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Coalesced Impact of Green Tea and Cinnamon on Metabolic Parameters of Overweight Subjects

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Abstract

Obesity is pandemic worldwide and even in developing countries significantly shares the proportion of its prevalence. Beyond pharmaco-therapy, overweight individuals have been seeking functional food supplements to manage their weight. Several functional foods have been suggested for the management of obesity. Particularly, certain functional foods that contain bio active compounds are believed to interfere in cell metabolism that brings changes in the metabolic parameters. The two functional foods green tea and cinnamon have been intensively studied individually on insulin sensitivity, blood glucose, body weight and lipid fractions using animal and human models. However, there has been seldom study available experimenting with both the functional ingredients (Green Tea and Cinnamon) together in over weight individuals. The inmates of St. Joseph Prasanth Nivas Ashramam, Jeppu Mangalore, India were selected as participants. A total of forty volunteers were recruited according to predetermined inclusion criteria were grouped into experimental and control groups equally. Supplementation of green tea with cinnamon twice a day for 30 days yielded a significant reduction in BMI ($P<0.05$) waist circumferences ($P<0.05$) and lipid parameters like TGL ($P=0.000$), HDL ($P=0.000$) and that of LDL ($P<0.05$). Thus, it is imperative that regular consumption of Green Tea with Cinnamon can modulate lipids favourably and moderately reduce body weight which on a long run may help one to prevent or decrease the risk of CVD.

Keywords: Obesity; Green tea; Cinnamon; Body weight; Lipid parameters

Introduction

Three decades ago, fundamental changes in social and economic situation occurred all over the world, which paved way for the development of modern conveniences in homes as well as in the work place. These progresses have shifted societies from communicable to non-communicable diseases (NCD) [1-3]. Obesity which is also described as the "New World Syndrome" are a serious health problem, as they are associated with other diseases, and they contribute to various ill health [4]. The World Health Organization (WHO) describes overweight and obesity as one of today's most important public health problems, which is rising as a global epidemic [5]. Obesity, in simple terms, may be defined as a state of imbalance between calories ingested versus calories expended which would lead to excessive or abnormal fat accumulation. Body Mass Index (BMI) is a measure of weight corrected for height and which reflects the total body fat and has been the most accepted parameter for defining over weight [6]. Optimal BMI increases with age. WHO also classified over weight according to BMI [7]. There is a very good correlation between BMI and the percentage of body fat in large populations. However, in certain context BMI may not be a reliable measure as it may not be suitable for pregnant women or body builders. Whereas, waist hip ratio will be a better assessment to judge body fat in terms of body fat distribution because even one has a near normal BMI yet the same subject may have abnormality in waist hip ratio, which in true sense reflects the body fat distribution.

Obesity, which has been increasingly recognized as a significant problem in developing countries and also in countries undergoing economic transition rather than which was seen only in developed nations [8]. This rising trend in developing countries is largely due to rapid urbanization and mechanization which led to reduction in energy expenditure along with increase in energy intake in the form of high calorie snack and junk food [9]. There are many possible pathophysiological mechanisms involved in the development and maintenance of obesity. Since leptin was discovered, many other hormonal mechanisms have been elucidated that participate in the regulation of appetite and food intake, storage patterns of adipose tissue, and development of insulin resistance. The adipokines are mediators produced by adipose tissue; their action is thought to modify many obesity-related diseases [10,11].

Management of obesity include both weight control or reducing excess body weight and maintaining that weight loss, as well as, initiating other measures to control associated risk factors. Periodic evaluation for obesity should be done by the measurement of BMI, measurement of waist circumference etc., to assess risk factors. Based on the evaluation, appropriate treatment can be suggested. Treatment may consist of modification of diet, increased physical activity, behavioural therapy, and in certain circumstances weight loss medication and surgery. The maximal success rate of these treatments; however, is only 21%, and the most popular method for weight loss is pharmacotherapy [12]. Apart from, pharmacotherapy many herbal medicines have also been in the market to manage obesity. However, there are very few clinical trials available to justify that these herbal remedies are worthwhile. Similarly, several functional foods have been suggested for the management of obesity. Particularly, certain functional foods that contain bioactive compounds are believed to interfere in energy and fat metabolism that bring in the weight reduction. One such strong functional food is said to be the green tea. Similarly, there are spices and condiments which are recognized to favour weight reduction by altering carbohydrate and fat metabolism. Cinnamon is one of the spices claimed to be a natural insulin sensitizer [13]. Obesity specifically refers to have a high amount

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of body fat, which is usually accompanied by abnormalities in leptin and insulin secretion and their action, together with defects in lipid and carbohydrate metabolism [14,15]. Cinnamon is such a dietary component that has shown to have biologically active substances with insulin-mimetic properties. In vitro [16,17] and in vivo [18,19] studies have shown that cinnamon enhances glucose uptake by activating the insulin receptor kinase activity, auto- phosphorylation of the insulin receptor and glycogen synthase activity. May be this could be the reason why carbohydrate is not converted to fat and does not increase body weight.

The consumption of tea is a very ancient habit and legends from China and India indicate that it was initiated about five thousand years ago. As the long-term consumption of green tea is traditionally regarded to cause weight loss, and as obesity is becoming one of the most severe health threats, there is increasing interest in this particular aspect of green tea. Green tea is a widely consumed beverage and, for centuries, has been regarded to possess significant health promoting effects. The health-promoting effects of green tea are mainly attributed to its polyphenol content. Green tea is a rich source of polyphenols, especially of flavanols, which represent approximately 30% of dry weight of the fresh leaf [20]. Catechins are the predominant form of the flavanols and mainly comprised epigallocatechin gallate (EGCG), epigallocatechin (EGC), epicatechin gallate (ECG), and epicatechin (EC) [21]. Traditionally, green tea was used to improve blood flow, eliminate alcohol and toxins, improve resistance to disease, relieve joint pain, and to clear urine and improve its flow [20]. Chen zang, a famous pharmacist of the Tang Dynasty (618–907), highlighted the broad range of health-promoting effects: "Every medicine is the only medicine for a specific disease, but tea is the medicine for all diseases." According to the pharmacist Wang Ang (1615–1695), drinking green tea for a long time can eliminate fat. In recent years, research has mainly focused on effects of green tea related to the prevention of cancer and cardiovascular disease [12]. Furthermore, the anti-inflammatory [22], antiarthritic [23,24], antibacterial [25], antiangiogenic [26,27], antioxidative [28,29], antiviral [30,31], neuroprotective [32], and cholesterol-lowering effects [33,34].

Similarly, Cinnamon also contains various bioactive compounds. Cinnamon extract contains cinnamic aldehyde, cinnamic acid, tannins and methyl hydroxy polymer as main components [17]. The insulin-sensitizing effect of cinnamon was established in vitro cell line studies with adipocytes [17] as well as in vivo animal studies [19]. The bioactive compound isolated from cinnamon was first classified as methylhydroxychalcone polymer (MHCP), which acts as a mimetic of insulin [35]. Components of cinnamon may be important in the alleviation and prevention of the signs and symptoms of metabolic syndrome, type 2 diabetes and cardiovascular and related diseases, which in all of these diseases, obesity is the root cause [36].

Methodology

Both men and women aged (30-70) who were residing at St. Joseph Prasanth Nivas Ashramam, Jeppu Mangalore were selected as subjects for the present study. Purposive Sampling technique was adopted. A total of 40 subjects were selected who were later grouped into experimental and control group comprising 20 subjects in each group. Among both the groups only two males were present in each group. Both the group subjects were obese or overweight. Initial and Final assessment of anthropometry measurement like height, weight, BMI and as a physiological index body fat percentage (measured by Omron body fat monitor- HBF 306) were done and compared between control and experimental group. For the selected experimental group 2 g of green tea sachet (Tetley green tea) and 2.5 g (half a teaspoon) of powdered cinnamon (without any brand name) was administered thrice a day in the early morning and evening respectively. Both the supplements were bought from the local departmental stores and were not subjected for any standardization as they were commercially available and certainly as such used by consumers. The cinnamon powder was first boiled in water and after removing from the flame and cooling for a while the green tea sachet was immersed into the extract. Further, allowing it to brew for 2 minutes, then it was administered. Intervention was carried out for 30 days for the experimental group and finally the lipid profile along with the body fat percentage and BMI, were assessed and compared between control and experimental group. However, only the selected parameters were assessed initially and finally but not administered with any supplementation. Subjects were selected without any chronic illnesses like diabetes, hypertension, cancer, CVD and debilitating diseases (Table 1).

The proposal of the study was approved by institutional human ethical committee certified with a number REC/ NCND/ K14008 dated 12/3/2014.

The above table depicts the baseline characteristics of the selected subjects. The mean ages of the experimental group were 52. 15 ± 12.40 and that of control group was 57.10 ± 12.66. Also, it is noticed that parameters like waist, hip circumferences, BMI and waist hip ratio which actually determine the body fat distribution and obesity are comparatively more for the experimental group than the control group. However, on the whole as per the inclusion criteria, both the group BMI fall under overweight category (Table 2).

The above table shows the comparison of anthropometric indices between control and experimental group before and after treatment with green tea and cinnamon supplementation. From the table it is clearly evident, that none of the anthropometrical indices had any significant changes among control group after the study period, whereas, green

S. No.	Parameters	Mean± Sd(Experiment Group)	Mean± Sd(Control Group)
1	Age	52.15 ± 12.40	57.10 ± 12.66
2	Weight	62.30 ± 12.58	60.85 ± 9.46
3	Height	147.35 ± 11.39	150.20 ± 10.39
4	Waist circumference	95.35 ± 8.91	92.85 ± 17.73
5	Hip circumference	93.60 ± 6.65	96.20 ± 7.49
6	Waist/Hip Ratio	1.01 ± 0.06	0.97 ± 0.15
7	BMI	28.09 ± 4.2	27.78 ± 2.76
8	BMR	1216.2 ± 343.66	1220.2 ± 196.82

Table 1: Baseline characteristics of the selected subjects in the experimental group.

S. No.	Parameters	Experimental group (n=20)		Control group (n=20)	
		Initial	Final	Initial	Final
1	BMI	29.08 ± 3.7	28.09 ± 4.2*	27. 78 ± 2.7	27.66 ± 3.1
2	Weight	62.30 ± 12.58	61.00 ± 18.64	60.85 ± 9.4	58.95 ± 2.5
3	Waist Circumferences	98.85 ± 8.88	95.35 ± 8.9*	92.85 ± 17.7	96.90 ± 7.8
4	Hip Circumferences	93.60 ± 6.6	90.70 ± 23.4	96.2 ± 7.4	94.6 ± 8.0
5	Waist/ Hip Ratio	1.07 ± 0.04	1.01 ± 0.01	0.97 ± 0.15	0.97 ± 0.22

Significance: **P<0.001, *P<0.05

Table 2: Comparison of anthropometric indices of the selected subjects before and after treatment.

tea with cinnamon administration for 30 days had brought significant reduction in three of the anthropometric indices namely BMI, waist and hip circumferences($p< 0.05$), in the experimental group . However, when it is looked in terms of % of reduction, actually it has occurred in a marked way. But at least it leaves an impression that the bioactive components of green tea cinnamon do bring about a metabolic modulations (Table 3).

From the table it is understood that there is no significant change in the body fat % of both the groups even after study period. However, there was a significant increase in the BMR of the control group after a 30 days period, which was measured by body fat analyser. Again, in this context also, the percentage of increase is only meagre and the increase in the BMR level is also within safe limits (Table 4).

With regard to control group who were not treated with any supplements did not have any significant changes after a study period of 30 days. However, there was a marked reduction on ($P<0.001$) in the case of TGL of experimental group due to treatment. Similarly, to the core surprise there was also a significant increase ($P<0.001$) in the HDL levels. However, LDL cholesterol of the experimental group declined to a moderate level ($P<0.001$). Correlating with the change in the individuals levels of HDL and LDL levels of experimental group, the HDL/LDL ratio also significantly got reduced ($P<0.001$).

Discussion

In the present research, a meticulous effort has been taken to explore the effect of green tea along with cinnamon on the selected metabolic parameters of overweight individuals at a voluntary organization run home for independent, destitute, widows and widower adults at Mangalore. The diet was maintained same for both the groups as such it was provided by the organization as cyclic menu. Hence, it is assumed that both the groups may not be affected weight wise as they were consuming same type of food provided by the home. However, one of the drawbacks of the study was, the authors did not calculate any proximate composition of the food consumed by the participants. Similarly it was also observed that none of the participants did involve themselves in any specific exercises. As far as the supplementation concerned, the green tea was selected as the core supplement because generally tea is the most widely consumed beverage in the world, second only to water. Indeed green tea which is sought widely for their health benefits is derived from the Camellia sinensis plant. Green tea is produced soon after harvest by applying less heat, in order to preserve that high level of catechins from oxidation, a particular class of poly phenols [29]. In fact, the green tea can be known as 'Virgin Tea" as they are non-oxidised and a non-fermented derivative of the tea leaves.

Through, there are numerous health benefits due to green tea, yet vivo studies, using animal models, have documented that green tea can induce a variety of health benefits including anti obesity, hypoglycaemic and hypolipidemic activities [37].

Wolfram et al., also stated that the antioxidant components from tea are potential to reduce the risk of CVD. There are also researchers that have proven that regular consumption of Green Tea on catechins extracted from Green Tea may influence energy metabolism, body weight and body fat content [38].

In the present study it has been noted that there was a drastic decline in the TGL level and a moderate increase and decrease in HDL levels and LDL levels were noted. This, in fact may be attributed to the mechanism that green tea with their polyphenols increase both LDL receptor binding protein and the conversation of the sterol regulated elements binding protein as suggested [39]. Our results are little different also to that of [40] in which administration of green tea plus 30 mg of powder catechin and green tea plus 100mg of powder catechin to animals led to a significant decrease in the mean value of serum cholesterol and triglycerides as compared to that of positive control group [40]. However, in our human study on administration of green tea with cinnamon infusion did not bring out any change in serum cholesterol but brought out a drastic reduction in TGL and a moderate decrease in LDL and concurrent considerable increase in HDL levels. Probably, addition of catechin powder to the level of 100 mg could have also been a reason to mitigate the total cholesterol levels. Similarly, surprisingly a increase in HDL levels of our study could also be attributed to addition of cinnamon powder (infusion) and may be as only rice bran oil (which possess oryzenol) was used for the preparation of foods of these selected subjects. However in contrary, the control group though they had same kind of foods yet did not have any change in their lipid levels. Hence, it may be considered that administration of Green Tea with cinnamon for 30 days do have a potential effect on lipid profile and BMI of the experimental group. At this juncture, it is to be considered whether body weight statistically did have any significant changes after treatment period. The answer is though the reduction in mean body weight of the experimental group was

S. No.	Parameters	Experimental Groups (N=20)		Control Groups (N=20)	
		Initial	Final	Initial	Final
1.	Cholestrol	233.1 ± 7.8	218.8 ± 6.8	248.70 ±	268. 50 ± 64.72
2.	Triglycerides	230.00 ± 151.82	178.15 ± 141.38***	190.50 ± 35.15	195.50 ± 48.85
3.	HDL	39.15 ± 14.18	46.25 ± 15.0***	41.90 ± 18.94	42.30 ± 21.60
4.	LDL	160.30 ± 52.77	146.20 ± 39.95*	174.15 ± 26.20	185.80 ± 41.19
5.	HDL/LDL Ratio	4.32 ± 2.05	3.17 ± 1.05**	2.69 ± 1.42	2.47 ± 0.96

Significance: ***P=0.000, **P<0.001, *P<0.05

Table 3: Comparison of body fat % and the bmr of the selected participants before and after treatment.

S. No.	Parameters	Experimental Group (n=20)		Control Group (n=20)	
		Initial	Final	Initial	Final
1	Fat	39. 45 ± 4.9	38.72 ± 4.5	36.47 ± 6.01	37.74 ± 1.27
2	BMR	1269.0 ± 25.18	1276.2 ± 12.01	1220.2 ± 196.8	1291.8 ± 209.04**

Significance: ***P=0.000, **P<0.001, *P<0.05

Table 4: Comparison of lipid parameters of the selected subjects before and after treatment.

recorded moderately favourable yet it did not have significant change statistically. However, the study by [41] intervention with green tea extract lowered body weight significantly when compared with control groups, again with regard to effect on lipid profile, epidemiological and animal experiments suggest that green tea extract alone may help to reduce serum Cholesterol, LDL, TGL and blood glucose content during one month.

Leaving out cinnamon, green tea alone brings appreciable modulations in the lipid panel of the subjects who consume this regularly. This impact is proven by many studies [42,43]. The mechanism behind this modulation may be due to the inhibition of intestinal absorption of cholesterol by green tea and catechin, similarly reduction in TGL is also in agreement with our study which confirmed that catechin of green tea have the same effect in the intestine as it mainly suppresses post prandial hypertriacylglycerolemia through the inhibition of pancreatic lipase, which therefore delayed the absorption of fat [44].

On the whole, the consumption of green tea may help in mitigation of lipid levels in the body by many ways via excretion of cholesterol in faeces [45], the activities of lipid enzymes [46], the Apo B secretion [47] and uptake by cells [48].

Life style changes, weight control, Physical activity and healthy nutrition practices are indispensable for obese to prevent lifestyle disorders and achieve longevity of life. To manage lifestyle disorders / diseases including obesity besides pharmacotherapy many herbs, spices and condiments have been proven to be effective. One such common spice, cinnamon has been used as traditional folk herbs to treat disease over several decades in Asia. Several studies have documented Cinnamon to be an insulin sensitizer and activator of glucose metabolism [17,19,49-51].

Khan et al. reported a considerable reduction in fasting serum glucose (18-29%) and blood lipid profile after 40 days of supplementation with one, three and six grams of whole cinnamon in patients with Type 2 diabetes [52]. However, there are seldom studies available to demonstrate the effect of cinnamon on body weight, blood glucose, fat mass and lipid profile in exclusive overweight or healthy volunteers. Indeed, the present study did not find out the impact on blood glucose but investigated only Body weight, waist hip circumferences, body fat % and lipid profile and importantly cinnamon was administered at the rate of 2.5 g (1/2 teaspoon) as infusion in green tea. As it has already been studied about the impact of green tea and cinnamon individually in various populations as afore mentioned, the present study investigated the plausible combined effect of green tea with cinnamon on above mentioned parameters [52].

The study conducted by Vafa et al. [53], showed that exclusive administration of 3 gm of cinnamon per day to diabetic subjects for eight weeks lead to 9.2% reduction in fasting blood glucose, 6.12% in Hba1c, 15.38% in TGL, body weight reduced by 1.19 %, BMI reduced by 1.54% and fat body mass decreased by 1.36%. Particularly change in TGL level of our study is even higher (i.e. 22.5 % reduction) which may be attributed to the associated effect of green tea with cinnamon. Similarly, there was a reduction of 8.7% in LDL cholesterol and a marked increase of 18.13% in HDL levels after treatment with dual supplementation. However, the duration and sample size in our study is a limiting factor as it is only one month and 20 subjects respectively. Another important aspect which lead to substantial reduction in lipid parameters is not only two different functional food ingredients but also the selected subjects was not diabetic subjects. Because, in diabetics, probably insulin resistance would lead to over production of VLDL and could reduce lipoprotein lipase activity, thereby tend to result in dyslipidemia [54]. Therefore attainment of better glycemic control may also improve the lipid profile. This phenomena has also been explained by a study conducted by Khan et al, in which poorly conducted Pakistani diabetes (140-400 mg/dl of mean fasting glucose) had a marked reduction in FBG and but not much with lipid profile.

However, in the same study of Vafa et al., there observed no significant inter groups differences in anthropometric variables of the subjects treated with cinnamon alone. Whereas in one study, there was a significant reduction in BMI and waist hip circumferences which may be ascribed not wholly due to cinnamon piece but significantly due to green tea as explained under discussion of green tea's impact on body weight [53]. However, the greatest limitation of the study was, authors did not standardize any supplements neither green tea nor cinnamon as they were bought commercially available ones. Hence, it may be understood that the impact of these supplements on physiological and anthropometric indices of the individuals who consume these may vary according to the origin and processing of these supplements.

Conclusion

The present study showed that the continuous ingestion of green tea (2 g) along with cinnamon extract (2.5 g) considerably improve certain lipid parameters like TGL, LDL and HDL cholesterol and moderately reduce body weight and body fat distribution without any intensive lifestyle changes even in overweight individuals without any adverse personal habits. Accordingly, the consumption of green tea with cinnamon might prevent or decrease the risk of cardiovascular diseases.

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Conflict of Interest

None declared by the authors.

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