

# Beneficial Action of *Citrus* Flavonoids on Multiple Cancer-Related Biological Pathways

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**ABSTRACT:** Attempts to control cancer involve a variety of means, including the use of suppressing, blocking and transforming agents. Suppressing agents prevent the formation of new cancers from pro-carcinogens, blocking agents prevent carcinogenic compounds from reaching critical initiation sites, while transformation agents act to facilitate the metabolism of carcinogenic components into less toxic materials or to prevent their biological actions. Flavonoids can act as all three types of agent.

Epidemiological and animal studies suggest that flavonoids have a protective effect against cardiovascular diseases and some types of cancer. Although flavonoids have been studied for about 50 years, the cellular mechanisms involved in their biological action are still not completely understood. In recent years, experimental studies have provided growing evidence supporting the beneficial action of flavonoids on multiple cancer-related biological pathways (carcinogen bio-activation, cell-signaling, cell cycle regulation, angiogenesis and inflammation).

Within the last decade, reports on flavonoid activity have largely associated with enzyme inhibition and anti-proliferative activity. Many of these studies have pointed to a structural-functional relationship, in that the antioxidant, enzyme-inhibition or antiproliferative activities of flavonoids are dependent on particular structural motifs. Our own studies have shown that structural factors would explain the antioxidant, antiproliferative and antimetastatic properties of some citrus flavonoids.

In this paper we discuss the relation between each structural factor and the anticancer activity of Citrus flavonoids.

**Keywords:** Flavonoid, *citrus*, cancer, apigenin, tangeretin, rutin, diosmin.