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Recent Advancements of Gallic Acid Derivatives in Medicinal Chemistry

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Introduction

Oxidative stress, a result of the overproduction and buildup of free radicals, is the main cause of a number of degenerative diseases, including atherosclerosis, cancer, ageing, cardiovascular, and inflammatory disorders. Polyphenols, which are naturally occurring antioxidants, have a wide range of biological effects, including antibacterial, anticancer, antiviral, antifungal, anticholesterol lowering, and ulcer healing. Gallic acid, or 3,4,5-trihydroxybenzoic acid, is a substance that occurs in nature and is a powerful antioxidant that may protect healthy people by preventing apoptosis. This nucleus has become an essential anchor for the design and development of new pharmacological agents thanks to pharmacological agents containing gallic acid and of various therapeutic categories, such as antioxidants, anticancer, antimicrobial, chondro-protective effect, carbonic anhydrase inhibitors, antidiabetic activity, anti-ulcerogenic, cathepsin D inhibitor, etc.

Description

Fruits and plants contain large amounts of gallic acid and its structurally similar substances. One of the primary phenolic components of both black and green tea is gallic acid, along with its catechin derivatives. Gallic acid esters are used in a wide variety of industrial applications, including as antioxidants in food, cosmetics, and the pharmaceutical sector. Gallic acid is also used as a source of raw materials for paints, colourants, and inks. These compounds have been studied extensively, and it has been discovered that they offer a wide range of medicinal possibilities, including anti-cancer and antibacterial characteristics.

A number of degenerative diseases, including cancer, atherosclerosis, cardiovascular disorders, ageing, and inflammatory diseases, are primarily brought on by oxidative stress, which is caused by an excessive generation and buildup of free radicals. Polyphenols are a significant class of naturally occurring antioxidants with a wide range of biological effects, including the ability to fight off diseases like cancer, fungi, bacteria, viruses, ulcers, and cholesterol, to mention a few. Gallic acid (3,4,5-trihydroxybenzoic acid), a naturally occurring low molecular weight triphenolic molecule, has distinguished itself as a potent antioxidant and an effective apoptosis triggering agent among different polyphenols.

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Gallic acid (3,4,5-trihydroxybenzoic acid) is a phenolic acid that is widely present in numerous genera of higher plants. It can be found both in its free form and as a component of more complex compounds, such as ester derivatives or polymers. Gallic acid and its derivatives are naturally found in almost all plant parts, including the bark, wood, leaf, fruit, root, and seed. Common foods like blueberries, blackberries, strawberries, plums, grapes, mango, cashew nuts, hazelnuts, walnuts, tea, wine, and others contain them in varying degrees. Approximately 70% of gallic acid is absorbed after eating and subsequently eliminated as 4-O-methylgallic acid in the urine.

Inflammatory, cardiovascular, pulmonary, gastrointestinal, and metabolic diseases brought on by bacteria, fungi, and viruses are just a few of the illnesses that can be managed with the help of gallic acid (GA) and its derivatives. It is important to note that in the current in silico study, compounds were chosen based on their pharmacological functions, abundance in nature, and—most importantly—the fact that they had never been tested against the coronavirus—the agent responsible for the recent outbreak—either in silico, in vitro, or in vivo. Gallic acid and its derivatives have been studied extensively for their potential to treat a variety of ailments, including bacterial, fungal, and viral illnesses. Despite this, no research has shown the use of gallic acid as a therapeutic agent.

As a starting point, methyl gallate was used to create two lipophilic derivatives of the natural phenol gallic acid (GA), and their efficacy was examined. In bulk oil, emulsion, and the DPPH systems, the antioxidant properties of these new phenolics were assessed in comparison to GA, tert-butylhydroquinone (TBHQ), and butylated hydroxytoluene (BHT). The Rancimat (100–140°C) and emulsion tests revealed that the novel compounds effectively delayed lipid oxidation significantly better than GA and other antioxidants. They continued to perform better than GA in the bulk oil system at 65°C, while TBHQ exhibited the highest activity. Thus, by covalently attaching sterically hindered phenols to the phenyl ring of GA in place of the electron-withdrawing carboxylic group, its lipophilicity was boosted, and this had synergistic effects that enhanced its overall antioxidant activity [1-5].

Conclusion

All higher plants contain esters and/or glycosides of different substituted benzoic acids. When examining the reality of this claim, one is reminded of Oscar Wilde's dictum that truth is rarely pure and always complex. Certainly, both plants and microbes produce large amounts of C6-C1 phenolic acids. For instance, the leaves of winter-green (Gaultheria procumbens), whose extracts when alkaline hydrolyzed yield p-hydroxy-benzoic, salicylic, protocatechuic, 2,3-dihydroxybenzoic, gentisic, vanillic, and syringic acids. According to the breadth of the literature, metabolites with these capabilities are broadly distributed in angiosperms (in the botanical sense), but their appearance is still erratic and frequently seems to comprise something.

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