Opinion
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Adhesive Bio-inspired Coating for Increasing the Bioactivity of Glass-Ceramic Scaffolds

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Introduction

The foundation of global food production is soil, which also serves as a habitat, regulates the hydrological cycle, and mitigates climate change through carbon sequestration. However, precision agriculture, soil mapping, contamination monitoring, and documentation of soil C sequestration all require a high spatial and temporal density of soil information due to the heterogeneous and dynamic nature of soils. In this context, sensors that make use of various parts of the electromagnetic spectrum offer a quicker, less expensive and non-destructive alternative to conventional laboratory procedures. Models can be used to predict a variety of soil properties after they have been calibrated with paired reference data and spectral measurements. However, the prediction mechanisms for the soil property of interest determine the accuracy of the resulting model.

In the field of soil science, the use of Mid-Infrared Spectroscopy (MIRS) is well-established. The fundamental vibrations of many organic molecules containing soil Organic Carbon (OC) and nitrogen (N) as well as minerals in the clay (such as kaolinite, smectite) and sand (such as quartz) particle size fractions are captured by MIRS using radiation in the range of 2500-25,000 nm (4000-400 cm^{1}). Quantitative spectral models are based on the proportionality and specificity of spectrally-active molecules in relation to the soil property of interest, and as a result, model accuracy is affected. Reviews, for instance, have found that complex properties related to both organic and inorganic soil fractions, such as pH and CEC, have lower and more inconsistent estimation accuracy than OC, total N, clay, and sand content.

Discussion

Hydrolysable tannin, for example, can be reinserted into the citric acid cycle after relatively simple breakdown (aerobic/anaerobic) by tannase enzymes, whereas condensed tannins, such as the mimosa extract, require different reductive breakdowns, making them even more recalcitrant. This is known as the feeding effect. Condensed tannins or catechin, the basic component of condensed tannins, have been reported to be degraded by certain microorganisms, including white-rot fungi like Trametes versicolor and bacteria in the family Pseudomonaceae and Bacillaceae. Fungi and bacteria use their phenoloxidase system, which includes enzymes like laccase, peroxidase, or catechin oxygenase, to break down condensed tannins instead of tannase. Other catechin-degrading fungi have also been shown *in vitro* to exhibit this effect only when exposed to low concentrations.

When the microorganism's other enzymes are prevented from performing their functions, the hindering effect occur. This has been observed in a number of enzymes, including amylase, glucosidase, glucoamylase, cholinesterase, and tyrosinase. Stable tannin–protein complexes, which prevent their enzymatic functions from being carried out, are the mechanism at work.

Conclusion

A tannin–furanic polymer was tested against mimosa tannin to see how it affected the *in vitro* growth of two white-rot fungi (*Trametes versicolor* and *Agrocybe aegerita*) and two strains of bacteria in the family Bacillaceae and Pseudomonaceae. The ability of tested bacteria and fungi to tolerate or eventually degrade condensed tannins was the criteria for selection. For the fungal experiments, the effect of the tannin content was looked at, and for the bacteria, the concentration chosen (1%) provided additional data for this study. The antimicrobial properties of the mimosa tannin caused bacteria to grow faster when combined with glucose than when glucose was used alone. However, growth did not increase when glucose was not present. In addition to the synergistic effect that the combination of glucose and MT/TFP has on bacterial growth, the bacteria in the family Bacillaceae appear to be able to use only TFP as a carbon source. They grow at the same rate as when glucose alone is the food source. For white-rot fungi, MT and TFP increased mycelia growth at concentrations as low as 1%, whereas doses as high as 10% clearly inhibited the growth of the fungi. TFP had a similar effect on fungi and bacteria to that of MT, but it inhibited the tested fungi *Trametes versicolor* and Bacillaceae slightly less than MT did.

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