans-anethole, estragole and sugar values were higher in the samples made from suma alone.

All of the analysed component levels of the Turkish Raki samples were in compliance with Turkish Distilled Beverage Regulations. The methanol levels ranged between 28.00–50.87 g/hL absolute alcohol (AA) in Type I samples and 22.03–41.06 g/hL AA in Type II samples.

Distillate based total volatiles levels ranged between 136.12–147.88 g/hL AA, with a mean value of 142.88 g/hL AA, in Type I samples and 102.44–113.45 g/hL, with a mean value of 107.9 g/hL, in the Type II samples.

The anise based compound trans-anethole levels were significantly higher in the Type I samples (1,298–1,570 mg/L) than in the Type II samples (1,014–1,199 mg/L).

According to distillate based volatiles, the Turkish Raki has a valuable content of volatile substances compared to other anise flavored spirits.

How much acetaldehyde in Turkish raki drink?

According to a 2021 study, the acetaldehyde content in Turkish rakı typically ranges between 1.41 and 9.21 grams per hectolitre of pure alcohol (g/hL PA). This is equivalent to 14.1 to 92.1 milligrams per liter of pure alcohol (mg/L PA).

Acetaldehyde is one of the primary aldehydes created during the fermentation process and is a key volatile compound found in distilled beverages like rakı. Its concentration is an important quality parameter.

Factors influencing acetaldehyde levels

The level of acetaldehyde can vary depending on several factors related to production:
Production process: As a byproduct of yeast fermentation, acetaldehyde is an intermediate in the formation of other compounds. The conditions of fermentation and distillation have an impact on its final concentration.
Raw materials: The type of grapes (or other raw materials) and the quantity of aniseed used can affect the final composition of volatile compounds.
Distillation practice: The number of distillations can also influence the concentration of acetaldehyde.
A 2007 study analyzed various Turkish rakı samples and found a wider range, from 12 to 116.11 mg % mL, and noted that levels varied significantly between different samples while remaining within European regulations.

How does acetaldehyde affect raki's flavor?
In Turkish rakı, the level of acetaldehyde is a crucial factor in its flavor profile, though its effect depends heavily on its concentration relative to other volatile compounds. While low amounts can contribute subtle, desirable characteristics, higher concentrations are generally considered an undesirable "off-flavor".

Effects of acetaldehyde on flavor
Low concentrations: At lower levels, acetaldehyde may enhance fruity or fresh notes in raki. Some sources describe lower concentrations as contributing a fresh green apple aroma.
High concentrations: When acetaldehyde levels increase, the flavor profile changes and is generally viewed as less pleasant. Sensory descriptors often include:
Bruised or overripe apples: This is a common description of the flavor profile at higher concentrations.
Sharp or green apple-like notes: It can add a tart, sharp flavor similar to an unripe apple.
Astringency: Higher levels can contribute a slightly astringent sensation to the drink.
Pungent notes: In excessive amounts, it can develop unpleasant, chemical, or "solvent-like" qualities.

How raki's production affects acetaldehyde
The flavor contribution of acetaldehyde in rakı is influenced by several factors during production:
Distillation: The distillation process is key to controlling the final amount of acetaldehyde.
The specific method and number of distillations (some producers perform multiple distillations) can remove more of this compound to create a smoother, cleaner spirit.
Maturation: During maturation, yeast can reabsorb acetaldehyde and convert it into ethanol.

Incomplete or rushed maturation can leave higher residual levels in the final product.
Source of distillate: Raki is made from a variety of raw materials, such as grapes, figs, and plums, with the most common being grapes and raisins.
The raw material and the "suma" (the base grape spirit) can influence the resulting flavor profile and the level of volatile compounds.
Overall, while acetaldehyde is a natural byproduct of fermentation in raki, its concentration must be carefully managed by distillers to avoid off-flavors and achieve a desired, balanced flavor profile.