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# Neuroscientific evaluation of characteristic bioactive compounds contained in roasted green tea

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## Abstract

Roasted green tea (RGT) has a unique flavor and aroma, which exhibits a relaxing effect. Few reports have elucidated the relaxing effect and other biological activities of RGT. Therefore, this study aimed to evaluate the neuroscientific functions of pyrazines, pyroglutamic acid, and epimerized catechins, which are produced during the roasting process in the manufacture of RGT. Pyrazines served as modulators of the ionotropic γ-aminobutyric acid receptor ($GABA_AR$), the inhibitory neurotransmitter receptor of the brain, in the *Xenopus* oocyte expression system. This was further confirmed by the elevated plus maze test. Pyroglutamic acid served as an agonist of $GABA_AR$. Gallocatechin gallate epimerized catechin during roasting, resuting in a compound with the same antioxidant effect on the human neuroblastoma cell line SK-N-SH against $H_2O_2$ as epigallocatechin gallate, a catechin before epimerization. These characteristic compounds could be responsible for the biological effects of RGT.

Keywords : pyrazine, $GABA_A$ receptor, pyroglutamic acid, gallocatechin gallate, antioxidative activity

## Ⅰ Introduction

Roasted green tea (RGT), known as hojicha in Japanese, is obtained by roasting green tea (GT) at a high temperature of approximately 200°C using a tea roaster. It has an attractive roasty and sweet aroma that is distinct from other teas, including GT, black tea, and oolong tea[1)]. The unique aroma of RGT has a relaxing effect, making it less irritating to the stomach and suitable for consumption during and after a meals. Tea, renowned for its medicinal properties since ancient times, has been recently been found to offer various health benefits[2)], including cancer prevention[3)], cardiovascular disease prevention[4)], immunoregulation[5)], and antioxidative activity[6)]. The biological activities of polyphenols in black tea and oolong tea have also been reported[7)]. Similarly, RGT exhibits health functions, particularly a relaxing effect, although its bioactivity requires further clarification.

Theanine, a well-studied compound in tea, induces relaxing effect by modulating neurotransmitters in the brain[8)]. Additionally, aroma compounds present in RGT contribute to its relaxing aroma by using gas chromatography–olfactometry (GC-O), which is a human sniffing method to detect aroma compounds separated by gas chromatography[9, 10)]. The most important aroma compounds are pyrazines, such as 2-ethyl-3,5-dimethylpyrazine, 2-ethyl-3,6-dimethylpyrazine, 2,3,5-trimethylpyrazine, and 2,3-diethyl-5-methylpyrazine, which were detected using high-sensitivity GC-O. Furaneol, another type of Maillard reaction product, geraniol, and linalool were also detected by GC-O.

Roasting alters the nonvolatile compounds in RGT. Amino acids are reduced and converted into aroma compounds, while pyroglutamic acid, resembling relaxing compounds, such as theanine and GABA, is generated from glutamine. Furthermore, roasting leads to epimerization of catechins. The four major tea catechins epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECg), and epigallocatechin gallate (EGCg)

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