

Mechanism of Tea Drinking in Regulating Mental Health and Obesity

Yitang Huang *

Guangzhou Huamei International School, Guangzhou, China, 510520

* Corresponding Author Email: ninah1753884167@gmail.com

Abstract. Tea provides notable health benefits through bioactive components, and various properties highlight tea's potential as a functional drink for mental and physical health. However, the mechanism by which tea drinks regulate mental state and obesity remains to be further analyzed. In order to clarify this regulatory mechanism, this research investigates tea's effects on mental health, particularly mood regulation, and physical health, focusing on lipid metabolism, anti-inflammatory responses, and bile acid metabolism. Tea consumption enhances cognitive functions, reduces depression risk via anti-inflammatory and neuroprotective effects, and mitigates obesity by promoting fat oxidation, suppressing inflammation, and modulating gut microbiota. Long-term green tea intake improves sleep quality, testosterone levels, and gray matter volume in middle-aged and elderly men, while various teas reduce fat accumulation in obese murine models through distinct pathways, AMPK activation, and IL-6 suppression. Future research should focus on mechanistic studies isolating tea components, and validating tea-based interventions for public health. This research reveals tea's potential and effects as a cost-effective dietary beverage for mental and physical health management.

Keywords: Tea; Mood; Obesity; Effects; Mechanisms.

1. Introduction

Tea represents a substantial character in people's daily lives, and it has had a profound impact throughout thousands of years in Chinese history. Teas are categorized into distinct types based on unique processing techniques, including green tea, White tea, yellow tea, Oolong tea, Dark tea, and Black tea. The variety of tea types satisfies regional tastes and the dietary habits of Chinese people, which significantly influence people's preferences for different teas. For instance, in Guangdong, people often pair tea with dim sum to help reduce greasiness. The Chinese passion for tea is not only due to the cultural importance, but also to its benefits to physical and mental health. Most of the teas contain caffeine and tea polyphenol (TP), where these elements have effective functions on human health.

Tea consumption is related to regulation of human health, such as mental health and obesity. Some of the researches have focused on the association among tea consumption, brain processing, and nervous system. Many studies have mentioned that tea consumption and cognitive activities are positively associated [1, 2]. Ikar et al. discovered that moderate tea consumption may positively affect human memory, attention, and reaction time [1]. Specifically, the existing research indicates that both EGCG and L-theanine show neuroprotective [3] activity, demonstrating that certain improvements in cognitive abilities are correlated with the consequence of multiple components [4]. L-theanine, tea polyphenols, and tea pigments exert antidepressant effects through synergistic mechanisms influencing multiple physiological pathways. Consuming decaffeinated green tea daily for six weeks significantly alleviated depression, anxiety, stress, and mental health issues related to stuttering in adolescents [5]. The research results indicate that green tea, green tea extract (GTE), L-theanine, and epigallocatechin gallate (EGCG) may alleviate mood disorder symptoms, especially depression [6]. Long-term tea consumption is beneficial for reducing BMI and increasing the level of testosterone, and it can lower the possibility of getting depression by reducing inflammation and improving sleep quality [2].

Tea is salubrious to physical health as well. It can help improve obesity levels and slightly modify daily diets. A great deal of people drink tea as a habit that permeates their daily diets, because long-term consumption of tea can have indirect effects. The consumption of tea can reduce the reliance on high-fat diets (HFD) and preferences for such foods [7, 8]. Liu et al. concluded that six types of tea effectively reduced the fat accumulation and inflammatory response in obese mice by enhancing lipid metabolism and inhibiting inflammation [9]. Despite the regulatory mechanisms in six types of tea are different, in general, tea is an essential product for anti-obesity and anti-inflammation. Numerous clinical studies demonstrate that green tea consumption may promote weight loss and help reduce obesity [10]. Some specific type of tea, oolong tea, can be used as a natural medicine to treat obesity induced by high-fat diets through several mechanisms: improving fat accumulation, hepatic damage, glucose intolerance, and endotoxemia, and alleviating inflammation by decreasing the levels of pro-inflammatory factors [11]. Sun et al. state that oolong tea is effective for anti-obesity, functioning to block weight gain by regulating bile acid metabolism and modulating intestinal bacteria [12]. Matcha improves insulin sensitivity by down-regulating the expression of certain genes in the liver (related to fat production), thereby indirectly reducing the tendency to overeat [8]. Most in vitro human fecal fermentation studies consistently show changes in gut microbiome, with increased populations of beneficial bacteria and suppression of harmful bacteria [13]. Dark tea extracts may exert an anti-obesity effect by decreasing levels of key transcription factors, such as C/EBP α and PPAR γ , which promote adipocyte differentiation [14]. However, the effect of tea consumption on human health still requires further analysis.

This research aims to investigate the effects of various tea components on mental health—particularly mood regulation and depressive states—and on physical health, including lipid metabolism, anti-inflammatory responses, and bile acid metabolism. Existing problem in the fields of mental health and obesity are also discussed in this research. Lack of research discusses the effects of tea components on human clinical fields. Precise experiments are further needed to address the various problems identified in previous investigations.

Table 1. Effects of different tea components on the primary underlying biological mechanism assessed in depressive symptoms [15].

Name	Influences on the pathophysiological processes underlying depression			
	Monoamine neurotransmitter system	Mental stress response and HPA axis function	Responses to anti-inflammation	Generation of new neurons and neural plasticity
Tea flavins	+	-	+	-
Digallate flavin	-	-	+	-
EGCG	+	+	+	+
EGC	+	+	+	+
EC	+	-	+	+
Methylated EGCG	+	-	-	-
Gallate	-	-	+	+
GCG	+	-	+	-
Decaf green tea	-	+	-	-
Green tea fragrance	-	+	-	-
Black tea scent	-	+	-	-

Here, + indicates positive impacts and - indicates no impacts.

2. Mental health: Reducing depressive level and protecting mood

2.1. Depression

Depression is associated with several components: monoamine neurotransmitter, HPA levels, the role of inflammation, the function of BDNF, gut microbiota and intestinal microbial [15]. The biological basis of depression disorder arises from the convoluted interplay of various dysfunctional systems. The polyphenol consumption is inversely associated with the risk and alleviation of depression (Table 1). For example, catechin has positively protective function for the brain and certain parts related to depression.

The consumption of polyphenols is inversely correlated with depressive disorder, while tea is a major source of dietary intake of polyphenols. A specific polyphenol contained in tea is catechin, which can enter the brain and lower cortisol levels by utilizing its oxidative and anti-stress functions. Not only is catechin useful against depressive symptoms, but theanine (γ -glutamylethylamide) and folate can also be used as an anti-depressive component.

There are a few limitations in the research. Despite the correlation between tea components and depression risk being successfully drawn, the cause-and-effect relation still needs to be established. Since most studies on tea components and depression derived from pre-clinical research, their feasibility to human clinical settings remains uncertain. Therefore, necessitating further studies are required to validate their therapeutic potential.

2.2. The ways affected mood

Tea compound affects humans' mood in several ways, including EGCG, L-theanine, and the combination of L-theanine and caffeine, either function individually or function together [4]. Consumption of EGCG exhibits a significant sedative effect and helps alleviate stress. L-Theanine lowers stress-induced heart rate and enhances the immunoglobulin A secretion. The combination of L-theanine and caffeine causes people to feel more alert, less tired, and less afflicted with headache and some mental fatigue in several past experiments.

Additional research is necessary to address several problems. First, it is essential to confirm that green tea components, such as L-theanine, consistently produce acute or chronic effects. Second, it is critical to establish the minimum duration required to achieve long-term benefits from green tea. Third, the mood-enhancing effects of EGCG remain uncertain and require further clarification.

2.3. Protections of mental health

Through a comparative study conducted from June 2023 to March 2024 in rural areas of Hubei Province, the impact of long-term consumption of green tea (at least 6 days a week, at least 500 milliliters per day, for more than 20 years) on the mental health of middle-aged and elderly men (aged 45 and above) was explored, focusing on changes in depression levels, hormones, and brain structure [2]. Long-term green tea consumption impacts depression levels, sleep quality, inflammation levels, hormone levels, brain structure, and body mass index (BMI). The group with long-term tea consumption exhibits lower depression levels compared to the non-tea-consuming group. The individuals in the tea-consuming group show substantially less severe insomnia than those in the non-tea-consuming group. The Systemic Immune Inflammation Index (SII) is considerably reduced in the tea-consuming group compared to the non-tea-consuming group. The testosterone concentrations are notably higher in the tea-drinking group, while no significant differences are observed in thyroid hormones (TSH, FT3 and FT4) or estradiol levels. The left medial temporal and parahippocampal gyrus gray matter volume in the tea-drinking group was higher, which may delay brain aging.

The mechanisms are further analyzed. The polyphenols (such as EGCG) and theanine in green tea may reduce SII through anti-inflammatory effects, alleviate neuroinflammation, and thereby decrease the risk of depression. The anxiolytic effect of theanine (chemical component of green tea) improves sleep quality, indirectly reducing depression. Long-term tea consumption may improve mood and

sexual function by increase testosterone levels, and reduce depressive symptoms. EGCG might enhance gray matter volume through its neuroprotective properties, such as preventing the loss of hippocampal neurons, potentially delaying brain aging. However, this research did not unify the concentration, frequency, and intake amount of green tea. The shortest period of long-term tea consumption required for significant efficacy remains undetermined. A wider age range is needed to generalize the results and conclusions to the entire population. Some confounding variables were not properly controlled in the existing experiment.

3. The impact mechanisms of different types of tea on obesity

3.1. Increasing lipid metabolism and suppressing inflammation

The unclear mechanism that explains the therapeutic actions of various types of Chinese Tea is investigated [9]. Through feeding the mice an HFD, the researchers established a murine model of obesity. As the HFD is assigned to the mice, the experiment shows that all 6 types of WEATs concentrated from tea have significantly reduced the weight of HFD mice. For example, the fat around the abdomen is lost, and lessens the hepatic steatosis. In the improvement of blood lipids and liver lipids, WEATs notably decrease the TG level in serum and liver. The TC level in the liver also decreases. In the regulation of fat metabolism enzymes, YEL and RPE considerably increase the p-AMPK level. WHI, GRE, and RPE decrease the FAS level, and WHI, YEL, and OOL raise the expression of CPT-1. For the expression of the inflammation factor, all the types of tea are significantly lower than IL-6, and GRE, YEL, and OOL can inhibit the expression of nitric oxide synthase (iNOS). All types of tea are available to lose weight and for anti-inflammation, however, in different pathways and mechanisms.

5'-AMP-activated protein kinase (AMPK) is a key enzyme that regulates cellular energy metabolism. When the energy supply is insufficient, AMPK gets activated, which subsequently inhibits fat synthesis and promotes fat oxidation. Studies have shown that green tea and raw Pu'er tea significantly increased the expression of p-AMPK in the livers of obese mice induced by HFD, suggesting that these two types of tea may enhance fat breakdown and energy consumption by activating the AMPK pathway, thereby exerting anti-obesity effects.

Fatty acid synthase (FAS) is a key enzyme in lipid synthesis, and its activity directly affects the production of fat. Experimental results show that green tea, white tea, and raw Pu'er tea can significantly reduce the expression of FAS in the liver, thereby effectively inhibiting the synthesis of fatty acids [9]. This mechanism helps to reduce the accumulation of new fat and alleviate obesity and its related metabolic disorders.

Carnitine palmitoyl transferase 1 (CPT-1) is a rate-limiting enzyme in the fatty acid oxidation process, mainly responsible for transporting long-chain fatty acids to the mitochondria for breakdown. This study shows that white tea, yellow tea, and oolong tea can significantly increase the expression of CPT-1 in the liver, enhance the ability of fat oxidation, thereby promoting the breakdown and energy release of fat and exerting the effect of weight loss.

Obesity is often accompanied by a low-grade chronic inflammatory state. The continuous elevation of pro-inflammatory factors such as Interleukin-6 (IL-6) and inducible iNOS can exacerbate fat accumulation and metabolic disorders. Studies have found that all six types of tea can significantly down-regulate the expression of IL-6 in the liver; among them, green tea, yellow tea, and oolong tea can also significantly reduce the level of iNOS. This indicates that tea extracts; by regulating inflammatory signaling pathways, help alleviate the inflammatory response caused by obesity.

However, there are some drawbacks. First, only murine models were used in the research; therefore, further studies are needed to prove the efficacy of clinical usage. Second, the author pointed out that the weight-loss effects of the six types of tea have no significant correlation with any single component. This indicates that the mechanism may be influenced by the interaction of multiple

components, but the specific active ingredients have not been fully identified. Third, a longer period for the experiment is required to investigate the effects of long-term consumption of tea.

3.2. The bile acid metabolism

The effects of green, black, white, and oolong teas, prepared from identical raw tea leaves, on the modulation of the plasma bile acid profile are discussed [12]. Various tea types consumption did not significantly affect fluid intake compared to the control group. The interaction between time and tea type was not considerable for food intake or feces weight, which shows that there is no influence on food intake or feces excretion trends by tea consumption. The repeated measures ANOVA with Greenhouse-Geisser correction indicates a significant effect ($P < 0.05$) of different tea types on weight increase. A t-test demonstrated that 11 BAs were significantly affected by tea consumption. The levels of different types of indicator substances slightly increased, while some of them decreased after tea exposure. Green tea has the highest levels of catechins and xanthines, while black tea has the lowest levels. No significant disparity in the amounts of these compounds was found between white and oolong teas. The EGC concentration is generally higher than the EGCG concentration, but excluding oolong tea.

Bile acids are the products of cholesterol metabolism, which is a way to eliminate cholesterol as well. Bile acids not only participate in lipid absorption, but also play a crucial role as molecules that regulate energy metabolism and immune function by activating receptor signaling pathways. It can activate several receptors such as FXR, TGR5 and VDR. FXR can activate the pathways of metabolism of cholesterol in liver, the reabsorption of bile acids in the gut, and the metabolism of glucose. Once TGR5 is activated, the pathways of energy consumption and heat production are promoted. The regulation of immune reaction and inflammatory status will be activated when signal molecules bind to VDR. Bile acids are not only influenced by the intestinal microbiota, but also can in turn regulate the host's metabolism. Previous research suggests that the blood bile acid levels in obese mice are lower, while those in lean mice are higher, indicating that the relationship between bile acid and metabolic disease is closely related.

However, the rat model in the experiment is maintained on a normal diet, not a high-fat diet. The use of test substance at a higher dosage is necessary in further investigation. All the conclusions are based on correlation, so the causal relationship needs more research to build up. The absorption of EGCG is extremely low, and its half-life is short. This evinces that the weight control effect may not be directly caused by a single component.

4. Discussion

Many studies investigate different and innovative mechanisms, which contribute to recent research field. For example, catechins are capable of crossing the blood-brain barrier and may reduce cortisol levels by exerting antioxidant and stress-reducing effects, thereby reducing depressive symptoms. However, there are still some problems need further research to complete. Although there are strong correlations between tea components and their effects on mental health and obesity, the detailed causal mechanisms have yet to be fully established. The minimum intake required for specific tea components, such as L-theanine and EGCG, to exert measurable effects remains unknown. The samples of some research cannot successfully generalize to the full population. The experimental models are limited, and further research using diverse models is needed to explore the clinical potential of tea components. While some mechanisms may result from interactions among multiple components, the precise active ingredients remain unidentified.

To establish the clinical potential of tea components in humans, future studies should employ more precise and comprehensive experimental approaches. Generalizability can be improved by including diverse age groups and controlling for confounding variables such as diet and lifestyle in future trials. Mechanistic studies should aim to isolate the effects of individual tea constituents and differentiate them from any synergistic interactions that may occur. Validating the efficacy of tea-based

interventions in clinical settings is essential, especially for developing targeted nutritional therapies for middle-aged and elderly populations at risk of depression or metabolic disorders. Such efforts will contribute to a more robust evidence base supporting tea as an affordable and widely accessible dietary intervention in public health strategies.

5. Conclusion

This research discovered that the intake of tea can regulate human health levels. Specifically, it focused on the effects of tea on mental status and obesity. For mental status, the tea components positively modulate mood, which means to reduce depressive symptoms. The consumption of tea components affects the human body through biochemical reactions of EGCG, L-theanine, and catechin in the neuronal system. The various tea components regulate the human obesity level by activating AMPK, reducing FAS, increasing the level of CPT-1, and inhibiting IL-6 and iNOS. The analysis of the mechanisms of tea's effects on mental status and obesity state is beneficial for the development and invention of new food components that can help people maintain a healthy life. However, causal relationships, optimal dosages, and generalizability remain unclear due to limited human clinical data and uncontrolled variables. In future studies, more precise experiments are needed to corroborate the human clinical potential.

References

- [1] Ikar M, Sable S. Tea, coffee and green tea consumption and mental health outcomes: A systematic review and meta-analysis of observational and intervention studies on stress and related conditions [J]. *Journal of Pharmacognosy and Phytochemistry*, 2023, 12 (2): 209 - 221.
- [2] Wan Z, Wan Q, Qin X, et al. Long-term consumption of green tea protects the mental health of middle-aged and older adult men by improving inflammation levels [J]. *Frontiers in Public Health*, 2025, 13: 1531953.
- [3] Xiao S, Li Y, Jiang H, et al. Tea and Its Active Ingredients in Preventing and Alleviating Depression: A Comprehensive Review [J]. *Foods*, 2025, 14 (12): 2054.
- [4] Mancini E, Beglinger C, Drewe J, et al. green tea effects on cognition, mood and human brain function: A systematic review [J]. *Phytomedicine*, 2017, 34: 26 - 37.
- [5] Almudhi A, Gabr S A. Green tea consumption and the management of adrenal stress hormones in adolescents who stutter [J]. *Biomedical Reports*, 2022, 16 (4): 32.
- [6] Cavanah A M, Robinson L A, Mattingly M L, et al. The Impact of Green Tea and Its Bioactive Compounds on Mood Disorder Symptomology and Brain Derived Neurotrophic Factor: A Systematic Review of Randomized Controlled Trials [J]. *Biomedicines*, 2025, 13 (7): 1656.
- [7] Moran-Lev H, Cohen S, Zelber-Sagi S, et al. Effect of coffee and tea consumption on adolescent weight control: an interventional pilot study [J]. *Childhood Obesity*, 2023, 19 (2): 121 - 129.
- [8] Wang Y, Yu Y, Ding L, et al. Matcha green tea targets the gut–liver axis to alleviate obesity and metabolic disorders induced by a high-fat diet [J]. *Frontiers in Nutrition*, 2022, 9: 931060.
- [9] Liu C, Guo Y, Sun L, et al. Six types of tea reduce high-fat-diet-induced fat accumulation in mice by increasing lipid metabolism and suppressing inflammation [J]. *Food & function*, 2019, 10 (4): 2061 - 2074.
- [10] Xu X Y, Zhao C N, Li B Y, et al. Effects and mechanisms of tea on obesity [J]. *Critical Reviews in Food Science and Nutrition*, 2023, 63 (19): 3716 - 3733.
- [11] Li A, Wang J, Kou R, et al. Polyphenol-rich oolong tea alleviates obesity and modulates gut microbiota in high-fat diet-fed mice [J]. *Frontiers in Nutrition*, 2022, 9: 937279.
- [12] Sun L, Xu H, Ye J, et al. Comparative effect of black, green, oolong, and white tea intake on weight gain and bile acid metabolism [J]. *Nutrition*, 2019, 65: 208 - 215.
- [13] Zhao Z, Chen R, Ng K. Effects of differently processed tea on the gut microbiota [J]. *Molecules*, 2024, 29 (17): 4020.
- [14] Lim H J, Lim T J, Lee J H, et al. Anti-obesity effects of dark tea extracts by down-regulation of C/EBP α and PPAR γ [J]. *in vivo*, 2022, 36 (4): 1753 - 1760.
- [15] Lange K W, Nakamura Y, Lange K M, et al. Tea and depression [J]. *Food Science and Human Wellness*, 2022, 11 (3): 476 - 482.