

# TOTAL PHENOLIC COMPOUNDS AND TANNINS CONTENT OF *BANCHA* GREEN TEA (*CAMELLIA SINENSIS*) DEPENDING ON EXTRACTION CONDITIONS

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## ABSTRACT

The effect of different extraction conditions of prepared infusions on the content of bioactive compounds of *Bancha* green tea (*Camellia sinensis* L.) were investigated. The content of total phenols, tannins and methylxanthines were determined spectrophotometrically. The highest content of total phenolic compounds and tannins were determined on the 30<sup>th</sup> minute of infusion – 7,71% and 4,49% respectively. The conditions with the most valuable (higher content of polyphenols) and the most healthy (lowest of tannins) combination is in the 10<sup>th</sup> minute of extraction – 7,47% and 3,84%. The tea also contained low percentages of methylxanthines (0,66%) and caffeine (0,09%).

**Keywords:** *Bancha* green tea, total phenols, flavonoids, methylxanthines, caffeine

## INTRODUCTION

Green tea is a regularly consumed traditional drink in Japan and China and is characteristic to their culture. Although produced from the same plant, *Camellia sinensis* L., differences in the manufacturing process specify that green tea has a higher catechin content than black tea (1), which may contribute to its beneficial effects on cancer, cardiovascular diseases and other conditions (9). Tea contains large amounts of various phenolic compounds as flavonoids, phenolic acids, tannins and others. Based on data in literature, higher content of total phenols

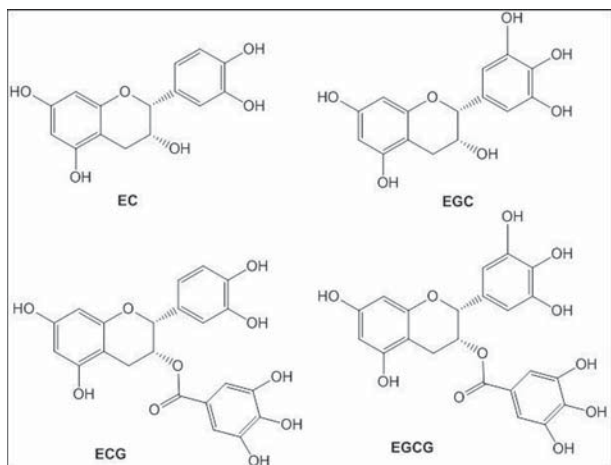
are connected with beneficial effects of the tea, while higher content of polymer phenolic - tannins is associated with adverse effects, mainly gastro-intestinal disorders (5). Another interesting group of phenolic compounds are the flavonoids. A class of tea flavonoids – catechins, include epicatechin (EC), epigallocatechin (EGC), epicatechin-3-gallate (ECG), and epigallocatechin-3-gallate (EGCG) (1,5) (Fig. 1). Other classes of compounds, important for their biological activity are methylxanthines. The main methylxanthine is caffeine, which has attracted much scientific and public attention during the past years. The caffeine content of tea leaves varies with tea type, but the normal range goes from 2–5% (dry weight, w/w) together with small amounts of theobromine and theophyllin. Caffeine is chemically 1,3,7-trimethylxanthine (C<sub>8</sub>H<sub>10</sub>N<sub>4</sub>O<sub>2</sub>), which is an alkaloid found in tea, guarana, kola nuts, coffee, cocoa beans and other plants. Caffeine acts as a stimulant for the heart, respiratory and the central nervous system, and is a vasodilator as well as a diuretic (Fig. 1) (7).

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**Fig. 1.** Chemical structures of major green tea polyphenols: The polyphenols that exist in green tea are mainly (+)-epicatechin (EC), (-)-epigallocatechin (EGC), (-)-epicatechin gallate (ECG), and (-)-epigallocatechin gallate (EGCG). EGCG is the most powerful and the most abundant of the major catechins found in green tea

The main objectives of the present study is to determine the correlation between different extraction time and the content of total phenolic compounds and tannins in *Bancha* green tea as well as estimate the content of methylxanthines and especially the caffeine in it.

## MATERIAL AND METHODS

### Plant materials and chemicals

Whole *Bancha* green tea leaves (*Camellia sinensis* L.) were purchased from a local market. All chemicals used in the spectrophotometric methods were purchased from *Sigma-Aldrich*.

### Quantification of total phenols and tannins

The determination of total phenols in the plant drugs was performed according to the *European Pharmacopoeia 6* involving *Folin-Chiocalteu* reagent and pyrogallol as standard (4). The measurements were carried out using an S-22, UV/VIS spectrophotometer (Germany) at 760 nm.

### Quantification of total methylxanthines and caffeine

Accurately weighed amount of the drug ( $\pm 0.0001$ g) were boiled in water for 15 minutes. The combined aqueous extracts were acidified with sulfuric acid and concentrated. The solution was extracted with chloroform in a separating funnel. Chloroform extract was washed with sodium hydroxide and

then with water. After the evaporation of chloroform a mixture of methylxanthines was obtained. From this mixture the caffeine was prepared by sublimation then the percentage of caffeine in the plant substances was calculated (in w/w).

### Statistical analysis

All experiments were done in triplicate and data in tables and figures represent mean values  $\pm$  standard deviation ( $n = 3$ ). Results were evaluated for statistical significance using one-way ANOVA using SigmaPlot (Version 11.0). The confidence level for statistical significance was set at a probability value of 0.05.

## RESULTS AND DISCUSSION

Increasing interest in the health benefits of tea has led to the inclusion of tea extracts in dietary supplements and functional foods. *Bancha* green tea (third or fourth flush of green tea; that is, the late seasonal picking) (Fig. 2) is the one main types of green tea consumed in Japan, and is usually prepared by steeping the tea leaves in hot water (6).



**Fig. 2.** *Bancha* tea leaves

In our study, we examined the impact of extraction time on total phenols and tannins content of *Bancha* green tea. Numerous extractions were conducted at different times between five and thirty minutes. Polyphenols content in these periods vary respectively between 6,99% (w/w) to 7,71% (w/w), and tannins between 3,65% (w/w) to 4,49% (w/w) (Fig. 3). The highest level of polyphenols (7,71% (w/w)) and tannins (4,49% (w/w)) were observed at the 30<sup>th</sup> minute of extraction and lowest in the 5<sup>th</sup> (6,99% (w/w) and 3,65% (w/w) for total polyphenols and tannins

respectively). In the other investigated conditions the level of extracted polyphenols increased insignificantly from 7,47% (w/w), to 7,55% (w/w) while the rise of tannins was more elevated - 3,84% (w/w) to 4,28% (w/w). The conditions with the most valuable (higher content of polyphenols) and the most healthy (lowest of tannins) combination is at the 10<sup>th</sup> minute of extraction where the content of total polyphenols was 7,47% (w/w) and tannins only 3,84% (w/w). Similar data for total polyphenols content were established in our previously study (8) with other types of tea (at the 30<sup>th</sup> minute) - black and green tea, where phenolic compounds were 7,32% (w/w) and 5,97% (w/w) respectively. While the content of tannins is mainly associated with unpleasant taste - astringent feeling inside of your mouth and no beneficial systemic effects, the higher content of polyphenols provide for antioxidant, anti-inflammatory and cancer protective activity (Fig. 3) (10).

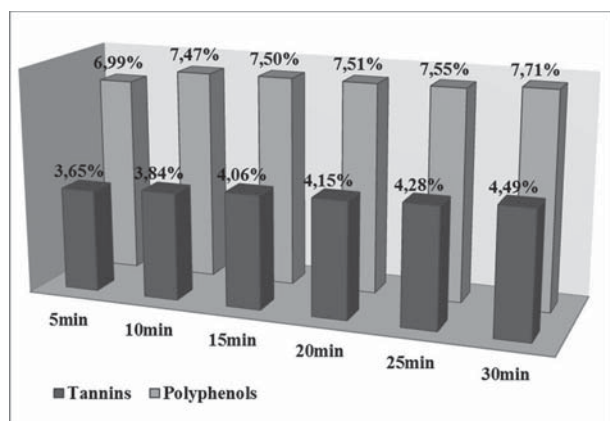


Fig. 3. Content (% w/w) of polyphenols and tannins in Bancha tea leaves depending on extraction time (min)

Methylxanthines, in particular caffeine, is the world's most popular drug and is found in many beverages including tea. Although caffeine is commonly ingested to enhance alertness and improve performance, its use should be avoided by pregnant women, children, and people with cardiovascular diseases and anxiety disorders (3). In a further study, we have determined the content of total methylxanthines and caffeine. The results have shown that in Bancha tea total methylxanthines are 0,66% (w/w), and caffeine is only 0,09% (w/w) (Fig. 4).

In the above mentioned study (8), the content of total methylxanthines and caffeine in black and

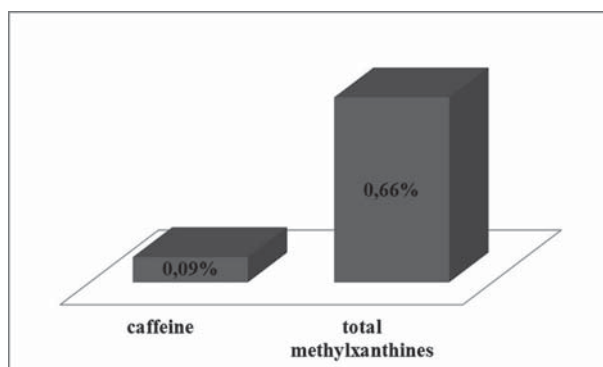


Fig. 4. Content (% w/w) of total methylxanthines and caffeine in Bancha tea leaves

green tea made in the same extraction, conditions were almost twice higher (1,15% (w/w) and 1,31% (w/w) respectively) and caffeine content 8-9 times higher (0,67% (w/w) and 0,80 % (w/w) respectively).

## CONCLUSION

The findings of the present study indicate that Bancha tea is a good source of plant polyphenols which may possess antioxidant, anti-inflammatory and cancer preventive action. The low content of caffeine allows its use by pregnant women, children, and people with cardiovascular diseases and anxiety disorders as a stimulant beverage with proven health properties. All these topics are under investigation and show a high potential for this tea species.

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