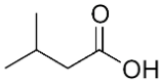
BEER OFF FLAVOR:
ISOVALERIC ACID



Isovaleric acid (IVA) is a volatile organic acid that can add complexity in select beer styles but is mostly known to impart unpleasant off-aromas when present above threshold. Commonly associated with sweaty sock or cheesy aromas, IVA is a marker of hop degradation, wild yeast activity, or poor ingredient handling.

HOW DOES ISOVALERIC ACID SMELL OR TASTE?

IVA is often described as having the aroma of cheese, sweaty socks, fish sauce, or body odor. In small amounts, particularly in sour and aged beer styles, these aromas may be desirable. However, in most modern beer styles, IVA is considered an off flavor.

HOW IS ISOVALERIC ACID MEASURED?

IVA can be measured with advanced lab equipment such as gas chromatography-mass spectrometry (GC-MS), high-performance liquid chromatography-ultraviolet (HPLC-UV), and liquid chromatography-mass spectrometry (LC-MS) or through a sensory panel that has been trained with isovaleric acid flavor spikes. These methods vary in cost and accessibility. Sensory detection remains a widely used approach in breweries without advanced lab equipment.

HOW IS ISOVALERIC ACID PRODUCED?

IVA can arise from three primary sources in the brewing process:

- **Hop Degradation:** Hops contain three primary alpha acids—humulone, cohumulone, and adhumulone—which differ based on their side-chain (R-group) structures. Humulone features an isovaleryl side chain. Oxidation that occurs through extended storage or exposure to oxygen, heat, or light can cleave this isovaleryl group, leading to the formation of cheesy aromas.
- **Mashing Conditions:** Some evidence suggests that infusion mashing may generate higher levels of IVA compared to decoction mashing.
- **Microbial Activity:** Wild yeasts, particularly Brettanomyces, can generate isovaleric acid during the metabolism of leucine, a branched-chain amino acid.

WHEN DOES ISOVALERIC ACID BECOME AN OFF FLAVOR?

Low levels of IVA are acceptable and even expected in certain styles like lambics and aged sour beers that incorporate aged hops. However, when present above threshold in most non-sour beer styles—particularly lagers and IPAs—IVA becomes an off flavor, often recognized by unpleasant sweaty or cheesy notes.

Reported sensory thresholds vary by source and beer matrix but typically fall between 0.1 mg/L and 2.0 mg/L (100 ppb–2 ppm).

HOW IS ISOVALERIC ACID CONTROLLED IN THE BREWERY?

Because IVA can originate from multiple sources, prevention requires careful control across raw materials, process hygiene, and storage protocols.

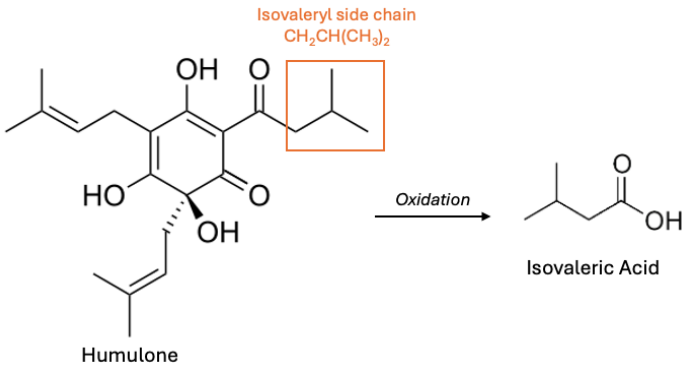


Figure 1. Simplified depiction of humulone side chain (isovaleryl) oxidizing to isovaleric acid due to improper hop storage.

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Do:

- ❑ **Store hops properly:**
  - *Short-term (<1 month): Ideal: ≤ 28°F (-2°C), Acceptable: 28°F (-2°C) to 39°F (4°C)*
  - *Long-term (>1 month): Ideal: ≤ 0°F (-18°C), Acceptable: 0°F (-18°C) to 25°F (-4°C)*
- ❑ **Purge air from hop packaging.** Best practice is to vacuum-seal or flush with nitrogen.
- ❑ **Use hops promptly—**employ FIFO (first in, first out) inventory management.
- ❑ **Evaluate hops via sensory assessment** before brew day.
- ❑ **Maintain strict CIP/SIP sanitation** on brewhouse, cellar, and barrel equipment to prevent wild yeast contamination.

Avoid:

- ❑ **Storing hops** at room temperature and/or exposed to light and air.
- ❑ **Leaving hop bags unsealed or open** in ambient conditions for extended periods of time.
- ❑ **Using hops with noticeable cheesy and oxidized aromas.**
- ❑ **Ignoring potential sources of Brettanomyces contamination,** especially in equipment shared between clean and mixed-fermentation products.

REFERENCES

1. Habschied, Kristina, Iztok Jože Košir, Vinko Krstanović, Goran Kumrić, and Krešimir Mastanjević. "Beer Polyphenols—Bitterness, Astringency, and Off-Flavors." *Beverages 7*, no. 2 (2021): 38. https://www.mdpi.com/2306-5710/7/2/38.
2. Ingram, Jack R. *Brewing Science: Principles, Processes, and Practices*. 2018.
3. Muñoz-Insa, Alicia, Mark Zunkel, Joshua McMillan, and Christina Schönberger. "Hops Don't Like to Get Old, Either." BarthHaas, May 15, 2024. https://www.barthhaas.com/ressources/blog/blog-article/hops-dont-like-to-get-old-either.
4. "Oxidation of 2-Methylbutyric Acid to Form Isovaleric Acid in Hops and Beer." J*ournal of the American Society of Brewing Chemists*, 2004.
5. "Characterization of the Flavor Profile of Isovaleric Acid in Beer." *Journal of the Institute of Brewing*, 1990.
6. "The Chemical Profiling of Fatty Acids During the Brewing Process." *Journal of the Science of Food and Agriculture*, 2018. https://scijournals.onlinelibrary.wiley.com/doi/abs/10.1002/jsfa.9369.