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Titel	Why Pure Menthol Crystals Should Not Be Used in the Sauna
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Short answer: Pure menthol crystals are a poor choice for routine public sauna use because they combine high pharmacological potency with an unusually difficult exposure situation. Menthol does not cool the body: it activates cold-sensitive TRPM8 channels and creates a powerful sensation of cooling while the actual thermal load from hot air, radiation, humidity and time remains unchanged. Pure L-menthol melts at about 41–44 °C, is only slightly soluble in water, becomes increasingly volatile as temperature rises, and has a closed-cup flash point of about 94 °C. Direct application to very hot sauna stones or heating elements therefore combines uncontrolled vaporisation with a combustible organic substance near surfaces far above its flash point. At the same time, there is no scientifically established universal sauna-specific safe dose of pure menthol crystals in g/m³ or 'crystals per Aufguss'. Irritation of eyes, skin and mucous membranes, respiratory reactions and documented contact allergy add further uncertainty. For health-oriented public sauna operation, the scientifically defensible approach is therefore not to apply pure menthol crystals directly to the sauna heater.

Menthol crystals have become a spectacular element in some sauna rituals. A few crystals are placed on ice, dissolved in a carrier, or put directly onto hot stones. Within seconds, the cabin can be filled with an intense sensation of cold and 'free breathing'. Precisely because the effect is so dramatic, pure menthol deserves a more critical assessment than an ordinary fragrance.

The central problem is not that menthol is inherently a highly toxic substance. Menthol is widely used in foods, cosmetics and medicines. The problem is the combination of near-pure substance, inhalation exposure, a hot enclosed room, highly heated surfaces, variable dosing, and a sensory effect that can contradict the body's real thermal state.

A professional risk assessment must therefore separate five questions: What is menthol physically? What happens when crystals are heated? What does menthol do pharmacologically? Can the inhaled dose be controlled? And what additional risks arise from irritation, allergy and combustibility?

1. What are menthol crystals?

Menthol is a cyclic monoterpene alcohol with the molecular formula $C_{10}H_{20}O$ and a molar mass of about 156.27 g/mol. Several stereoisomers exist; naturally occurring peppermint oils contain predominantly L-menthol, the isomer associated with the characteristic mint odour and strong cooling sensation.

At ordinary room temperature, L-menthol is a colourless-to-white crystalline solid. Authoritative product data give a melting range of approximately 41–44 °C and a boiling point around 212–216 °C at atmospheric pressure. Its water solubility is low—roughly a few tenths of a gram per litre—while it dissolves readily in alcohol and oils. [1–3]

These simple properties already explain why a menthol crystal behaves very differently from a conventional water-based Aufguss preparation.

2. Melting is not vaporisation

A frequent error in sauna descriptions is to call 42–45 °C the 'vaporisation temperature' of menthol. That is incorrect. Around 41–44 °C, L-menthol melts: the crystal changes from solid to liquid. Its normal boiling point is above 200 °C. [1–3]

This distinction matters. A substance does not need to boil in order to evaporate. Menthol has a measurable vapour pressure below its boiling point, and evaporation becomes faster as temperature increases. BASF reports a vapour pressure of about 0.085 hPa at 25 °C and 0.804 hPa at 50 °C for L-menthol. [2]

In a sauna, a crystal therefore first softens and melts as it is warmed. On a very hot surface, heat transfer then becomes intense and evaporation can accelerate rapidly. The relevant process is not a magical 'vaporisation point' at 42 °C, but temperature-dependent melting, evaporation and—at sufficiently high local temperatures—possible thermal decomposition or ignition.

3. Why direct application to sauna stones is difficult to control

Sauna stones are not maintained at one uniform, precisely known temperature. Their surface temperature varies with heater design, stone position, previous water applications, airflow and operating state. Heating elements can be substantially hotter than surrounding stones.

A pure menthol crystal placed on such a surface receives heat locally. Its mass, shape and contact area vary. It melts, spreads, evaporates and may move into hotter zones. Consequently, two visually similar 'crystals' need not produce the same airborne concentration.

The guest dose is even less predictable. Airborne exposure depends on cabin volume, ventilation, distance from the source, vertical position, air movement, fanning, number of guests, duration, prior dosing and the rate at which menthol is released.

Counting crystals is therefore not a scientifically meaningful dosing method.

4. Why water does not solve the dosing problem

Menthol is only slightly soluble in water. Pure crystals placed in an Aufguss bucket do not automatically create a stable, homogeneous aqueous solution. Undissolved material, droplets of molten menthol or material adhering to the vessel can produce non-uniform delivery.

Dissolving menthol in ethanol is not an appropriate improvisation for public sauna use. It introduces a second readily flammable substance into a process already involving highly heated surfaces. A formulated commercial sauna product is fundamentally different: its composition, concentration, solvent system and instructions are defined by the manufacturer.

Pure menthol crystals should therefore not be treated as if they were simply a stronger version of a normal Aufguss fragrance.

5. Menthol does not cool the body

The characteristic effect of menthol is pharmacological, not thermodynamic. Menthol activates cold-sensitive sensory pathways, particularly the transient receptor potential melastatin 8 channel, TRPM8. TRPM8 is a calcium-permeable ion channel expressed in sensory neurons and is activated both by physical cooling and by chemical agonists such as menthol. [4–7]

The nervous system consequently receives a signal normally associated with cooling even though menthol itself has not removed a physiologically relevant amount of heat from the body.

This distinction is crucial in a sauna. Air temperature, thermal radiation, water-vapour pressure, air movement and exposure time continue to determine heat transfer. Menthol can change how the environment feels without proportionally changing the heat entering or leaving the body.

A useful formulation

Menthol changes thermal perception more than thermal balance.

A guest can therefore experience intense subjective coolness while skin and core temperature remain elevated and the cardiovascular and sweating responses to heat continue.

6. TRPM8: why a chemical can feel cold

TRPM8 is one of the principal molecular sensors involved in innocuous cool perception. Cooling shifts the probability that the channel opens; menthol can activate the same signalling pathway chemically. Opening of the channel permits cation influx, including calcium, and increases activity in cold-sensitive afferent neurons. [4–7]

This is why menthol can make room-temperature air feel unusually cool and why inhalation can create a sensation of freshness in the nose and upper airways.

At higher exposures, however, menthol is not simply 'more cooling'. Experimental literature describes burning, irritation, pain, cold allodynia and cold hyperalgesia at sufficiently high concentrations. Menthol can also interact with other sensory channels, including TRPA1, which contributes to irritant and nociceptive signalling. [5,8]

7. The paradox of menthol in a hot sauna

The sauna already places the thermoregulatory system under substantial load. Skin temperature rises, cutaneous blood flow increases, heart rate rises and sweating attempts to dissipate heat. During Aufguss, higher water-vapour pressure can reduce evaporative cooling and increase the net thermal burden.

Menthol superimposes a strong cold signal on this hot environment. That does not prove that every menthol exposure will cause overheating. But it removes the simple assumption that subjective thermal sensation reliably reflects the actual environmental heat load.

For health-oriented sauna practice, this is an unnecessary source of ambiguity. A sensory additive should not be used to encourage guests to tolerate a heat exposure that they would otherwise find excessive.

8. 'Free breathing' is mainly a sensory effect

Menthol is often promoted as 'opening the airways'. The sensation can be convincing, but perception and airway calibre are not the same thing.

In a randomised controlled crossover study in healthy adults, 90% of participants reported that breathing felt easier during menthol exposure, yet measured upper-airway resistance did not significantly change. The study therefore provides an elegant demonstration of the difference between sensory relief and mechanical airway dilation. [9]

Claims that a menthol Aufguss 'opens the bronchi', 'increases oxygen uptake' or objectively clears the airways are therefore not justified simply from the cooling sensation.

9. Irritation is dose-dependent

Safety data for L-menthol classify the substance as a skin irritant and eye irritant (H315 and H319 in common European product classifications). Safety documentation also advises avoiding skin and eye contact. [1–3]

In inhalation exposure, the relevant surfaces are not only the skin but the conjunctivae and the mucous membranes of the nose, mouth, pharynx and respiratory tract. A sauna adds heat, humidity and often vigorous air movement, while fanning can transport the vapour rapidly toward guests' faces.

A transition from pleasant freshness to eye burning, throat irritation, coughing, painful cold sensation or respiratory discomfort is therefore pharmacologically plausible and exposure-dependent. Such symptoms are warning signs, not evidence that an Aufguss is 'working'.

10. Asthma and bronchial hyperreactivity require particular caution

Menthol is not uniformly bronchoconstrictive, and it would be incorrect to label every low exposure as dangerous to every person with asthma. Nevertheless, inhaled sensory-active substances can provoke symptoms in susceptible individuals, and a published case report documents menthol-induced asthma. [10]

The practical problem in a public sauna is that the operator normally does not know the airway reactivity of every guest. People with asthma, bronchial hyperreactivity, chronic irritant cough, acute respiratory infection, sensitive mucous membranes or a previous adverse reaction to menthol represent groups for whom an intense, unnecessary inhalation exposure is difficult to justify.

The appropriate professional response to coughing, wheezing, chest tightness or marked mucosal irritation is to end or reduce exposure and allow the guest to leave—not to interpret the reaction as airway 'cleansing'.

11. Allergy is possible—but should not be exaggerated

Menthol can cause allergic contact reactions, although allergy appears uncommon relative to the enormous worldwide use of menthol-containing products. Case reports describe allergic contact dermatitis, cheilitis and oral contact sensitivity attributable to menthol. [11–14]

This distinction is important: irritation and allergy are not the same. Irritation can occur in anyone when exposure is sufficiently intense. Allergic contact dermatitis requires prior sensitisation and an immunological response. A public sauna cannot determine in advance which guest is sensitised.

The existence of documented allergy therefore adds another reason for transparent guest information and avoidance of unnecessarily concentrated exposure, but it should not be presented as if menthol commonly causes severe allergy in the general population.

12. The fire question: what does a 94 °C flash point actually mean?

L-menthol is a combustible organic substance. Merck/Sigma lists it in storage class 11, 'combustible solids', and gives a closed-cup flash point of 94 °C. BASF likewise reports a 94 °C closed-cup flash point and an autoignition temperature of 271 °C for its L-menthol product. [1,2]

The flash point is frequently misunderstood. It does not mean that a menthol crystal automatically catches fire when the sauna air reaches 94 °C. Flash point is a standardised property describing the lowest temperature at which a liquid under defined test conditions produces enough vapour to form an ignitable mixture near its surface when an ignition source is applied.

It also does not mean that 94 °C is a safe-versus-unsafe dividing line for sauna use. The critical fact is that direct heater application places a combustible organic material onto or close to surfaces that can be far hotter than both its melting point and flash point, and in some heater zones may approach or exceed temperatures relevant to ignition.

13. Why the heater is different from the sauna air

A sauna cabin may operate with air near 80–100 °C, but the stones and electric heating elements are much hotter. This is necessary because they must store and transfer enough energy to heat the room and rapidly vaporise Aufguss water.

Water is deliberately applied to sauna stones because its behaviour and the heater's design are intended for that use. Pure menthol is an organic combustible substance. Applying it directly introduces a different material with different phase behaviour, vapour generation and combustion properties.

If menthol reaches a sufficiently hot element or if locally generated vapour encounters an ignition-capable surface, ignition cannot be excluded from the physical data. The responsible conclusion is not that every crystal will ignite, but that there is no reason to introduce this avoidable fuel source into the hottest part of the sauna system.

14. Flash point, autoignition and open flame are three different concepts

- Melting point (~41–44 °C): the solid crystal becomes liquid.
- Flash point (~94 °C, closed cup): under a defined test method, enough vapour can be generated for momentary ignition in the presence of an ignition source.
- Autoignition temperature: the temperature at which ignition can occur without an external flame or spark under the specified test conditions; BASF reports 271 °C for its L-menthol product.
- Boiling point (~212 °C): the vapour pressure equals atmospheric pressure; evaporation occurs well below this temperature.

Keeping these concepts separate prevents two opposite errors: claiming that menthol 'vaporises at 42 °C', and claiming that it cannot present a fire hazard because its boiling point is above 200 °C.

15. Why there is no defensible universal 'safe crystal dose'

For a substance used by inhalation in a public sauna, a meaningful dose would have to relate the amount released to the concentration in air and the guests' inhaled exposure over time.

A rule such as 'one crystal per 10 m³' or 'two crystals per Aufguss' ignores crystal mass, release rate, ventilation, air mixing, cabin geometry, fanning, temperature and exposure duration. Even a mass-based rule in g/m³ would require sauna-specific toxicological and exposure data establishing a concentration-response relationship under realistic thermal conditions.

At present, there is no sufficiently established universal sauna-specific exposure limit that allows the International Sauna Academy to define a general safe dose of pure menthol crystals in crystals per cabin, grams per Aufguss or g/m³.

This is not a claim that every conceivable lower dose is toxic. It is a statement about evidence and standardisation: a reproducible public-use safety dose has not been established.

16. Why 'we have always used two crystals' is not a dose assessment

A crystal is not a unit of mass. Commercial crystals vary in size and shape. The fraction released into the air also varies. Human perception is a poor dosimeter because TRPM8 activation is extremely noticeable at concentrations far below those that would make visual estimation meaningful.

Experience without documented exposure does not convert an uncontrolled method into a standardised one. A professional dosing system should be reproducible, measurable and tied to a product specification.

17. Pure crystals are different from a formulated menthol-containing sauna product

The recommendation against pure menthol crystals should not be confused with the statement that any trace of menthol in every fragrance product is unacceptable.

A formulated sauna infusion agent can contain a defined concentration of menthol within a tested solvent and fragrance system and can carry manufacturer instructions for dilution and use. Its risk assessment must be based on that product's composition and intended application.

Pure crystals, by contrast, are essentially concentrated raw material. Direct placement on stones bypasses dilution control and places the substance at the point of maximum thermal energy.

18. Why adding menthol to ice does not eliminate the problem

Ice can delay the moment at which menthol reaches a hotter surface, but it does not create a defined inhaled dose. As the ice melts, both water and menthol are transferred toward the stones. The subsequent release still depends on mass, geometry, stone temperature and airflow.

Ice therefore changes the time course of release; it does not by itself solve the toxicological, dosing or fire-safety questions.

19. Why the perceived benefit is not necessary for sauna physiology

Menthol is not required for thermoregulation, adaptation, cardiovascular response, sweating or the health-oriented warm–cold–recovery sequence. Its contribution is predominantly sensory.

This matters for risk-benefit assessment. When a substance is medically necessary, a certain risk may be justified by a demonstrated benefit. In a sauna ritual, pure menthol crystals provide an optional sensory effect. The threshold for accepting poorly controlled inhalation and fire risk should therefore be correspondingly low.

20. A risk-based professional position

The case against routine use of pure menthol crystals does not depend on one dramatic hazard. It arises from the combination of several smaller but mutually reinforcing problems:

- a pharmacologically powerful cold sensation that does not equal body cooling;
- possible distortion of perceived thermal stress;
- no demonstrated mechanical opening of the upper airways despite a sensation of easier breathing;
- dose-dependent irritation of sensory nerves, eyes and mucous membranes;
- documented, although uncommon, allergic reactions;

- particular uncertainty in guests with asthma or bronchial hyperreactivity;
- poor water solubility and non-uniform improvised formulations;
- no established universal sauna-specific safe dose for pure crystals;
- highly variable release from crystals placed on hot surfaces;
- a flash point around 94 °C and combustible-material classification;
- direct proximity to heater surfaces far hotter than the cabin air;
- no physiological necessity that would offset these uncertainties.

21. What the evidence does—and does not—justify

A robust safety article must avoid replacing one exaggeration with another.

The evidence does not justify saying that every menthol crystal placed in a sauna will ignite, that every guest with asthma will react, or that any trace of menthol is inherently dangerous.

It does justify saying that pure menthol crystals are combustible, melt around 41–44 °C, evaporate increasingly with heat, can irritate skin and eyes, have documented sensitisation cases, strongly alter cold perception through TRPM8, and lack a generally validated sauna-specific dosing standard. Direct heater application combines these properties in an exposure situation that is unnecessarily difficult to control.

That is sufficient for a precautionary professional decision.

Conclusion

Pure menthol crystals are impressive precisely because menthol is pharmacologically potent. The intense cooling sensation is real—but the cooling of the body is not. Menthol activates cold-sensitive sensory pathways while the sauna's actual heat load continues.

At the same time, the physical properties of the substance are poorly suited to improvised heater dosing. L-menthol melts near 41–44 °C, is poorly soluble in water, becomes more volatile as temperature rises, and has a flash point around 94 °C. A crystal placed on a hot sauna heater is therefore not a controlled fragrance dose but a concentrated combustible organic substance undergoing rapid, temperature-dependent release.

Add uncertain airborne dosing, mucosal and eye irritation, respiratory susceptibility and documented contact allergy, and the professional conclusion becomes straightforward:

For health-oriented routine public sauna operation, pure menthol crystals should not be applied directly to sauna stones or heating elements.

This is not a toxicological claim that every possible menthol exposure is unsafe. It is a quality and safety standard: where exposure cannot be reliably quantified, the sensory effect can mask thermal perception, and the substance is combustible near very hot surfaces, there is no compelling reason to use the pure crystalline material.

References

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Editorial note: This article distinguishes hazard properties from actual risk. Flash point is not an ignition temperature, melting point is not a vaporisation temperature, and the existence of case reports does not imply that allergy or asthma reactions are common. The recommendation against direct use of pure menthol crystals in routine public sauna operation is a precautionary professional standard based on the combined problems of sensory pharmacology, exposure control, irritation susceptibility and combustible-material handling near highly heated surfaces. It does not apply automatically to every formulated menthol-containing sauna product used according to a verified manufacturer specification.