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Effect of green tea on metabolic and hormonal aspect of polycystic ovarian syndrome in overweight and obese women suffering from polycystic ovarian syndrome: A clinical trial

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Abstract:

BACKGROUND AND OBJECTIVE: Polycystic ovarian syndrome (PCOS) is the common cause of Oligo-ovulation. This syndrome causes long-term metabolic issues as well as increase the risk of diabetes type 2, hypertension, dyslipidemia, and cardiovascular disease. The current research aimed to study the effect of green tea on weight and hormonal changes of women suffering from PCOS.

METHODS: This two group, double-blind, randomized clinical trial was conducted in Isfahan city. Overweight women suffering from PCOS ($n = 60$) were randomly divided into two groups. Green tea was prescribed to the experimental group, and placebo was prescribed to the control group. Free testosterone hormones and fasting insulin were compared in both groups at the beginning and 12 weeks after the study commencement. The weight of participants of both groups was also measured before and after the study. The statistical data were analyzed by SPSS software and paired t -test.

RESULTS: The paired t -test showed that there was no significant difference in the mean weight of both groups before the intervention ($P = 0.812$), but the difference was significant after the intervention ($P = 0.031$). There was no significant difference in the mean fasting insulin of both groups before the intervention ($P = 0.352$), but the difference was significant after the intervention ($P < 0.0001$). Moreover, there was no significant difference in the mean free testosterone level of both groups before the intervention ($P = 0.638$), but the difference was significant after the intervention ($P < 0.0001$).

CONCLUSION: The consumption of green tea by overweight and obese women suffering from PCOS leads to weight loss, a decrease in fasting insulin, and a decrease in the level of free testosterone.

Keywords:

Free testosterone, green tea, insulin resistance, obesity, overweight, polycystic ovarian syndrome

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Introduction

Polycystic ovarian syndrome (PCOS) is the common cause of Oligo-ovulation and anovulation in the general population and infertile women who constitute about 2–20% of the population of women.^[1] This syndrome causes long-term metabolic issues as well as impotency in women. This syndrome can increase the risk of diabetes type 2, hypertension, dyslipidemia, and

cardiovascular disease in postmenopausal years.^[2] In addition, anovulatory infertility, which is accompanied by hyperandrogenism and polycystic ovaries, is considered one of the diagnosis criteria for this syndrome and major concern for the suffering women.^[3]

PCOS manifests clinically when genetic is coupled with environmental factors, such as overweight and inactivity, which lead to an increase in insulin resistance.

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Obesity is a threat to women suffering from PCOS that aggravates many related symptoms.^[4] The studies have shown that women suffering from PCOS were fatter than the members of control group.^[5] This point signifies that overweight facilitates the clinical manifestations in the women who are prone to this syndrome.^[6] In fact, the slim women suffering from PCOS are of greater body fat percentage mean and higher waist-to-hip ratio mean in comparison with the members of control group with a similar body mass index (BMI). Visceral fat produces inflammatory cytokines and plays a role in these women's insulin resistance and decreased ovulation.^[7]

This effect on ovulation is due to insulin resistance that causes hyperinsulinemia and triggers the overproduction of androgens by ovaries.^[8] Weight loss brings about a return to ovulation cycles and pregnancy for these patients. On the other hand, studies show that women with weight over the normal one are less likely to respond to methods of ovulation induction medications, that is, although obesity is not an intrinsic characteristic of PCOS, it certainly intensifies insulin resistance and hyperandrogenism.^[4] As per the studies, a weight loss of about 5% of the initial weight led to 75% decrease in the levels of insulin and free testosterone within 6 months. Although this amount seems modicum, it is coupled with 30% decrease in visceral adipose tissue which is adequate for a significant improvement of insulin resistance and fasting insulin level.^[9] Green tea, with the scientific name of *Camellia sinensis*, is one of the richest sources of flavonoids and is used as a medicinal plant in many countries.^[10] Many studies have dealt with the effect of green tea on various diseases, and it has been determined that drinking green tea reduces fasting blood glucose and checks diabetes in diabetic patients. It also reduces the risk of cardiovascular disease, cancer, and metabolic syndrome.^[11,12]

Green tea is produced through processing green leaves right after picking. It is believed that catechins that are polyphenolic components of tea inhibit the degradation of norepinephrine and thus make the tea release heat.^[13] This property of catechins increases the oxidation in mitochondria and thus decreases the production and the heat produces adenosine triphosphate simultaneously.^[14] In a study, green tea extract containing 90 mg of green tea catechins called epigallocatechin gallate and 50 mg of caffeine, only a capsule containing 50 mg of caffeine, or placebo was prescribed to 10 healthy men (mean age: 25-year-old; mean BMI: 25 kg/m²) at three different periods. The mean consumed energy within 24 h after consumption of the prescribed medicine was higher in the men to whom green tea extract was prescribed than those who consumed only caffeine or placebo.^[15]

Chan *et al.*, in their study on the effect of green tea on the weight, hormonal and biochemical profiles of Chinese obese patients suffering from PCOS—a trial randomized by placebo, concluded that green tea as a complementary medicine does not have a significant effect on reducing the weight loss.^[16] Considering the large number of studies conducted on the effect of green tea on weight loss and the fact that PCOS management is coupled with changes in lifestyle with an emphasis on weight loss in all obese and overweight women, the researchers conducted a study to assess the effect of green tea on the weight and hormonal changes of PCOS in Iran.

Methods

To start the study, required licenses were obtained from Isfahan University of Medical Sciences and were offered to the research environment. It was also ensured that ethical considerations were observed with Ethical Committee and formal consent. Then, 70 overweight and obese women aged between 20 and 40 and suffering from PCOS who had referred to gynecological clinic of Isfahan city and had the inclusion criteria were participated in this research and were studied from October 27, 2013 to April 30, 2014. Patients were divided randomly into two groups as experimental (who took green tea as Green teadin tablet produced by DINEH IRAN; the group of pharmaceutical, hygienic & food industries) and control groups. Thirty-five patients (with 5 patients removed) were ultimately allotted to the experimental group, and 35 patients (with 5 patients removed) remained in the control group. Thirty patients were present in each group at the end of the study.

The selected population was suffering from PCOS and overweight or obesity and their syndrome were confirmed by a gynecologist with Rotterdam criteria. The processes and procedures were explained to each participant and their written informed consent was obtained. The participants were equalized based on their age and BMI profile. Upon their referral to the health clinic, the participants were allotted alternately and randomly to either group by a person unaware of the study project. The weight of the patients was measured by a digital scale with an accuracy of 100 g, and their height was measured by a tape with an accuracy of 1 cm. All the above measurements were conducted before and after the intervention. In days 0 and 12 weeks after the study initiation, 5 cc venous blood was taken from patients after an overnight fasting. The tests requested for all patients included fasting insulin and free testosterone and were taken using laboratory kits (Siemens Company) through Komono essay method.

Inclusion criteria

Women were suffering from PCOS and overweight or obesity and their syndrome were confirmed by a gynecologist and their age were 20–40.

Exclusion criteria

Women have metabolic disorders such as diabetes, hypertension, dyslipidemia, and cardiovascular disease and women use hormonal drugs such as contraception, slim drug, and metformin.

With regard to the time, the blood tests were taken, the blood test of the women having amenorrhea was taken randomly, and the blood test of menstruating women was taken between 2 and 5 days after their menstruation. The experimental group received 500 mg green tea capsules (to be taken twice a day for 12 weeks), and the control group received only placebo. Green tea pills produced by Dineh Industries of Iran (as Green Teadin) were ground and poured into capsules as green tea capsules. For placebo, capsules were filled with wheat flour. It is worth to note that none of these women were on infertility pills during the research. In addition, due to the thermogenic quality of green tea and its effect on weight loss, participants' physical activity level was specified and considered a mitigating criterion. In addition, the patients were contacted once in 2 weeks to ensure that they took green tea capsules as per instructions. It is noteworthy that 4 of the participants were removed from the study due to the gastrointestinal side effects of green tea. Six patients also discontinued their participation as they had decided to get pregnant. SPSS version 19 (IBM Corp.: Armonk, NY) was employed for data analysis. An error rate of 5% was considered for all statistical tests (paired *t*-test, Fisher test, and Shapiro–Wilk). This study is registered in the Iranian Registration Center of Clinical Trials under the code IRCT2013111015349N1.

Findings

According to the Shapirp–Wilk test, all variables (weight, insulin resistance, and free testosterone) were

of normal distribution before and after the intervention. According to the Shapirp–Wilk test, only the distribution of free testosterone was not normal after the intervention in the experimental group. Both groups maintained a balanced homogeneity in terms of age, the number of kids, educational level, economic situation, and their spouse's educational level. The comparison the two groups' demographic properties through Kai-2 showed that both groups maintained a balanced homogeneity in terms of demographic properties and no significant difference from one another in this respect [Table 1].

The paired *t*-test showed that there was no significant difference in the mean weight of both groups before the intervention ($P = 0.812$), but the difference was significant after the intervention ($P = 0.031$). In addition, according to the analysis, *P* values of weight loss intensity have been significantly greater in the experimental group ($P = 0.00$) [Table 2].

The paired *t*-test showed that there was no significant difference in the mean fasting insulin of both groups before the intervention ($P = 0.352$), but the difference was significant after the intervention ($P = 0.00$). In addition, according to the analysis, *P* values of fasting insulin decrease intensity have been significantly greater in the experimental group ($P = 0.00$) [Table 3].

The paired *t*-test showed that there was no significant difference in the mean free testosterone level of both groups before the intervention ($P = 0.638$), but the difference was significant after the intervention ($P = 0.00$). In addition, according to the analysis, *P* values of free testosterone decrease intensity have been significantly greater in the experimental group ($P < 0.05$) [Table 4].

Table 1: The demographic properties of experimental and control groups and the comparison results

Variable	Groups				P value comparison two groups
	Control groups		Experimental groups		
	Frequency (%)	n	Frequency (%)	Count	
Education					
Illiterate	13.3	4	16.7	5	0.673
Primary	26.7	8	20	6	
High school	50	15	43	13	
Collegiate	10	3	20	6	
Job					
Homemaker	73.3	22	63.3	19	0.694
Employee	13.3	4	20	6	
Private jobs	13.3	4	16.7	5	
The economic situation					
Desired	16.7	5	23.3	7	0.805
Inappropriate	13.3	4	13.3	4	
Having children					
Yes	40	18	53.3	14	0.301
No	60	12	46.7	16	
Sum	100	30	100	30	

Table 2: The comparison of the mean weight of experimental and control groups before and after the intervention

The time	Groups (mean±SD)		P	t
	Control groups	Experimental groups		
Number	30	30		
Before the intervention	86.28±6.03	86.68±6.86	0.812	0.22
After the intervention	86.37±6.03	82.9±6.09	0.031	-2,21
Comparison of intervention	P=0.00, F=91.36			

SD = Standard deviation

Table 3: The comparison of the mean fasting insulin of experimental and control groups before and after the intervention

The time	Groups (mean±SD)		P	t
	Control groups	Experimental groups		
Number	30	30		
Before the intervention	86.28±6.09	86.68±6.86	0.812	0.22
After the intervention	86.37±6.03	82.9±6.09	0.031	-2,21
Comparison of intervention	P=0.00, F=91.36			

SD = Standard deviation

Table 4: The comparison of the mean free testosterone level of experimental and control groups before and after the intervention

The time	Groups (mean±SD)		P	t
	Control groups	Experimental groups		
Number	30	30		
Before the intervention	86.28±6.09	86.68±6.86	0.812	0.22
After the intervention	86.37±6.03	82.9±6.09	0.031	-2,21
Comparison of intervention	P=0.00, F=91.36			

SD = Standard deviation

Discussion

As per the results obtained by the study, it can be concluded that green tea consumption has positive effects on weight loss, insulin resistance decrease, and free testosterone level decrease in overweight and obese women suffering from PCOS. The obtained results showed that green tea consumption has a significant effect on the weight loss of women suffering from PCOS. Auvichayapat *et al.*, in their clinical trial on 60 Thai obese women with a BMI of 25 kg/m², showed that consumption of green tea for 12 weeks resulted in an increase in calorie consumption and oxidation of fat and ultimately in weight loss.^[17] Chan *et al.*, in their study on 34 Chinese obese women suffering from PCOS, prescribed green tea capsules to them for 3 months, but the results showed no significant decrease in patients' weight.^[16] Hursel *et al.*, in their meta-analytical study on the effect of green tea on

weight loss, reported that the ingredients of green tea can have a dramatic effect on weight loss, but mitigators such as regular intake of caffeine and race can also play a role.^[18] The results of the present study showed that green tea consumption can significantly decrease the insulin resistance in overweight and obese women suffering from PCOS.

Hininger-Favier *et al.*, in their study on laboratory rabbits, found out that consumption of green tea reduced rabbits' glucose, insulin, and triglyceride and showed protective effects against insulin resistance that can be used for patients with decreased sensitivity against insulin.^[19] The consumption of green tea decreases significantly the fasting insulin in patients with PCOS. As per the results obtained by Brown *et al.*, a daily consumption of green tea, in the form of two capsules a day and for 8 weeks, had no effect on the insulin resistance of obese or overweight men aged 45–60.^[12]

Level of fasting insulin and free testosterone level decrease in overweight and obese women suffering from PCOS. This study showed that green tea reduces the free testosterone level in patients with PCOS. Figueiroa *et al.*, also in a laboratory study on the effect of green tea ingredients on the production of testosterone in rabbits' Leydig cells, found out that green tea ingredients inhibit the basic and stimulated production of testosterone.^[20] Wu *et al.* investigated the effect of a 2-month plan of green tea consumption on testosterone hormone level in healthy women after their menopause. Green tea made no changes in the testosterone level in this clinical trial.^[21] One of the limitations of the study was the costly tests and medicine required for this study.

Conclusion

Based on the obtained results, it can be concluded that the consumption of green tea can help weight loss, decreases BMI, decreases insulin resistance, and decreases free testosterone in overweight and obese women suffering from PCOS. Fortunately, Dineh Industries Company of Iran provided the required green tea pills. The researchers recommend an assessment of the effect of green tea on the diameter of the dominant follicle and the level of LH and FSH hormones, and the effect of green tea and metformin on weight and hormone levels in women suffering from PCOS.

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Conflicts of interest

There are no conflicts of interest.

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