



Extraction Efficiencies of Green Tea Bioactive Metabolites and their Anti-Diabetic Activity



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Abstract

Green tea is considered as the most popular beverage in the world due to their higher antioxidant's contents, good taste, aroma, and lately reported health benefits. Green tea bioactive compounds have many beneficial health effects against cancer, cardiovascular disorders, obesity, diabetics and inflammatory disorders etc. Thus, these health functionalities of green tea extract mainly depend on the number of bioactive metabolites are extracted during green tea infusions preparation. Several factors can influence the extraction yields of green tea derived bioactive metabolites including extraction temperature, time, solvents, and solvent to solid ratio etc. However, this review will focus on the extraction efficiencies of green tea metabolites and their effect on type 2 diabetes with possible mechanistic exploration.

Keywords: Extraction; Green tea; Bioactive compounds; Anti diabetic activity

Introduction

From ancient time green tea has been used as traditional medicine due to their various health beneficial effects antioxidant, anticancer, antimutagenic, antidiabetic, antimicrobial, neuroprotective and cardiovascular diseases preventing activities [1,2]. These potential health functionalities are mainly associated with green tea derived bioactive compounds such as, various polyphenols, flavonoids, amino acids, caffeine, flavanols like, catechin, epicatechin, epigallocatechin gallate, Gallocatechin gallate, gallic acid, epigallocatechin gallate, epigallocatechin, catechin gallate [3] and phenolic acid like gallic acid, protocatechuic acid, vanillic acid, galloylquinic acid, coumaroyl quinic acid, ferulic acid, sialic acid, and galloylated glucose derivatives [2]. Recently, the health benefits in relation to diabetes from natural antioxidant compounds are in focus of scientific investigation due to their less undesirable adverse effects [4]. Diabetic Mellitus (DM), a complex and progressive metabolic disorder, may lead to various health complications and one of the leading cause deaths in the world [5]. Among two types of diabetes, type 2 diabetes mellitus (T2DM), serious chronic diseases accompanied by cellular mediated destruction of pancreatic β cell and attendant several health complications such as cardiovascular diseases and oxidative damages etc. [6]. Epidemiologically, it has been suggested that green tea bioactive metabolites were demonstrated to modify glucose metabolism and reduces the risk of diabetes [5,7-10].

Extraction amounts of the bioactive polyphenols during the preparation of green tea extracts can facilitate the nutritional values and provides health benefits. Brewing conditions, including water temperature, solid to solvent ratio, time and extraction techniques,

contribute to the amounts of bioactive compounds within the tea infusion [3].

Despite the considerable differences in the bioactive metabolites of green tea extracts obtained by different extraction techniques and conditions, studies comparing the anti-diabetic activities of different green tea extracts are limited. Therefore, this review will focus on extraction efficiencies of green tea metabolites and their anti-diabetic activities.

Extraction efficiencies of green tea bioactive metabolites

The suitable extraction conditions are influential to increase the extraction yield of green tea polyphenols that will elevate the health functionalities. Many extraction techniques have been used to extract phenolic compounds like hot water extraction, microwave-assisted extraction, supercritical fluid extraction, ultrasonication extraction etc. [3]. Green tea major catechin and phenolic compounds extraction yields are dependent on the extraction parameters, solvent, ratio of solvent to material, extraction temperature and time. In respect to extraction temperature and time, it is advisable to use either a combination of high temperature and short extraction time, or lower temperature and longer extraction time to increase the extraction efficiency and a higher ratio of solvent to material gave better yields [11]. In addition, the application of different extraction techniques could increase the extraction yields of bioactive compounds [3].

Green tea extracts and anti-diabetic activity

Green tea flavonoids have been used to investigate the hyperglycemic effects using different in-vivo models [5,7,8,10].

The effects of green tea extracts on hyperglycemic activities are described in Table 1. The anti-diabetic activity of 70% green tea extracts (GTE) and black tea extract was conducted in mice model [5]. Authors observed that GTE was more effective in hyperglycemic activity through lowering blood glucose levels and ameliorated glucose intolerance. The possible mechanism for the anti-diabetic activity of GTP was explored by insulin resistance (IR) and β -cell function (B%) using homeostatic model assessment (HOMA) to find out the relationship between hepatic glucose and insulin in the basal state that, reflects the balance between hepatic glucose output and insulin secretion. This result indicated that GTE was potential to suppress the IR whereas, in diabetic group was higher. In contrast, β -cell function was also higher with GTE treatment. This might be due to the presence of 71.5% catechins in green tea extracts. The effects of polyphenols present in aqueous green tea extract were conducted by in diabetic rat induced by alloxan [7]. The result found that green tea extract at a dose of 100mg/kg (b.wt.) was potential to reduce serum glucose level and the daily consumption (15%) at 50, 100mg/kg (b.wt.) showed 29 and 44% reduction. Green tea extracts also increased the liver glycogen, which was decreased due to alloxan treatment and showed antioxidant potentials through increased the superoxide dismutase and glutathione levels.

Hyperglycemic effects of green tea ethanol extract using glucose tolerance methods on rats were studied [8]. From the results, the consumption of 720mg/kg (b.wt.) of green tea ethanol extract could reduce the glucose content in the body at 120, 180 and 240 minutes after application. In contrast, the application of 180 and 360mg/kg (b.wt.) of green tea ethanol extract reduced body glucose content at 180 and 240minutes, respectively.

The effects of green tea water extract (65mg/kg) on serum paraoxonase/aryl esterase activities and lipoprotein ionizability in streptozotocin-induced diabetic rats was studied [11]. The result indicated that the green tea ethanol extract was capable to increase

the serum total antioxidant ability. Finally, the author group concluded that green tea ethanol extract had antihyperlipidemic and antioxidative effects and slowed the progression of atherogenesis by reducing oxidation of lipoproteins and preserving paraoxonase activity.

Therefore, the anti-diabetic mechanism of natural polyphenols including green tea derived bioactive compounds might be the reduction of bold glucose levels, increase β -cell function, increase glucose uptake (via increasing GLUT4, p13k), decrease lipid accumulation and glucose production etc. [2] are described in (Figure 1) C/EBP α : CCAAT-enhancer-binding protein α ; FAS-fatty acid synthase; GLUT4: glucose transporter 4; G6Pase: glucose-6-phosphatase; HMG-CoA reductase: 3-hydroxy-3-methylglutaryl coenzyme A reductase; INS: insulin gene; PDX-1: pancreatic and duodenal homeobox 1; PEPCK: phosphoenolpyruvate carboxykinase; P13K: phosphatidylinositol-3-kinase; PPAR-peroxisomal proliferator-activated receptor).

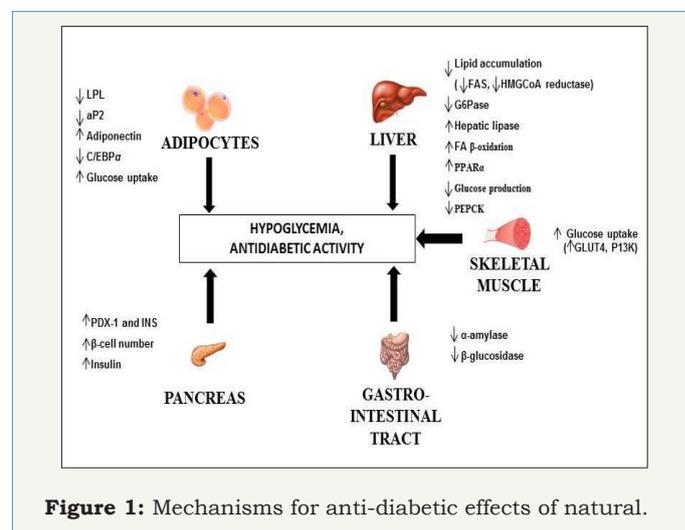


Figure 1: Mechanisms for anti-diabetic effects of natural.

Table 1: Anti-diabetic activities of different green tea extracts.

Sample	Types of Extracts	Experiment type	Results	References
Commercial green tea extract	70% extract	In vivo experiment using female CD-1 mice model	hypoglycemic effects through reduces the insulin resistance	5
Green tea	Aqueous extract	In vivo experiment using Wister rat model	lipid peroxidation inhibition	7
Green tea	Ethanol extract	In vivo experiment using rat model	reduce glucose content	8
Green tea	Aqueous extract at 38 °C for 15min	In vivo experiment rat model	antihyperlipidemic and antioxidative effects by reducing oxidation of lipoproteins and preserving paraoxonase activity.	10

Concluding Remarks and Future Prospective

The effects of green tea extract regarding anti-diabetes are summarized in Table 1 and their possible mechanistic approaches are described in Figure 1. The anti-diabetic potentials of green tea extracts can be substitute for other commercial anti-diabetic drugs. Green tea intake at different concentration showed significantly decreased in blood glucose level through different mechanism. However, the anti-diabetic activities of green tea extracts are mainly dependent on presence of their bioactive compounds. Therefore, further studies need to demonstrate the effects of different new extraction techniques to increase green tea bioactive metabolites yield and improving anti-diabetic activity.

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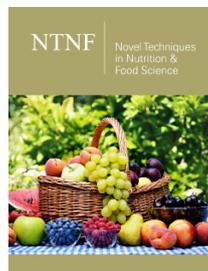
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