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Perspective Article

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Synthesis and Antioxidant Properties of Novel Flavonoid Derivatives

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DESCRIPTION

Derivatives of flavonoids have attracted a lot of interest lately because of their exceptional antioxidant qualities and possible medical uses. Fruits, vegetables and medicinal plants are rich sources of flavonoids, a broad class of polyphenolic chemicals. Their capacity to contribute hydrogen atoms or electrons to neutralize free radicals and Reactive Oxygen Species (ROS) is what gives them their antioxidant action and shields biological systems from oxidative damage. However, flavonoids' natural existence is frequently associated by drawbacks, such as poor solubility, fast metabolism and reduced bioavailability. These difficulties call for the creation of derivatives that solve the intrinsic drawbacks of parent flavonoids while maintaining or boosting their antioxidant activity. Functional groups are strategically changed during the synthetic modification of flavonoids in order to maximize their chemical and biological characteristics.

Numerous synthetic techniques have been used to create new flavonoid derivatives with enhanced antioxidant capacity. For example, the radical-scavenging action of flavonoids has been demonstrated to be enhanced by the addition of electron-donating groups, such as hydroxyl or methoxy groups. Similar to this, hydroxyl group alkylation and acylation can make flavonoid derivatives more lipophilic, enhancing their bioavailability and cellular absorption. Since the C-ring is essential in determining the antioxidant activity of flavonoids, altering it is a noteworthy method in the synthesis of flavonoid derivatives.

In order to improve the stability and electron-donating potential of flavonoid derivatives, heterocyclic moieties, such as imidazole or pyridine rings, have been investigated for inclusion into the C-ring structure. It has also been studied to create flavonoid-metal complexes with both antioxidant and enzyme-inhibitory properties by conjugating flavonoids with metal ions like copper or zinc. An important stage in the creation of flavonoid derivatives is the assessment of their antioxidant qualities. To evaluate their capacity to scavenge free radicals, lessen oxidative stress and shield biomolecules from harm, a variety of *in vitro* and *in vivo* tests are used. The Ferric Reducing Antioxidant Power (FRAP) assay, the ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) assay and the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay are frequently used assays. The protective actions of flavonoid derivatives at the molecular level are shown by cellular tests that include oxidative stress-induced damage, such as lipid peroxidation or DNA strand breaks. The *in vivo* antioxidant activity and pharmacokinetics of flavonoid derivatives are assessed using animal models, such as rats exposed to oxidative stress from chemicals or environmental variables.

Novel flavonoid compounds have medicinal promise that goes beyond their antioxidant qualities. Numerous biological activities, including as anti-inflammatory, anticancer and neuroprotective properties, have been established by these substances. These activities are directly related to their capacity to regulate oxidative stress. By triggering oxidative stress-mediated apoptosis, for example, flavonoid derivatives with increased antioxidant activity have been demonstrated to prevent the growth of cancer cells. Similar to this, these derivatives might lessen neurodegenerative processes by modifying signaling pathways linked to oxidative stress and shielding neurons from harm caused by ROS. The creation of flavonoid derivatives as medicinal agents is fraught with difficulties, notwithstanding its potential. The intricacy of flavonoid chemistry, which sometimes entails difficult synthesis pathways and low yields, is one significant obstacle. To get beyond these obstacles and provide scalable synthesis procedures for flavonoid derivatives, advances in synthetic organic chemistry such as catalytic techniques and green chemistry strategies are being utilized. Additionally, to logically create derivatives with the best pharmacological and antioxidant qualities, a greater comprehension of the Structure-Activity Correlations (SAR) of flavonoids is required.