Investigating the Pharmacological Effects of Synephrine, L-Theanine, and Ginsenosides as a Natural Caffeine Substitute via Tea Bag

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Abstract

Excessive caffeine consumption is associated with adverse health effects, prompting the search for safer alternatives that provide similar stimulation without harmful side effects. This study investigates the potential of pomelo peel (*Citrus maxima*) as a source of synephrine, Asian ginseng (*Panax ginseng*) leaves for ginsenosides, and Assam tea (*Camellia sinensis*) leaves for L-theanine to create a natural caffeine substitute in tea bag form. Each plant material underwent washing, drying, and extraction, followed by compound identification using paper chromatography and specific reagents: Dragendorff for synephrine, vanillin-sulfuric acid for ginsenosides, and ninhydrin for L-theanine. Results confirmed the presence of the target compounds, with pomelo peel showing red coloration, ginseng producing yellow spots, and Assam tea yielding purple coloration. These findings suggest that the selected botanical extracts can be combined into a functional tea blend with stimulant and cognitive-enhancing potential. Further studies, including animal trials and plasma analysis via HPLC, are recommended to evaluate pharmacological efficacy and safety compared to caffeine.

Keywords: caffeine, citrus maxima, panax ginseng, camellia sinensis, synephrine

1. Introduction

As defined by the National Center for Biotechnology Information (NCBI), caffeine is a natural stimulant that works by stimulating the central nervous system to enhance alertness and reduce fatigue. Caffeine is the most widely consumed psychoactive substance globally, with over 1 billion people drinking coffee every day, making up about 12.6% of the world's population. While most commonly associated with coffee, caffeine is also present in tea, energy drinks, soft drinks, and certain medications like pain relievers. In fact, studies show that over 85% of the U.S. population consumes caffeine at least once daily, whether in coffee or other beverages. [1] This widespread consumption has made caffeine one of the most recognized and studied compounds in the food and beverage industry. Its popularity is largely due to its ability to boost energy and alertness. [2]

Caffeine, while beneficial in moderation, can lead to a range of