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環境中におけるタンニンの構造と機能の変化
Changes in the structure and function of tannins in natural environments

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Tannins are polyphenols that are contained in plants where they can account to 20% of the plant dry weight depending on its species and organs. Tannins are known to bind to proteins, making insoluble complexes that are resistant to microbial degradation. While tannins are considered to play various roles in ecosystems, we are not fully understand the dynamics and functions of tannins in them. Here, I would like to present the changes in the structure and function of tannins in water and soil environments. Furthermore, their possible influence on nitrogen cycling in mangrove ecosystems will be proposed.

Molecular structure and protein binding ability of CT changes during the decomposition of foliage (Maie et al. 2003)
Tannins are classified into two subgroups, condensed tannins (CT) and hydrolysable tannins (HT). CT are mixtures of polymers of flavan-3-ol units with different degrees of polymerization and mostly hydroxyl substitutions. Molecular structure of CT in foliage changes during the decomposition of foliage. CT molecules composed of prodelphinidin unit (PD), which has more hydroxyl groups than procyanidin (PC), are more susceptible to structural changes. Structural change of CT accompanied with the decrease of protein-binding ability.

Tannins are important source of DOM leached from litter, especially at the early stage of decomposition (Nishimura et al. 2012)
Dissolved organic matter (DOM) leached from litter may contain tannin-derived materials. Since tannins are water-soluble and has wide structural variety among different species, DOM composition in leachate is most diverse at the early stage of the decomposition, but converge into relatively similar composition by time when lignin-degradation products become a major source of DOM.

Tannins-protein complex may contribute to nitrogen cycling in mangrove ecosystem, acting as a delayed release fertilizer (Maie et al., 2008)
Fate of CT leached into water environments can be variable. They may aggregate in saline water, adsorb to sediment, and complex with proteins. CT change their chemical structure quickly in water, becoming ”invisible” to analytical window. CT-protein complexes are refractory to microbial degradation, but photo-reactive. By exposing CT-protein complexes to sun light, proteins can be released into water. In mangrove estuary, a large amount of tannins and proteins could be released into water in a relatively short period when leaves fall into water. CT might be contributing to preserve N in mangrove ecosystem, by acting as a delayed release fertilizer.

References
Maie et al. 2003. Soil Biology & Biochemistry 35, 577-589.
Maie et al., 2008. Limnology & Oceanography 53, 160-171.
Nishimura et al. 2012 J. Environ. Quality 41, 823-833.

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