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Recent Scientific Studies of a Traditional Chinese Medicine, Tea, on Prevention of Chronic Diseases

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ABSTRACT

Green tea (綠茶 Lǜ Chá), made from the leaves of the plant *Camellia sinensis*, has traditionally been used as a medicine in China for thousands of years. According to the classical work of Li Shizhen (李時珍 Lǐ Shí Zhēn) of the Ming Dynasty, "tea is cold and lowers the fire." Since fire (inflammation) causes many diseases, could tea be effective in the prevention of many diseases? The possible prevention of chronic diseases such as cancer, metabolic syndrome, obesity, diabetes, and cardiovascular diseases has been studied with contemporary scientific methods, and the results are promising. The molecular mechanisms underlining these observations will be discussed in this presentation. One of the reasons for the failure to demonstrate a disease-preventive effect of tea in some epidemiological studies is the lower quantities of tea consumption in humans. Can we increase the quantity of tea consumption to harness its health benefits without causing gastrointestinal irritation? This is a topic for further research.

Key words: Cancer, Cardiovascular diseases, Diabetes, Green tea, Metabolic syndrome, Obesity

INTRODUCTION

Tea, made from the leaves of *Camellia sinensis*, is a popular beverage consumed worldwide. Historically, tea has been used for thousands of years as a medicinal herb and was also used widely as a beverage starting from the Tang and Song Dynasties. In the *Cha Jing* (*Tea Bible*) by Lu Yu of Tang Dynasty[a], the production of tea, the water and utensils used in the preparation of the tea beverage, and the possible health effects were described in detail. Tea was formally considered as a medicine in the *Xin Xiu Ben Cao* of the Tang Dynasty[b]. Tea was described as "… bitter and sweet, slightly cold and with no toxicity. It has the functions of pushing down the perverse rising qi; eliminating thirst, heat and phlegm; diuretic, shortening of sleeping time, and…"[b]. In the classical *Ben Cao Gang Mu* (本草綱目 Běn Cǎo Gāng Mù) by Li Shizhen (李時珍 Lǐ Shí Zhēn) of the Ming Dynasty, "Tea, bitter and cold … is strongly anti-inflammatory. Inflammation is the cause of many diseases."[c]. In modern medicine, it is also now recognized that inflammation is a causative or contributing factor to many diseases. If tea has anti-inflammatory activity, can it help to prevent many diseases?

An important aspect of Traditional Chinese Medicine (TCM) is the concept of preventing diseases before their manifestation; this is similar to modern preventive medicine. However, modern preventive medicine, unlike TCM, does not rely on classical litera-

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ture; it is based on evidence from experiments in animal models and cell lines, human epidemiology studies, and clinical trials. For the past 25 years, tea has been studied for its beneficial health effects. These include the reduction of body weight, alleviation of metabolic syndrome (MetS), and prevention of cardiovascular diseases (CVDs), cancer, and neurodegeneration. Results on its promising beneficial health effects when tea is consumed in sufficient quantities are emerging, and this topic was recently reviewed.[1] Did Li Shizhen, the grandmaster of TCM, have the insight that took 450 years for modern medicine to discern? Or are we interpreting his simple statement more deeply than he intended? What useful information can we obtain from classic TCM literature? These are topics for discussion.

CVDs and cancer are the two most common diseases in modern society. Obesity and diabetes are emerging as major health issues, and the closely related MetS also predisposes individuals to CVDs. If tea could prevent or delay the development of these diseases, the public health implications would be tremendous. Because of this, there is great public interest in this area of research. This article provides a critical review of these topics, discusses the possible common mechanisms involved, and evaluates the human relevance of the published health effects.

CHEMISTRY OF TEA CONSTITUENTS

The classical tea is believed to be mainly green tea (綠茶 Lǜ Chá). In the manufacturing of green tea, the tea leaves are steamed or baked, rolled, and dried. The heating and drying of the tea leaves help to stabilize the tea constituents during storage. Green tea possesses characteristic polyphenolic compounds known as catechins, which include: (−)-epigallocatechin-3-gallate (EGCG), (−)-epigallocatechin (EGC), (−)-epicatechin-3-gallate (ECG), and (−)-epicatechin (EC). The structures of catechins together with theanine are shown in Figure 1. Catechins account for about 30-42% of the dry weight of brewed green tea, and EGCG is the major form of tea catechins. Tea leaves also contain lower quantities of other polyphenols, such as quercetin, kaempferol, and myricetin, as well as alkaloids such as caffeine and theobromine. A typical brewed green tea beverage (e.g. 2.5 g tea leaves in 250 ml of hot water) usually contains 240-320 mg of catechins, of which 60-65% is EGCG and 20-50 mg is caffeine.[2,3] In the manufacturing of black tea (紅茶 Hóng Chá), the tea leaves are withered and crushed to cause enzyme-mediated oxidation in a process commonly referred to as "fermentation." During this process, most of the catechins are oxidized, oligomerized, and polymerized to form theaflavins and thearubigins, which provide the red-brown color of black tea.[2,3] In brewed black tea, catechins, theaflavins, and thearubigins each account for 3-10%, 2-6%, and greater than 20% of the dry weight, respectively. The caffeine contents in black tea are the same as in green tea. Oolong tea is manufactured by crushing only the rims of the leaves and limiting fermentation to a short period of time to produce the tea's specific flavor and taste. Generally, oolong tea contains catechins, theaflavins, and thearubigins, as well as some characteristic components such as epigallocatechin esters, theasinensins, dimeric catechins, and dimeric proanthocyanidins.[3] The contents of theanine, a characteristic amino acid in tea, vary with conditions of cultivation and manufacturing of tea.

Tea catechins and other tea polyphenols are strong antioxi-

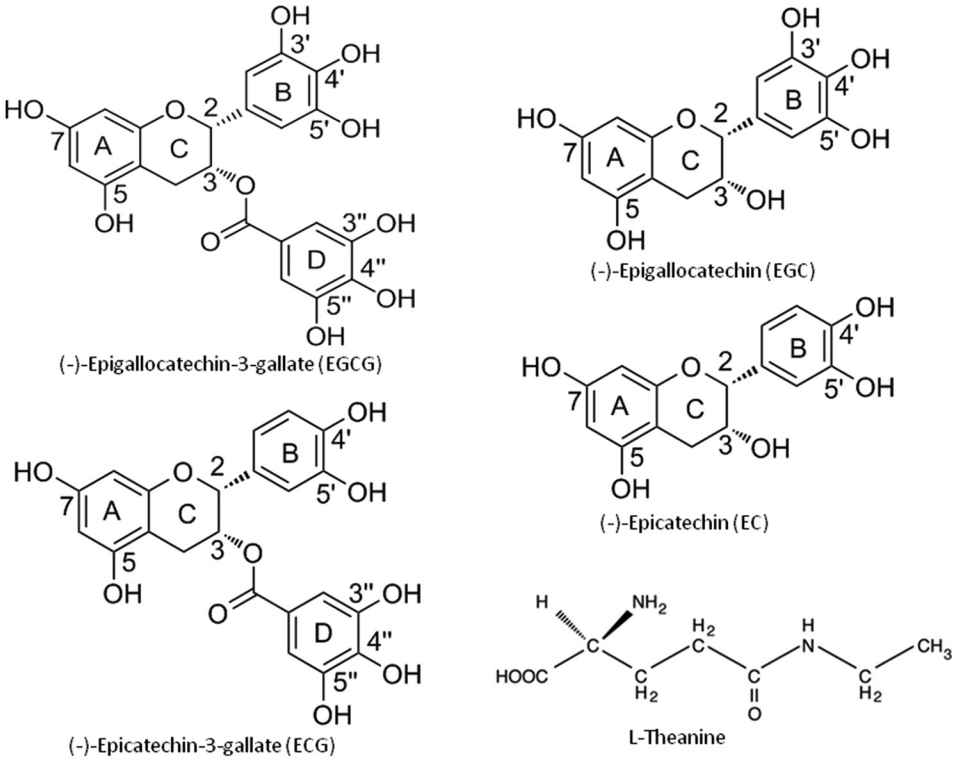

Figure 1. The structures of tea catechins and l-theanine (from [1])