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Inhibitory Effects of Quercetin and Kaempferol as two Propolis Derived Flavonoids on Tyrosinase Enzyme

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Background: Tyrosinase is a copper-containing enzyme, which is widely distributed in microorganisms, animals and plants. It is also a key enzyme in melanin biosynthesis, which plays a crucial role in determining the color of mammalian skin and hair. In addition, unfavorable enzymatic browning of plant-derived foods by tyrosinase causes a decrease in nutritional quality and economic loss of food products.
Objectives: In the present study the activity of this enzyme was examined against quersetin and kaempferol as two potentially flavonoid inhibitors.
Materials and Methods: In this work, the effects of quercetin and kaempferol as propolis-derived compounds on activity of mushroom tyrosinase (MT) were studied. These flavonoids showed inhibitory activity on catecholase and cresolase reactions in presence of caffeic acid and p-comaric acid, respectively. The inhibition mode of quercetin and kaempferol were competitive towards both catecholase and cresolase activities of the enzyme.
Results: The inhibition constants (Ki) were determined as 0.072 and 0.112 mM for catecholase activity, and 0.016 and 0.06 mM for cresolase activity, respectively.
Conclusions: In general, quercetin and kaempferol can be used as good candidates in melanogenesis inhibition. Moreover they should be considered as good blockers of enzyme activity in hyper pigmentation and clinical application.

Keywords: Motor Activity; Quercetin; Kaempferol

1. Background

Tyrosinase (EC 1.14.18.1) is a copper-containing enzyme, which is widely distributed in microorganisms, animals and plants. It is also a key enzyme in melanin biosynthesis, which plays a crucial role in determining the color of mammalian skin and hair. In addition, unfavorable enzymatic browning of plant-derived foods by tyrosinase leads to a decrease in nutritional quality and economic loss of food products (1, 2). On the other hand, the activity of this enzyme in the skin causes excessive production of melanin, which results in the creation of dermatological disorders such as melanoma and other skin hyperpigmentations and depigmentation (3-5). In cosmetic applications, tyrosinase inhibitors can be considered as skin whitening agents (6). Therefore, tyrosinase inhibitors may be clinically helpful in dealing with skin cancers and cosmetics.

The formation of melanin in the human body is influenced or reduced by several mechanisms, including anti-oxidation, direct tyrosinase inhibition, melanin inhibition of migration from cell to cell and hormonal activities, etc. (7). In fact, the tyrosinase enzyme catalyzes the hydroxylation of tyrosine to form 3,4-dihydroxyphenylalanine (L-DOPA), and also catalyzes the reaction leading to formation of DOPA quinine from L-DOPA (8). Quinones, in turn, develop chemically to form melanins and other polyphenolic compounds (9). Quinones chemically evolve to give rise to melanins or react with amino acids and proteins to enhance the color products, which are brown, black, or red heterogeneous polymers (10).

Flavonoids and phenolics are major groups of non-essential dietary components that have been associated with the inhibition of atherosclerosis and cancer (11). Flavonoids and polyphenolic crude extracts have been reported to possess xanthine oxidase inhibitory activity (12). A potential source of such compounds is mushrooms (13). Mushrooms accumulate a wide variety of secondary metabolites including phenolic compounds. Mushrooms have long been widely appreciated for their good flavor and texture. They are recognized as a nutritious food as well as an important source of biologically active compounds of medicinal value (14-16). Flavonoids and phenols have been shown to possess important antioxidant activities toward highly active free radicals, which are principally based on the redox potentials of their phenolic hydroxyl groups and the structural relationships between different parts of their chemical structure (17).

2. Objectives

Pursuing our previous studies on inhibition and stabil-