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Commentary

PHYTOALEXINS: FUTURE APPLICATIONS

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COMMENTARY

Phytoalexins are antibacterial compounds with some antioxidative properties. They are identified by the fact that they are defensively generated de novo by plants that manufacture the chemicals fast at pathogen infection sites, rather than by any particular chemical structure or feature. Phytoalexins are broad-spectrum inhibitors that are chemically diverse, with various chemical classes of substances being specific to different plant species. Phytoalexins are phytochemicals that are induced by microbial infection and belong to a variety of chemical classes, including terpenoids, glycosteroids, and alkaloids.

Plants produce phytoalexins, which act as toxins against invading organisms. They may pierce the pathogen's cell wall, delay maturation, alter metabolism, or limit reproduction. When phytoalexin biosynthesis is impeded, plant tissue becomes more susceptible to infection, indicating their relevance in plant defence. Pathogen colonisation is more extensive in mutants that lack phytoalexin synthesis than in wild types. As a result, pathogens that can degrade phytoalexins are more virulent than pathogens that can't. When a plant cell recognises particles from damaged cells or pathogen particles, it responds in two ways: a generic short-term response and a delayed long-term specialised response.

The plant uses reactive oxygen species like superoxide and hydrogen peroxide to destroy invading cells as part of the induced resistance, or short-term response. The hypersensitive response, in which cells near the site of infection are signalled to undergo apoptosis, or programmed cell death, in order to prevent the pathogen from spreading to the rest of the plant, is a common short-term reaction in pathogen interactions.

Long-term resistance, also known as systemic acquired resistance (SAR), is caused by plant hormones such as jasmonic acid, ethylene, abscisic acid, or salicylic acid communicating with the remainder of the plant. The signal causes widespread changes in the plant, including the expression of genes that guard against additional pathogen entry, such as enzymes involved in phytoalexin synthesis. When jasmonates or ethylene (both gaseous hormones) are produced from injured tissue, adjacent plants often respond by producing phytoalexins. These and other wound response aromatics appear to act as a message to herbivores, which are common disease vectors, that the plant is no longer edible. [requires citation] Also, as the old proverb goes, "an enemy of my enemy is my friend."

Phytoalexins as antimicrobial agents

Plants accumulate phytoalexins, which are antimicrobials that inhibit bacteria once the plant interacts with pathogenic germs. Plants produce phytoalexins in reaction to pathogen identification (an induced response mechanism), which leads in the secretion of powerful antimicrobials to infected locations. Phytoalexins' antibacterial properties could be used to treat human ailments caused by germs.

Phytoalexin as anti-inflammatory, antitumor and anticancer agents

Phytoalexins work as an anti-inflammatory drug through a poorly understood process that involves inhibiting the development of inducible nitric oxide synthases (NOS), which is implicated in the generation of a high concentration of NO in inflammation. Resveratrol, one of the most studied phytoalexins, inhibited the inflammatory response induced by lip polysaccharide (LPS) in colon cancer cell lines by inhibiting the signalling pathway, which could be related to a direct action on the nuclear transcription factor via phosphorylation inhibition or reversal of the level and expression of, for example, hepatic tumour necrosis factor-alpha, TNF-. Uncontrolled cell proliferation, the acquisition of metastatic traits, and complex connections between elaborate signalling networks characterise cancer as a multistep disease.

Phytoalexin as anti-hyperglycemic agent

Inappropriate insulin production or insulin resistance, or both, are pathophysiological pathways that contribute to hyperglycemia and, eventually, diabetes. Hyperglycemia can be caused by a

decrease in the number of glucose transporters, a decrease in the number of insulin receptors, or a malfunction in tissue insulin signalling. And, as a result of the lack of carbs for energy metabolism, an absolute rise in hepatic glucose output exceeds glucose utilisation, resulting in protein waste.

Phytoalexin as anti-apoptotic and cardio protective agents

Cardio-toxicity was mediated by increased myocardial cell death, mitochondrial malfunction, and a caspase-independent apoptosis mechanism. There's a lot of evidence that resveratrol can operate as an anti-apoptotic drug that protects the heart by inhibiting caspase-3 production and activation. A previous study found that concurrent administration/injection with resveratrol reduced the cardiotocic effects of doxorubicin, a cardiotoxic drug. The apparent benefit of resveratrol in the prevention of cardiovascular diseases, as well as other significant health conditions such as cancer prevention, obesity prevention, diabetes prevention, and neurodegenerative disease prevention, supports important future applications of phytoalexins in disease control in humans.

Phytoalexin in oxidative stress

Surprisingly, continuous resveratrol administration reduced the formation of free radicals, which protected a variety of tissues from ischemia injury. Resveratrol's ability to reduce free radicals may protect neurons from the reactive oxygen species produced by ischemia-reperfusion. In rats, resveratrol injection boosted hippocampus NO (nitric oxide) production, which resulted in improved cerebral blood flow, which protected the animals against ischemia-induced neuron loss. Due to the fact that nitric oxide is a vascular dilator, it can increase arterial volume while lowering arterial pressure according to Boyle's law.

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