Inspiration from Mother Nature leads to improved wood

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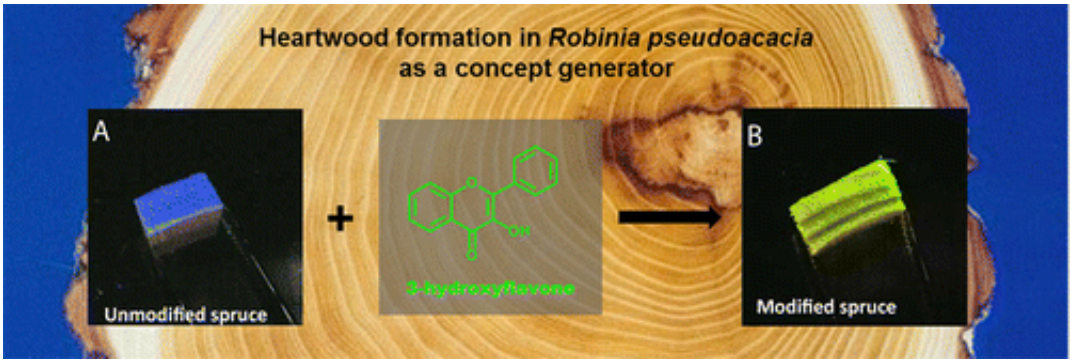

Using the legendary properties of heartwood from the black locust tree as their inspiration, scientists have discovered a way to improve the performance of softwoods widely used in construction. The method, reported in the journal *ACS Applied Materials & Interfaces*, involves addition of similar kinds of flavonoid compounds that boost the health of humans.

Ingo Burgert and colleagues explain that wood's position as a mainstay building material over the centuries results from a combination of desirable factors, including surprising strength for a material so light in weight. Wood is renewable and sustainable, making it even more attractive in the 21st century. Wood, however, has a major drawback that limits its use: It collects moisture easily—warping, bending, twisting and

rotting in ways that can undermine wooden structures. Some trees, like the black locust, deposit substances termed flavonoids into their less durable "sapwood." It changes sapwood into darker "heartwood" that reduces water collection and resists rot. The scientists used this process as an inspiration for trying an improved softwood that is more stable than natural wood.

They describe a process that incorporates flavonoids into the walls of the cells of spruce wood, a common building material for making houses and other products. The hydrophobic flavonoids are embedded in the more hydrophilic cell wall environment, meaning that the cell walls take in less water. Burgert and coworkers report that the treated wood was harder than untreated wood and more resistant to the effects of water, holding its shape better through changing humidity.

More information: "Flavonoid Insertion into Cell Walls Improves Wood Properties" ACS Appl. Mater. Interfaces, Article ASAP. DOI: 10.1021/am301266k

Abstract
Wood has an excellent mechanical performance, but wider utilization of this renewable resource as an engineering material is limited by unfavorable properties such as low dimensional stability upon moisture changes and a low durability. However, some wood species are known to produce a wood of higher quality by inserting mainly phenolic substances in the already formed cell walls – a process so-called heartwood formation. In the present study, we used the heartwood formation in black locust (Robinia pseudoacacia) as a source of bioinspiration and transferred principles of the modification in order to improve spruce wood properties (Picea abies) by a chemical treatment with commercially available flavonoids. We were able to effectively insert hydrophobic flavonoids in the cell wall after a tosylation treatment for activation. The chemical treatment reduced the water uptake of the

wood cell walls and increased the dimensional stability of the bulk spruce wood. Further analysis of the chemical interaction of the flavonoid with the structural cell wall components revealed the basic principle of this bioinspired modification. Contrary to established modification treatments, which mainly address the hydroxyl groups of the carbohydrates with hydrophilic substances, the hydrophobic flavonoids are effective by a physical bulking in the cell wall most probably stabilized by π–π interactions. A biomimetic transfer of the underlying principle may lead to alternative cell wall modification procedures and improve the performance of wood as an engineering material.

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