How wood chemistry relates to structural stability

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Credit: Julie Bossu – Ecofog laboratory
(CNRS/Inra/Cirad/Agroparistech/Université de Guyane/Université des Antilles)

Wood has many uses, which require to know its shrinking and swelling

capacity in relation to humidity (known as dimensional stability). Researchers from the CNRS and Cirad have shown that in Bagassa guianensis, a fast-growing Guianese tree, the secondary metabolites, whose main purpose is to defend the tree against insects and fungi, also serve to reduce shrinkage. These metabolites therefore make B. guianensis wood very stable. These results were obtained using a method that will be applied to a broad range of other tree species. They show how describing biodiversity through in-depth analysis of wood properties can help identify promising species for future plantation. These findings will be published in *PLOS ONE* on March 23rd 2016.

To improve the diversity of trees commercially exploited for wood, while relying as far as possible on local biodiversity, new tree species need to be found for cultivation. This requires a continued effort to describe biodiversity, not only from a taxonomic point of view – meaning the scientific classification of species – but also by the characterization of the properties of their wood. The objective is to respond to the demand for lumber materials, notably in tropical regions where there is rapid population growth.

For this reason, chemists and biomechanists from the EcoFoG laboratory (CNRS / Agroparistech /Cirad / Inra /Université des Antilles / Université de Guyane) first selected several species of interest by combining two databases containing several decades of measurements made in French Guiana. The first of these contained data on tree growth, the second on the technological properties of wood. Out of the species selected, the researchers targeted Bagassa guianensis, a fast-growing Guianese tree with high-durability, medium-density wood (neither too heavy nor too light). By measuring the physical and mechanical properties of several hundred wood samples from a dozen trees at different stages of growth, the researchers revealed that B. guianensis wood has a particularly strong dimensional stability, whatever its density.

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To understand why the wood of this species is so stable, the scientists investigated the secondary metabolites contained in its 'heartwood'. This central part of the trunk is darker in color than the outer layer of 'sapwood' around it because of defense metabolites synthesized to protect the tree from insects and fungi. The researchers compared the way B. guianensis wood samples reacted to drying in relation to the quantity of metabolites present. Their results demonstrate that the heartwood is very stable, whatever the humidity, and that this stability increases as the metabolite content rises. It is therefore the metabolites that prevent shrinkage and give the wood its high stability. These findings show that metabolite content could play a greater role than wood density in drying shrinkage. They also make it possible to hypothesize about the mechanisms of mechanical deformation during

shrinkage.

In addition, the results have enabled researchers to test new statistical models integrating metabolite content in order to predict wood shrinkage and, therefore, its behavior during drying. The researchers now want to take their work a step further in order to understand the effects of metabolite chemistry on wood properties. They also want to expand their analyses to a greater variety of Guianese species to find suitable candidates for plantation and local production of construction lumber. They are looking for other trees with useful properties like B. guianensis, which was already known for its rapid growth and durability and has now been shown to have high dimensional stability.

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More information: Julie Bossu et al. New Insights on Wood Dimensional Stability Influenced by Secondary Metabolites: The Case of a Fast-Growing Tropical Species Bagassa guianensis Aubl., *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0150777