Black Tea, Green Tea, and Tea Polyphenols

Effects on Trace Element Status in Weanling Rats

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ABSTRACT

Previous studies have shown that tea consumption can impair trace element metabolism, particularly iron status, and increase the risk of anemia in humans and animals. More recently, however, evidence has been accumulating to show that, in animals, consumption of green tea or its polyphenols is associated with a reduction of the incidence and severity of a variety of experimentally induced cancers. In this study we have monitored the growth, trace element status, including hematological parameters of weanling rats given either (1) water, (2) 1% black tea, (3) 1% green tea, or (4) 0.2% crude green tea extract as their sole drinking fluid while consuming diets containing either adequate or low amounts of iron. With the exception of manganese, none of the trace elements studied (iron, copper, zinc, and manganese) or the hematological indices measured were affected by the type of beverage supplied, even though the polyphenol extract was shown to chelate metals in vitro and all the animals fed the low iron diet were shown to be anemic. There appeared to be an effect of black and green teas on manganese balance in both the first and last weeks of the study. A lower level of brain manganese was associated with green tea consumption, and a higher level of this element in the kidneys of animals fed black tea. The results demonstrate that both black and green teas and a green tea polyphenol extract do not represent a risk to animals consuming the beverages as their sole fluid.

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intake with respect to iron availability, although the interactions with manganese deserve further study.

Index Entries: Tea; polyphenols; trace element status; antioxidants; rats.

INTRODUCTION

Tea (Camellia sinensis [L]) is the most widely used beverage in the world. Two types of tea are generally consumed: green in China, Japan, North Africa, and the Middle East; and black, predominantly in Europe (British Isles), India, and Sri Lanka. The main difference between these two types of tea is that, in the preparation of black tea, the green leaf is dried, crushed, and the flavonols present are oxidised by polyphenol oxidase and atmospheric oxygen during a "fermentation" process. Condensation of these flavonols forms theaflavins and thearubigens, which impart the black color to the tea. Green tea is prepared from leaves that are dried quickly and do not undergo oxidation. Green tea is held in high regard in Asia not only as a beverage, but also as a medicinal herb. Indeed a number of epidemiological and laboratory studies have shown that administration of green tea, or its main constituents, the polyphenols, in drinking water can influence the occurrence and development of cancers of the lung, intestinal tract, and skin and reduce the incidence of chromosomal aberrations in animals (1-4). Green tea is also reported to have hypocholesterolemic, antibacterial, antiviral, and antioxidant properties (5-9).

There is however evidence from human studies that black tea inhibits the absorption of iron from food (10), which can be of considerable importance during pregnancy and early development (11). Studies by Greger and Lyle (12) and Fairweather-Tait et al. (13), using animals fed low iron diets, have demonstrated that black tea can have detrimental effects on trace metal status and hematological parameters. The effect of green tea or the main constituent flavanols, the catechins, on these parameters has received little attention, although the available information suggests that changes of trace element levels are minimal (12).

The main active principals in green tea appear to be four structurally related polyphenols—(-) epicatechin, (-) epigallocatechin, (-) epicatechin gallate, and (-) epigallocatechin gallate—and it is these that appear to have antioxidant and anticarcinogenic properties. The relative amounts found in fresh dried tea leaves are approx 1-3, 3-6, 3-6, and 9-13%, respectively (14).

Many tumor initiators and promotors are free radical generators with the result that antioxidants are often anticarcinogens. In addition, free radicals can be generated by redox reactions involving trace metals such as iron and copper. Three of the four polyphenols have gallate residues and (-) epicatechin has a catechol residue, all of which are able