

Detailed Study about Tannins in Plant Chemistry

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INTRODUCTION

Tannins are a diverse group of naturally occurring polyphenolic compounds found in many plant species. These compounds are known for their astringent taste and have a wide range of biological activities. Tannins have been studied for centuries due to their importance in various fields, including food science, medicine, and ecology. In this article, we will discuss the chemistry of tannins in plants, their functions, and their applications in different industries.

DESCRIPTION

Chemical structure of tannins

Tannins are polyphenolic compounds that are chemically classified as condensed tannins or hydrolyzable tannins. Condensed tannins, also known as proanthocyanidins, are formed by the polymerization of flavan-3-ol units (catechins and epicatechins) through carbon-carbon or carbon-oxygen linkages. Hydrolyzable tannins are formed by the esterification of gallic or ellagic acid with a sugar molecule. The esterified molecule is then attached to a flavonoid or flavonol through a carboncarbon or carbon-oxygen linkage.

Tannins are usually classified based on their molecular weight, degree of polymerization, and solubility in water. Low molecular weight tannins are more soluble in water than high molecular weight tannins. Tannins are also classified as either true or pseudo tannins. True tannins are derived from the flavonoid pathway, while pseudo tannins are derived from the shikimate pathway.

Functions of tannins in plants

Tannins play an important role in the growth and development of plants. They are synthesized in the plant as a response to biotic and abiotic stress factors, such as herbivory, pathogen infection, drought, and UV radiation. Tannins act as a defense mechanism for the plant by inhibiting the growth and reproduction of herbivores and pathogens. Tannins also play a role in regulating plant growth and development by influencing nutrient uptake and hormone signaling pathways.

Tannins have also been found to have ecological functions, such as modifying the physical and chemical properties of soil, influencing the decomposition of plant litter, and regulating microbial activity. Tannins can form complexes with soil minerals, such as iron and aluminum, which can influence soil pH and nutrient availability. Tannins also inhibit the activity of soil microorganisms, which can slow down the decomposition of plant litter and influence the cycling of carbon and nutrients in the soil.

Applications of tannins

Tannins have a wide range of applications in different industries, including food, medicine, and industrial processes. Tannins are commonly used as food additives to improve the color, flavor, and stability of food products. They are also used as a clarifying agent in the production of wine and beer. Tannins can also be used as a natural preservative to prevent the growth of bacteria and fungi in food products.

Tannins have been found to have medicinal properties, such as anti-inflammatory, antioxidant, and anti-cancer activity. Tannins can scavenge free radicals and prevent oxidative damage to cells, which can reduce the risk of chronic diseases. Tannins can also inhibit the growth of cancer cells by inducing cell death and preventing angiogenesis.

Tannins are used in various industrial processes, such as the production of leather, wood adhesives, and dyes. Tannins are used as a natural tanning agent to convert animal hides into leather. Tannins can also be used as an adhesive in the production of wood based panels, such as particleboard and plywood. Tannins can also be used as a natural dye to color textiles and paper products.

CONCLUSION

In conclusion, tannins are a diverse group of naturally occurring polyphenolic compounds found in many plant species. They have a wide range of biological activities and play important

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roles in the growth and development of plants, as well as their interactions with the environment. Tannins act as a defense mechanism for the plant by inhibiting the growth and reproduction of herbivores and pathogens, and they also play a role in regulating plant growth and development by influencing nutrient uptake and hormone signaling pathways. Tannins have ecological functions, such as modifying the physical and chemical properties of soil and regulating microbial activity.