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PHARMACOLOGICAL AND CHEMICAL ASPECTS OF CAFFEIC ACID

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DESCRIPTION

Caffeic Acid (CA) is a phenolic chemical produced by all plant species and found in foods like coffee, wine, and tea, as well as common medications like propolis. The antioxidant, anti-inflammatory, and anticarcinogenic properties of phenolic acid and its derivatives are well known. *In vitro* and *in vivo* investigations have shown that this chemical has anticarcinogenic effect against Hepatocarcinoma (HCC), a kind of cancer with a high incidence, high aggressiveness, and a high fatality rate around the world. CA has anticancer properties due to its chemical structure, which includes free phenolic hydroxyls, the number and position of OH in the catechol group, and the double bond in the carbonic chain.

Pharmacokinetic studies show that this compound is hydrolyzed by colony microflora and metabolised primarily in the intestinal mucosa by phase II enzymes, then conjugated and methylated by the action of sulfotransferases, UDP-glucotransferases, and o-methyltransferases, resulting in sulphated, glucuronic, or methylated conjugates. CA is transported across the membrane of intestinal cells by active transport mediated by monocarboxylic acid carriers. CA inhibits the generation of Reactive Oxygen Species (ROS), induces cancer cell DNA oxidation, and inhibits tumour cell angiogenesis by blocking STATS (transcription factor and signal translation 3) and suppressing MMP2 and MMP-9 (collagen IV metalloproteases).

Caffeic Acid (CA) is a polyphenol produced by the secondary metabolism of plants such as olives, coffee beans, fruits, potatoes, carrots, and propolis, and is the most common hydroxycinnamic acid present in human diets. This phenolic molecule can be found in monomers (organic acid esters, sugar esters, amides, and glycosides), dimers, trimers, and flavonoid derivatives, or coupled to proteins and other polymers in the vegetable cell wall. CA helps plants defend themselves against predators, pests, and illnesses by inhibiting the growth of insects, fungi, and bacteria, as well as promoting the protection of plant leaves from Ultraviolet radiation B. (UV-B).
AC (3,4-dihydroxycinnamic acid) is a phenolic acid with a phenylpropanoid (C_6-C_3) structure and a 3,4-dihydroxylated aromatic ring connected to a carboxylic acid *via* a transethylene wire. The endogenous shikimate pathway, which produces aromatic amino acids from glucose, is responsible for the manufacture of this chemical in plants.

The reaction begins with shikimic acid and proceeds through three enzymatic reactions: The first is phosphorylation, which is mediated by the enzyme shikimato-kinase, followed by the conjugation of a molecule of phosphoenolpyruvate, which is mediated by 5-Enolpyruvylshikimate-3-Phosphate (EPSP) synthase, and finally by the enzyme chorismate synthetase, which leads The enzyme chorismate mutase transforms this into prephenic acid (a precursor of L-phenylalanine).

CONCLUSION

In the deamination process, Pyridoxal Phosphate (PLP) acts as a coenzyme, while Nicotinamide Adenine Dinucleotide (NAD) acts as an electron exchanger, resulting in the synthesis of L-phenylalanine. Cinnamic acid is formed when the enzyme Phenylalanine Ammonia Lyase (PAL) deaminates L-phenylalanine. The enzyme cinnamate-4-hydroxylase (C_4H) converts it to p-coumaric acid, which is then transformed to caffeic acid by the enzyme 4-coumarate 3-hydroxylase (C_3H). Caffeic acid in coffee is also recommended to be neuroprotective. Caffeic acid produces antidepressive movement in forced-swim mice. It is suggested that caffeic acid reduces the downregulation of brain-derived neurotrophic factor (a member of the neurotrophin family that has vital roles in depression pathophysiology and treatment.