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Effects of Green Tea Extract on Body Composition in Overweight Adults

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Abstract

Previous researches have reported several positive effects of green tea on weight control and body composition, mainly focusing on weight and body fat loss. In this 12-week experimental cross-over control study, the effects of green tea extract on body composition, specifically body fat percentage and visceral fat level, were investigated. Fifteen overweight Thais (age 30-40 with BMI between 23.0 to 27.5 kg/m^2) were assigned to a 6-week control period with no green tea extract consumption, then continued with a 6-week experimental period of green tea extract consumption (103.56 mg daily). Their body composition (weight, BMI, body fat percentage, visceral fat level, and waist-to-hip ratio) was obtained at baseline, Week 6, and Week 12. Results analyzed with repeated measures ANOVA showed significant differences between means of body weight, BMI, and visceral fat level. Pairwise comparison revealed further that a statistically significant decrease in visceral fat level (with a mean difference of 0.53 and p-value of 0.044) was evident after 6 weeks of green tea extract consumption.

Keywords: Green Tea Extract, Overweight, Body Composition, Body Fat, Visceral Fat

Introduction

Many research studies have shown that body composition is directly related to health. Healthcare professionals, researchers, and even fitness personnel have been measuring and obtaining figures on our body composition to learn more about possible health risks and promote healthier conditions. Classification from the World Health Organization (WHO) to determine if an individual is underweight, normal, overweight, or obese using the Body Mass Index (BMI) lends itself as one of the easy predictors of mortality and morbidity associated with obesity (WHO expert consultation, 2004). Body circumference measurement is another method that can be used as an indicator of central obesity and a predictor of disease risk factors (Cahalin & DeTurk, 2017). Risk factors for cardiovascular diseases (such as hyperglycemia, hypercholesterolemia, and hypertension) are associated with waist-to-hip ratios higher than 0.95 in men and 0.8 in women (Powers & Howley, 2018). Apart from simple external measurement, the Bioelectrical Impedance Analysis (BIA) can be used to gauge our body composition, by measuring the resistance to a small electrical current released from the BIA equipment into the body (impedance). An estimate of total body water (TBW), which can potentially predict fat mass and fat-free mass, can be obtained from these impedance values (Powers & Howley, 2021; Ward, 2018). Many BIA equipment have been developed to provide details of, for example, muscle-fat analysis, lean balance, and visceral fat area, with moderate accuracy, which can offer insights to our current health status (Chaichalotornkul, 2021).

There has been evidence of the beneficial effects green tea catechins can provide us through numerous mechanisms, ranging from antioxidant, anti-viral, and anti-cancer effects to lipid (fat) and sugar regulation, heart health, and weight reduction (Balsaraf & Chole, 2015; Chinchole et al., 2014; Sinija & Mishra, 2008). In addition, supporting evidence of the positive effects of green tea catechins on weight, body composition (body fat), lipid profile, blood sugar, and even hormonal changes have also been reported (Belcaro et al., 2013; Di Pierro et al., 2009; Gilardini et al., 2016; Huang et al., 2014; Wang et al., 2010). Given the evidence of its effects on our weight, green tea has been incorporated into weight loss regimen, either as a drink or as a supplement. Several underlying mechanisms for green tea's weight control effects have been proposed. A study by Dulloo et al. (1999) found that green tea catechins functioned to inhibit catechol-O-methyltransferase (COMT), a catecholamine-degrading enzyme. Since norepinephrine (NE; one chemical in the catecholamine family) cannot be degraded when COMT is inhibited, the sympathetic nervous system (SNS) is constantly aroused due to the presence of NE, which binds to b-adrenoceptors and produces an increase in energy expenditure (thermogenesis) and fat oxidation (Hursel & Westerterp-Plantenga, 2010). Due to this reaction, it was proposed that by inhibiting COMT, green tea catechins can consequently prolong either thermogenesis or fat metabolism, or both. Faster metabolism of fats and sugars has also been shown with green tea consumption. With its inhibitory effect on insulin, green tea can redirect sugar to be used immediately by muscles instead of being converted and stored in our body as fats (Sinija & Mishra, 2008). Green tea catechins have also been reported to affect visceral adipose tissues to address visceral adiposity. Choi et al. (2020) found that EGCG activated autophagy and lipolysis of visceral white adipose tissue via the AMP-activated protein kinase (AMPK) signaling pathway. These mechanisms activate ATP production, increase lipolysis and fatty acid oxidation, and inhibit lipogenesis. As a consequence, green tea consumption could lead to lower levels of fat deposits.

Meta-analyses reported that green tea extract studies positively affect body composition, with the dosage ranging from 140.8 to 1345 mg per day during a follow-up ranging from 8 to 24 weeks (Huang et al., 2014; Hursel & Westerterp-Plantenga, 2010; Hursel et al., 2009). One study on obese Thai participants also showed favorable outcomes for green tea consumption at 8 weeks using high dose green tea extract of 750 mg daily (Auvichayapat et al., 2008). However, the minimum effective dose and consumption duration have not yet been established. Therefore, this study aimed to investigate the effects of green tea extract consumption on body composition, body fat percentage, and visceral fat level in overweight Thais using a standard supplement dose.

Research Methodology

Eighteen subjects initially recruited for this study, from individuals who were interested in the advertising poster via the researcher’s social media, were healthy Thai individuals, male and female, aged 30 – 40 years old, whose BMI is 23.0 – 27.5

kg/m^2 (classified as overweight) (WHO expert consultation, 2004). Exclusion criteria included: (1) history of hyperglycemia, hyperlipidemia, or hyper- or hypothyroidism, (2) history of metabolic disease (such as diabetes mellitus or Cushing syndrome) or systemic disease (such as heart or liver disease), (3) pregnancy, planning for pregnancy, or lactating, (4) unidentifiable significant weight loss in the past 3 months, (5) currently has an implantable electronic defibrillator or pacemaker, or (6) regular smoking or alcohol consumption. After being informed of the study's objectives and protocol, the subjects signed the consent form once they agreed to participate. This study was approved by the Mae Fah Luang University Ethics Committee on Human Research.

All participants' baseline characteristics, including personal information, medical history, weight, waist and hip circumferences, and body composition measurements were obtained at the start of the enrollment using the same equipment throughout the study. All subjects' whole-body composition was measured using an InBody Dial H20N (Seoul, Korea). Their body composition was recorded in the InBody mobile application. The testing protocol was in compliance with the precautionary measures and instructions detailed in the InBody User's Manual (2020). The subjects' waist and hip circumferences were recorded (in centimeters) using a measuring tape.

This was an experimental cross-over control study. During the first six weeks (from Baseline to Week 6), which was the "control" period, subjects were informed to continue their usual diet, exercise, and avoid additional supplements that can affect thermogenesis. Subjects' body composition and waist and hip circumference measurements were measured again at the end of Week 6. During the second six weeks (from the end of Week 6 to Week 12), which was the "experimental" intervention period, subjects were introduced to the green tea extract supplementation, Nutrilite™ Green-T Plus. Nutrilite™ Green-T Plus, a commercially available Amway (Thailand) product, was approved by the Thai FDA. One tablet contains the following ingredients: 51.78 mg (12.82%) of green tea extract (decaffeinated) with GreenSelect® Phytosome technology. Subjects were instructed to consume two tablets daily (one tablet after breakfast and one tablet after dinner, 103.56 mg of green tea extract total). The same instruction as the control period to avoid confounders was given to the subjects. Online follow-up sessions were conducted in Week 3, Week 6, and Week 9 to monitor for compliance and any possible side effects or allergic reactions to the supplement. The subjects' body composition and waist and hip circumference measurements were then obtained at the end of Week 12.

Subjects' data (weight, BMI, body fat percentage, visceral fat level, and WHR) were analyzed by comparing pre and post-intervention. Continuous data were presented in mean ± standard deviation (SD). Repeated measures ANOVA was used to compare the differences between baseline (Week 0), Week 6, and Week 12. Statistical analyses were performed using SPSS version 21.0 (NY, USA).

Results

Eighteen subjects were initially recruited for this study. Three subjects discontinued because of COVID-19 infection during the body composition measurement follow-up sessions (2 subjects) and the use of medication that might interfere with the intervention and its effects (1 subject). Fifteen subjects, female 66.7% with mean age 34.5 ± 3.4 years, remained and completed the study period at 12 weeks. Baseline and followed-up body composition data were presented in Table 1.

Table 1 Comparing means of body composition variables within-group at Baseline (Week 0), Week 6, and Week 12 (n = 15)

Body Composition	**Baseline** $\underline{x}\ (SD)$	**Week 6** $\underline{x}\ (SD)$	**Week 12** $\underline{x}\ (SD)$	p^{a}
Body weight (kg)	67.79 (6.53)	68.50 (6.23)	68.73 (6.71)	0.030*
BMI (kg/m^2)	24.89 (1.12)	25.16 (1.09)	25.29 (1.41)	0.029*
Body fat (%)	31.10 (7.65)	31.65 (7.35)	30.88 (7.60)	0.177
Visceral fat	9.20 (2.88)	9.67 (2.89)	9.13 (2.69)	0.049*
Waist-to-hip ratio	0.85 (0.06)	0.84 (0.06)	0.83 (0.05)	0.288

At the end of Week 6, subjects' weight, BMI, body fat, and visceral fat increased from baseline during the period of no intervention. After the green tea extract implementation, body weight and BMI increased. However, the body fat percentage, visceral fat, and waist-to-hip ratio showed downward trends after the intervention. Out of the five outcome variables measured within the group, differences between means of three variables (body weight, BMI, and visceral fat level) were statistically significant between Baseline, Week 6, and Week 12.

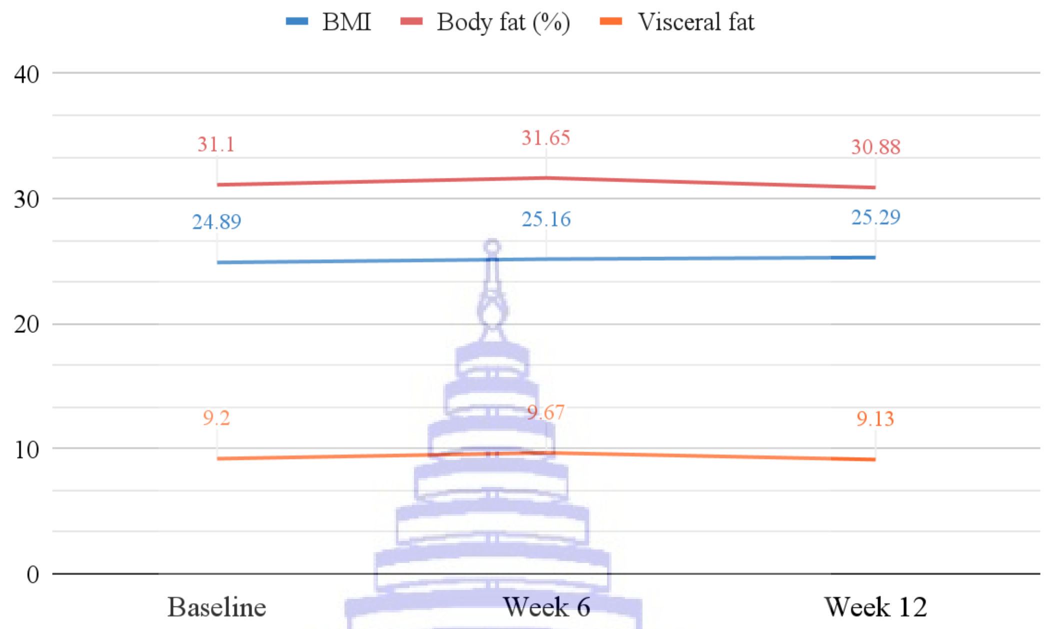

Figure 1 Comparison of means of BMI, body fat percentage, and visceral fat level at different body composition measurement sessions

To be able to discern which pair was the one that differed statistically significantly, pairwise comparison was then employed with the three variables above (body weight, BMI, and visceral fat level) and detailed in Table 2. From the results analyzed, the means of body weight and BMI at Week 12 were significantly greater than that at baseline (0.94 kg with $p = 0.026$ and 0.40 with $p = 0.020$, respectively), while the mean of the visceral fat level at Week 12 was significantly less than that at Week 6 (0.53 with $p = 0.044$). Figure 2 provides a joining line comparison of the means of the variables of interest at three measurement sessions.

Table 2 Pairwise comparison of means of body weight, BMI, and visceral fat between Baseline – Week 6, Baseline – Week 12, and Week 6 – Week 12.

Body Composition	**Baseline – Week 6**	**Baseline – Week 12**	**Week 6 – Week 12**
Body weight (kg)			
Mean difference	-0.71	-0.94	-0.23
p[a]	0.190	0.026*	1.000
BMI			
Mean difference	-0.27	-0.40	-0.13
p[a]	0.279	0.020*	1.000
Visceral fat			
Mean difference	-0.47	0.07	0.53
p[a]	0.268	1.000	0.044*

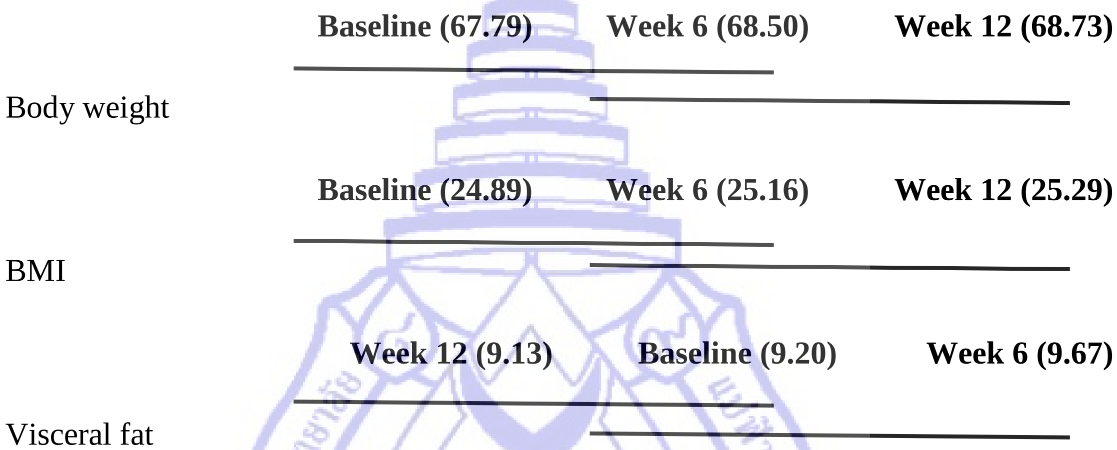

Figure 2 Joining line comparison of means of body weight, BMI, and visceral fat at different body composition measurement sessions

Discussion and Suggestion

This study is the first to test green tea extract's efficacy at a low dose concentration in overweight Thai people. The subjects' body weight and BMI significantly increased at week 12 compared to baseline. Given that body weight and BMI merely display an individual's total body mass and cannot distinguish between fat mass and fat-free (such as muscle and bone) mass, the experimental results cannot be concluded from these two variables. However, the visceral fat level significantly decreased after being given green tea extract for 6 weeks. The body fat percentage also decreased but was not statistically significant.

Compared to previous studies with longer follow-ups and higher doses of green tea extraction, this study has a shorter consumption duration (6 weeks) and lower daily dose (103.56 mg). The findings of this study suggest that green tea extract at a lower concentration does not help with weight reduction. However, it can significantly reduce the visceral and may help reduce the overall body fat percentage. Several mechanisms can explain this. The green tea catechins have demonstrated their ability to inhibit COMT resulting in increased NE, which can result in prolonged thermogenesis and fat oxidation. Green tea also inhibits insulin, which consequently improves glucose tolerance. As a result, digested sugar will be more likely to be redirected and immediately used by muscles rather than be converted and accumulated as body fats. The evidence also suggests that EGCG (one form of green tea catechin) can reduce visceral fat via the AMP-activated protein kinase (AMPK) signaling pathway, which could activate autophagy and lipolysis of visceral white adipose tissue.

Several limitations were experienced during this study. Due to the spread of COVID-19, two subjects discontinued as they tested positive for COVID-19 infection at the end of Week 6, rendering them unavailable for their body composition measurement. The remaining subjects reported verbally during the measurement sessions that it had been somewhat challenging to maintain their physical activity routines during this period, with occasional disruptions from minor outbreaks in their communities. This may contribute to the increase in body weight at the end of the study. Also, with 3 missing subjects, the study's power may decrease even though the number of subjects exceeds the minimum calculated sample size. Experimental design, even though the experimental cross-over control study design could help to control for various confounding factors, it could not control for events (such as Songkran) that might occur during the passage of the experimental period. A more tightly controlled design might be required for future studies to consider these temporal factors that might influence the results.

In conclusion, a daily dosage of 103.56 mg green tea extract for 6 weeks can lead to a statistically significant decrease in visceral fat level in overweight Thai subjects. However, it does not lower the subjects' BMI and body weight. Further research is needed to find an optimal dosage of green tea extract on the effect on body composition and understand the green tea effects on fat loss and concurrent muscle gain. This further study could be a valuable investigation, as it might give green tea a promising position as an efficient weight-management nutraceutical.

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