Researchers discover method to control carcinogenic formaldehyde release from wood in the home

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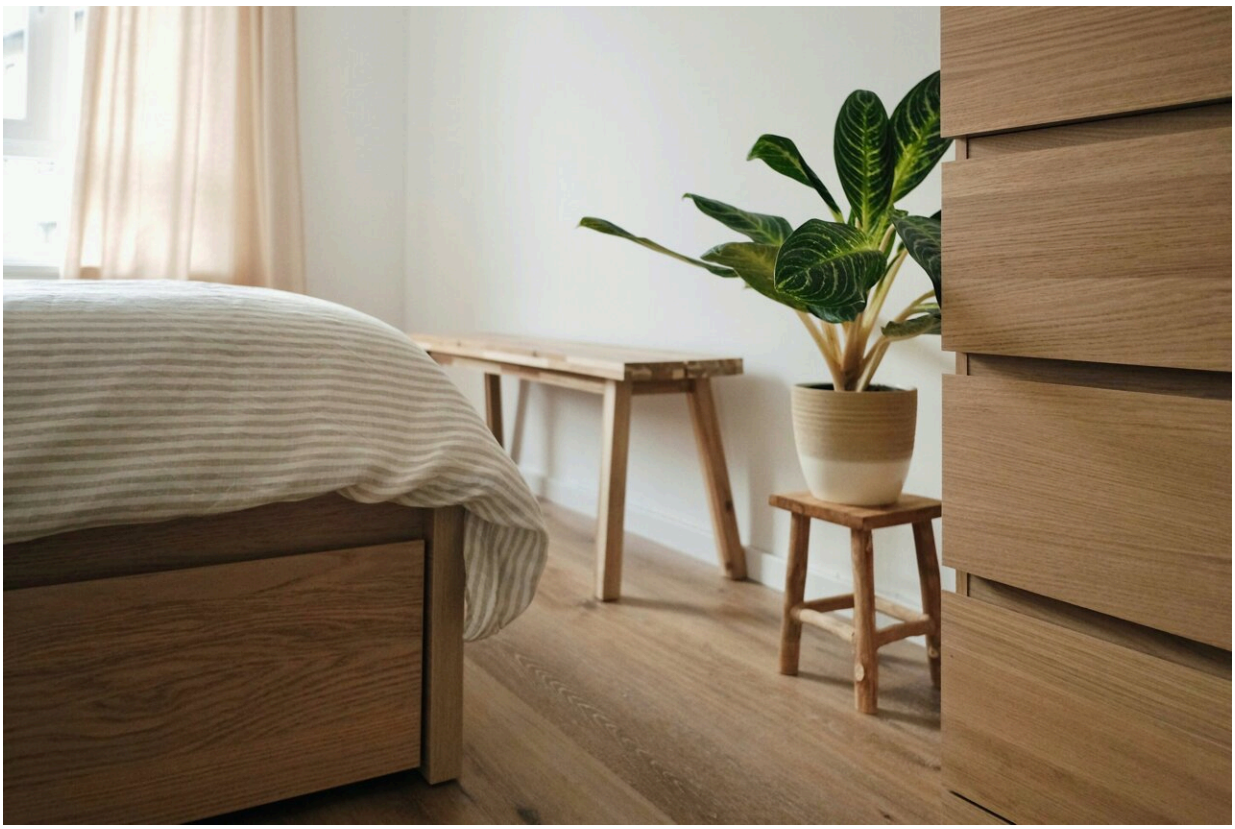

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New research, led jointly by the University of Massachusetts Amherst and the University of North Texas, advances our understanding of how

the wood in our homes and offices can release formaldehyde, a potent carcinogen, at levels that can exceed certain health limits. The findings, published recently in *Green Chemistry*, promise to advance public health. Their solution, for which the team has filed a patent, is an effective, low-cost way to mitigate the damage wrought by formaldehyde.

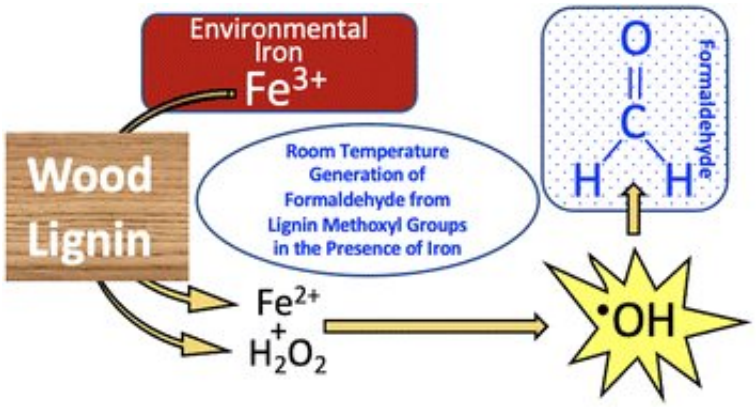
Formaldehyde is a colorless, odorless gas and a potent carcinogen. Even low exposure levels have been linked to some types of cancers and leukemia. It has long been known that certain manufactured household products, ranging from particleboard to curtains and carpets, can release formaldehyde into living spaces. Wood itself can also release formaldehyde, and high-temperature wood-processing is known to release large amounts of the chemical.

However, it turns out that wood—including the wooden furniture and woodwork in our houses—can release low levels of formaldehyde even at room temperature. "This low-level release had been understood for some time now, but no one really knew how that formaldehyde was being produced," says Barry Goodell, professor of microbiology at UMass Amherst and one of the paper's senior authors. Until now.

The key is a chemical phenomenon, which the authors have described as a "lignin-mediated Fenton reaction."

In the case of wood, it works like this: Wood's "woodiness"—its rigidity and stiffness—is due to a substance called lignin, which creates tough cell walls. Trees, because they grow in the soil, are constantly absorbing trace amounts of iron, one of the most abundant elements on earth, which lodge in the wood. Then, when the tree is felled and turned into lumber by tools containing iron, such as saws and planers, even more particles of iron are driven into the wood's surface. Lignin then modifies the iron, forming a kind of highly reactive iron. When this highly reactive iron meets the air, it forms corrosive oxygen radicals that then

combine with the lignin to form formaldehyde, which seeps out of the wood, into the air and into our lungs.



Credit: Yu Fu et al, *Green Chemistry* (2022). DOI: 10.1039/D2GC02632E

This finding represents a scientific breakthrough in our understanding of how formaldehyde is generated from wood and wood surfaces at room temperature.

But that's not all. "Once we understood how this lignin-mediated Fenton reaction worked, and how it was at play in the wood," says Goodell, "we had some guesses as to how we might keep the reaction from occurring." Antioxidants—often found in breakfast cereal to preserve freshness—might block the oxygen radicals from being produced, while simple "chelators" that tie up iron, and which are often found in foods as well, could prevent iron from reacting with its surroundings.

As it turns out, the team's experimental work verified their findings with these food-safe compounds, and these ingredients are the building block of a patent that Goodell and his University of North Texas colleague and co-author, Sheldon Shi, recently filed. By simply mixing these

antioxidants and chelators with wood, or, in some cases, spraying them on wood surfaces, the researchers have shown that the release of formaldehyde can be mitigated and brought down to safe levels. Formaldehyde mitigation may be possible for commercial wood-based products as well. "The invention is simple and low cost and could easily be incorporated into the existing wood processing lines so that high quality and environmentally friendly wood products are produced," said Shi. "The formaldehyde control methods we have developed should also be safe for application at home, too, so that homeowners can easily use the systems in the house for air quality improvement."

Goodell and Shi are looking for cooperators that are interested in reducing formaldehyde generation from wood and wood-based products, and in developing products that can be used in the home and workplace to mitigate formaldehyde release from products in those environments.

More information: Yu Fu et al, Formaldehyde emission from wood promoted by lignin in the presence of iron residues, *Green Chemistry* (2022). DOI: 10.1039/D2GC02632E

Provided by University of Massachusetts Amherst