Antibiotic resistant bacteria are a global threat—oak surfaces might thwart their growth

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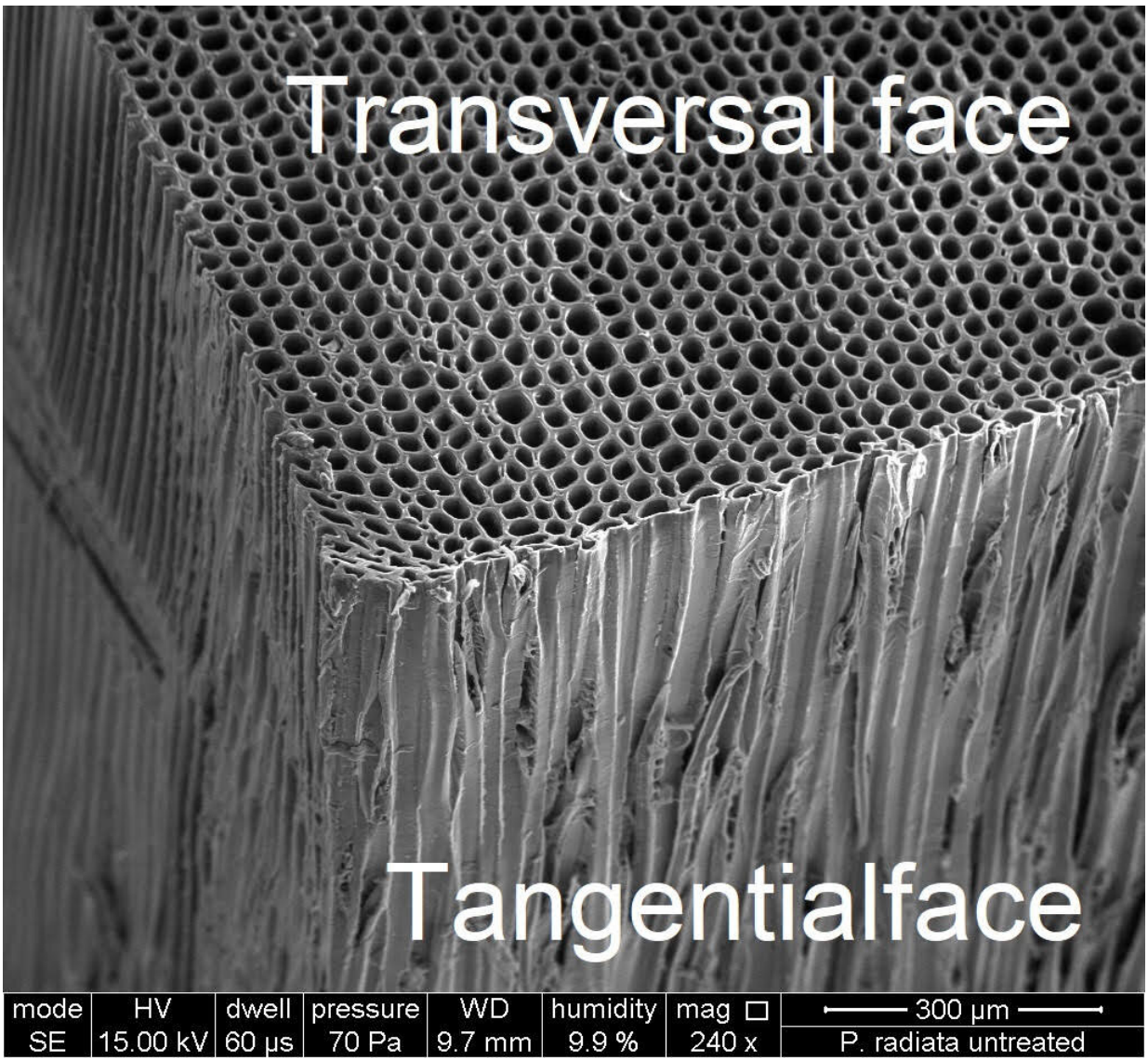

Magnified view showing the microscopic anatomy of oak. Most fibers in the living tree run longitudinally. Research at Ecole Supérieure du Bois found that oak samples cut in either the transversal or tangential direction thwarted the growth of four major bacterial species linked to hospital infections. Credit: Muhammad Tanveer Munir et al.

Drug resistant superbugs are expected to overwhelm the healthcare system, reverse a century's worth of medical progress and claim more lives than cancer by 2050 unless efforts are accelerated to stop antibiotic resistant bacteria in their tracks.

While most studies to address the problem are focusing on the development of new drugs, a series of elegant studies in France has taken an unusual angle—analyzing the types of surfaces that can harbor drug resistant bacteria in healthcare settings. Surfaces can serve as fomites, which refers to objects or materials likely to harbor infectious organisms, allowing them to promote the spread of pathogens when touched or used. Scientists have long known that environmental surfaces are a potential reservoir for healthcare-associated infections. So the hunt has been underway in France to find a material with potent antimicrobial activity.

In the journal *Antibiotics*, Muhammad Tanveer Munir and colleagues at Ecole Supérieur du Bois in Nantes, located in northwestern France near the Atlantic coast, worked with collaborators from elsewhere in the region to take a fresh approach to potential materials in the healthcare environment. They have discovered what may at first blush seem the most unlikely surface for healthcare settings—oak. Although his institution is aimed at studying wood, it is not designed to promote wood as a product for hospitals.

Wood is an old-school material and seems almost unthinkable for surfaces in a modern healthcare facility. It's porous, and has nooks and crannies where bacterial colonies hypothetically might flourish. Moreover, it just isn't as sleek as stainless steel. But scientific research is proving otherwise.

"That is exactly the first perception—the porosity and organic nature of wood would somehow help the bacteria survive," Munir told Medical Xpress.

Munir and his team compared oak to aluminum, polycarbonate and stainless steel surfaces and found that when four of the most notorious causes of drug-resistant bacterial infections were placed on these surfaces, oak fared best in thwarting pathogenic growth. The finding was stunning—because oak would seem to be the least likely surface. Indeed, to most well-read armchair biologists the choice of oak as a material in hospitals would seem not only counterintuitive, but almost difficult to imagine as a surface for hospital bedrails, table tops, trays and other common items used in healthcare facilities.

But the research dramatically proved otherwise. Oak didn't promote bacterial growth, it did the opposite—it inhibited it. For example, the four bacterial species whose survival was studied in the research included Acinetobacter baumannii, Enterococcus faecalis, Klebsiella pneumoniae, and Staphylococcus aureus. Each species was analyzed on oak versus the three other materials.

"This investigation is a 'One Health approach' in collaboration with laboratories of multiple institutes including two public hospitals … and a veterinary school," Munir said.

One-health approaches recognize the interconnection among people, animals, plants, and their shared environment.

"The multidisciplinary team of this project includes veterinarians, microbiologists, pharmacists, biologists, medical doctors, chemists, engineers and social scientists," he added.

Millions of bacterial cells were deposited on each material, Munir explained, and their survival was measured on day 0, 1, 2, 6, 7 and 15 of the experiments. Analyses were performed in triplicate for each material. When it came to oak surfaces, the team found the bacterial count decreased rapidly on transversal- and tangential-cut oak. "Wood from a tree can be cut in various directions, the most commonly known are the tangential and transversal directions," Munir explained.

"These two directions have a different cellular arrangement and their microscopic anatomy is different.

"For example, most of the fibers in wood run longitudinally in a tree, and when it is cut transversally, more cells would be exposed showing higher porosity, while the tangential—longitudinal—cut wood will have lower porosity."

However, results of the research revealed no overall difference between transversal and tangential oak regarding a capacity to inhibit bacterial growth. Yet the question remains: Why would oak thwart antibiotic resistant bacteria? The answer: Oak, like any plant, has natural antimicrobial capabilitites, Munir said.

"The tested bacteria are not the natural flora found on wood," he explained. "The wood material is hygroscopic, which means its fibers can absorb moisture and make it unavailable to these microbes, thus limiting their growth or killing them by a desiccation effect.

"The other mechanism is the chemical effect. The trees have a chemical defense mechanism against microbes in form of extractives—chemical

compounds. These compounds are present even in dead wood material and have antimicrobial activities.

"We used untreated oak wood in this study because we have previously observed antimicrobial activities of this wood, and our objective was to study the natural antimicrobial potential of wood material."

The French research arrives in the midst of a global coronavirus pandemic, which is overshadowing all other infectious diseases.

But in late November, Dr. Tedros Adhanom Ghebreyesus, director general of the World Health Organization, declared antimicrobial resistance as worrisome as the coronavirus pandemic. "Antimicrobial resistance may not seem as urgent as a pandemic but it is just as dangerous," he said.

While most of the world is riveted on the growing number of infections caused by SARS-CoV-2, which have exceeded 63 million worldwide, the drug resistance crisis threatens to reverse a century of medical progress, Ghebreyesus told a WHO news conference.

An estimated 700,000 people die annually of infections directly linked antimicrobial resistant organisms, according to WHO's estimates, which also includes deaths attributed to a range of resistant microbes, such as fungi. The agency additionally predicts drug resistance will likely soar uncontrollably to become the globe's leading cause of death by 2050 unless measures are undertaken now to rein in drug resistant infections.

Munir, meanwhile, concludes that considering oak surfaces in hospitals might help lower the burden of drug resistant infections. "Bacteria responsible for healthcare-associated infections may survive for days to months on the commonly used hospital surface materials."

Although wood unfairly is perceived as an unhygienic material "our research showed that the four most common bacteria responsible for healthcare-associated infections survive least on this material compared to other inanimate surfaces."

More information: Ju-Chi Chen, et al. Survival of Bacterial Strains on Wood (Quercus petraea) Compared to Polycarbonate, Aluminum and Stainless Steel, *Antibiotics* (2020) DOI: 10.3390/antibiotics9110804