

The use of green tea (*Camellia sinensis*) and its parameters in the intervention of obesity

O uso do chá verde (*Camellia sinensis*) e seus parâmetros na intervenção da obesidade

El uso del té verde (*Camellia sinensis*) y sus parámetros en la intervención de la obesidad

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Abstract

Obesity is a problem that affects millions of people worldwide. It is a disease of multifactorial etiology, it is the result of a complex interaction between behavioral, cultural, genetic, physiological and psychological factors. Currently, it is a serious public health problem where there is a high percentage of treatment failure and relapses. The perception of the curative power of some plants is one of the forms of relationship between human populations and medicinal plants. Phytotherapy has shown positive effects under the prevention and treatment of several diseases, including obesity. Green tea (*Camellia sinensis*) contains flavonoid polyphenolic compounds. These substances found are known as catechins, highlighting epigallocatechine gallate. The objective of this research was to verify the properties presented by green tea that may contribute to the treatment of obesity. This is a qualitative bibliographic survey, using scientific articles and books. The results obtained through in vitro and in vivo experiments point to green tea as a product that has properties capable of acting in the slimming process. The studies indicate that green tea may act mainly in increasing the production of body heat (thermogenesis), promoting greater energy expenditure. It has been observed that there is no determination of the dosage and the form of preparation of the tea that can ensure the achievement of the desired effects. We emphasize the importance of more studies for a better understanding of its bioactive effects.

Keywords: *Camellia sinensis*; Green tea; Tea; Obesity; Weight loss.

Resumo

A obesidade é um problema que afeta milhões de pessoas em todo o mundo. É uma doença de etiologia multifatorial, resultado de uma complexa interação entre fatores comportamentais, culturais, genéticos, fisiológicos e psicológicos. Atualmente, é um grave problema de saúde pública onde há um alto percentual de falha no tratamento e recaídas. A percepção do poder curativo de algumas plantas é uma das formas de relacionamento entre as populações humanas e as plantas medicinais. A fitoterapia tem demonstrado efeitos positivos na prevenção e tratamento de diversas doenças, incluindo a obesidade. O chá verde (*Camellia sinensis*) contém compostos polifenólicos flavonóides. Essas substâncias encontradas são conhecidas como catequinas, com destaque para o galato de epigallocatequina. O objetivo deste trabalho foi verificar as propriedades apresentadas pelo chá verde que podem contribuir para o tratamento da obesidade. Trata-se de um levantamento bibliográfico qualitativo, utilizando artigos científicos e livros. Os resultados obtidos através de experimentos in vitro e in vivo apontam o chá verde como um produto que possui propriedades capazes de atuar no processo de emagrecimento. Os estudos indicam que o chá verde pode atuar principalmente no aumento da produção de calor corporal (termogênese), promovendo maior gasto energético. Observou-se que não há determinação da dosagem e da forma de preparo do chá que possa garantir a obtenção dos efeitos desejados. Ressaltamos a importância de mais estudos para um melhor entendimento de seus efeitos bioativos.

Palavras-chave: *Camellia sinensis*; Chá verde; Chá; Obesidade; Perda de peso.

Resumen

La obesidad es un problema que afecta a millones de personas en todo el mundo. Es una enfermedad de etiología multifactorial, es el resultado de una compleja interacción entre factores conductuales, culturales, genéticos, fisiológicos y psicológicos. Actualmente, es un grave problema de salud pública donde existe un alto porcentaje de fracaso del tratamiento y recaídas. La percepción del poder curativo de algunas plantas es una de las formas de relación entre las poblaciones humanas y las plantas medicinales. La fitoterapia ha mostrado efectos positivos en la prevención y tratamiento de diversas enfermedades, entre ellas la obesidad. El té verde (*Camellia sinensis*) contiene compuestos polifenólicos flavonoides. Estas sustancias encontradas se conocen como catequinas, destacando el galato de epigallocatequina. El objetivo de este trabajo fue verificar las propiedades que presenta el té verde que pueden contribuir al tratamiento de la obesidad. Se trata de un levantamiento bibliográfico cualitativo, utilizando artículos y libros científicos. Los resultados obtenidos a través de experimentos *in vitro* e *in vivo* apuntan al té verde como un producto que posee propiedades capaces de actuar en el proceso de adelgazamiento. Los estudios indican que el té verde puede actuar principalmente en el aumento de la producción de calor corporal (termogénesis), favoreciendo un mayor gasto energético. Se ha observado que no existe una determinación de la dosificación y la forma de preparación del té que pueda asegurar la consecución de los efectos deseados. Resaltamos la importancia de más estudios para una mejor comprensión de sus efectos bioactivos.

Palabras clave: *Camellia sinensis*; Té verde; Té; Obesidad; Pérdida de peso.

1. Introduction

The participation of processed foods in the family diet, including foods rich in sugars, fats that are sources of complex carbohydrates and dietary fiber, become a striking feature in the dietary pattern. Consequently, this fact contributes to the emergence of chronic non-communicable diseases such as obesity, circulatory system diseases, diabetes and neoplasms, a result of changes in the global pattern since the second half of the 20th century (Polonioa and Peres, 2009; Santos et al 2007).

Obesity is one of the problems that affects millions of people around the world, bringing with it a series of other chronic pathologies such as: hypertension and diabetes. This pathology is the increase in body fat, causing a health problem, causing functional disability, reducing life expectancy and increasing mortality (Lamarão and Fialho, 2009; Cercato et al 2004; Bray, 2002).

In an attempt to minimize the damage to health that this erroneous eating behavior has caused, many people have resorted to supermarket shelves in search of foods considered healthier, including functional foods, which are related to the metabolic or physiological role that a nutrient or non-nutrient plays. has on the growth, development and maintenance of organism functions (Castro et al 2021; O`keeffe et al., 2017; Topolska et al., 2021).

The use of medicinal plants for the maintenance and recovery of health has occurred over time from the simplest forms of local treatment to the most sophisticated forms. The perception of the healing power of some plants is one of the forms of relationship between human populations and a practice related to traditional use as an alternative for maintaining health or treating diseases (Giraldia and Hanazaki, 2010).

Studies indicate that medicinal plants continue to occupy a prominent position in the therapeutic arsenal. The World Health Organization (WHO) shows that 80% of the world's population use popular medicinal resources to meet private medical care needs. Showing that popular observations about the use and efficacy of medicinal plants from all over the world remain in practice, making therapeutic information that has been accumulated for centuries valid (Macedo; Oshiiwa and Guarid, 2007).

Green tea originated in China, it is one of the most consumed beverages in the world and belongs to the class of functional foods, it has been studied in recent years due to its effectiveness in reducing weight and body fat, as well as in preventing obesity and associated diseases (Ratnani and Malik, 2022).

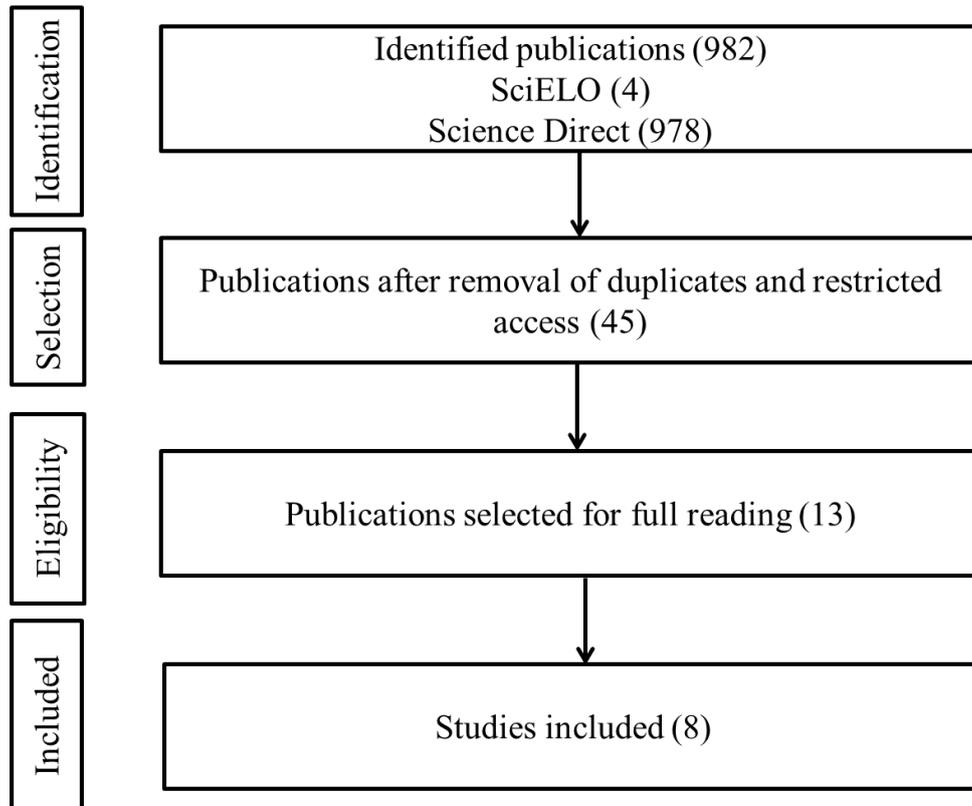
Many studies indicate that *Camillia sinensis* (green tea) has an anti-inflammatory, antitherogenic, hypoglycemic, anticarcinogenic and antioxidant effect, as it is constituted by polyphenolics and flavonoids, acting in the prevention of obesity due to the thermogenic effect and ability to oxidize body fat, resulting in weight loss. They are also composed of catechins,

mainly epigallocatechingallate (EGCG) which acts by removing part of the fat present in the tissues, removing a small portion of cholesterol, triglycerides present in the blood, lipids, concentrations of high density lipoproteins (HDL) and decreasing appetite, causing weight loss and improving health, are responsible for the beneficial effect, helping to lose weight and preventing chronic diseases (Senger; Schaeanke and Gottlieb, 2010; Duarte et al, 2014). Within this context, the objective of this work was to carry out a literature review on the properties contained in green tea that may contribute to the treatment of obesity.

2. Methodology

The present study is a narrative and descriptive review research with the use of green tea (*Camellia Sinensis*) and its parameters in the intervention of obesity. This research took place in several stages: choice of theme, choice of period, bibliographic survey, reading of scientific articles, selection and interpretation of the analyzed studies, ending with the production of the text. Data were collected using published scientific articles available in the Electronic Database SciELO (Scientific Electronic Library Online) and Science direct in the period 2016 to 2022, with the following descriptors: Green tea, Herbal medicine and obesity. As an exclusion criterion, they were submitted to the evaluation of duplicity, restricted access and later to the process of reading the abstracts in order to select those who contemplated the theme addressed according to the Figure 1 flowchart.

Figure 1 - Workflow of research methodology.



Source: Own authorship.

Notes were made of the essential points and the potentially relevant data of each text to meet the objectives that were intended to be achieved with the research developed.

3. Results and Discussion

3.1 Pathogenesis of metabolic disorders

Eating habits are motivated by physiological, psychological, sociocultural and economic factors that will form the preference and frequency with which certain foods will be consumed, in addition to family, school, friends contributing to the development of eating habits, as they are these “vehicles of consumption”. of society that interact in the formation of the individual at various moments in life (Sales et.al, 2014).

In an attempt to adapt food to the fast pace of everyday life, choices and consumption habits began to point to foods more in keeping with the new lifestyle, causing quick and practical habits to be incorporated. These foods that are considered practical do not have a content that is entirely harmful to the body, but the form and frequency with which they are consumed will lead to consequences that are not always advantageous, such as bad eating habits, which is the repetitive eating behavior aimed at foods with harmful properties and the low intake of foods with beneficial characteristics (França et al, 2012).

The consumption of industrialized products with a high amount of fat, sugar and salt (either by wrong amounts added in the preparation of food or by the frequency of consumption of foods that have a high salt content), can favor the emergence of many pathologies such as obesity, diabetes and high blood pressure, where these diseases have as their main cause the indiscriminate intake of processed foods with a large caloric factor, as well as the excessive use of saturated fat, simple carbohydrates and sodium (Brasil, 2007).

According to the World Health Organization (WHO), the projection is that by 2025 about 2.3 billion adults will be overweight and more than 700 million obese worldwide. In addition to a large number of overweight and obese children that could reach 75 million cases. According to the Brazilian Association for the Study of Obesity and Metabolic Syndrome, more than 50% of the Brazilian population is overweight, in the overweight and obese range, including children who correspond to a range around 15% (ABESO, 2016).

3.2 The use of herbal medicine today

The beauty of nature hides a war for survival, plants to survive and evolve have to compete for space and defend themselves from the attack of herbivores and pathogens. Plants are complex and synthesize substances that act on specific targets in their predators. Secondary metabolites of plants and microorganisms are produced to modulate their own metabolisms and, consequently, can reach therapeutic targets of human diseases (Ferreira and Pinto, 2010).

The World Health Organization (WHO) treats as a medicinal plant every plant that contains in one or more of its organs, which contains substances that can be used for therapeutic purposes or precursors of substances used for such purposes. The herbal medicine, in turn, is obtained exclusively from raw materials of active plant origin and can be characterized by its efficacy and/or risks during use, as well as by the reproducibility and constancy of its quality (Pereira et al., 2015)

The relevance in the use of medicinal herbal drugs has been evidenced over time in several regions of our country. Phytotherapy is currently based on techniques that provide us with in-depth knowledge about active principles, showing its importance to the socio-economic environment, being a strand of easy access for the population (Zuanazzi and Mayorga, 2011).

The population has the perception that every natural product is safe and devoid of side effects, but in reality in some cases the effects of natural products cause irreversible damage to health and others are only psychological. However, the lack of public information about herbal medicines has been exploited in search of miraculous cures and great profits, which can cause doubts, rather than clarifying the benefits. The only way to combat this doubt about herbal products is to bringing reliable and scientific information to the general public, without partiality or economic interests (Ferreira and Pinto, 2010)

Adverse effects of the use of herbal medicines can result from contamination by pesticides, heavy metals and microorganisms, as well as psychological effects (WHO, 2004).

3.3 Bioactivity of the *Camellia sinensis*

The *Camellia Sinensis* originated in China, is cultivated and consumed for its aroma characteristics, flavor and medicinal properties. Tea is a widely used beverage, reaching the second position of functional drink most consumed, can present a worldwide consumption of approximately 120 mL /day, losing only the first position for water (Lamarão and Fialho, 2009).

In the literature there is still no evidence or studies related to the specific dosage of catechins that could benefit human health. Studies suggest that the consumption of 4 to 7 cups of green tea per day reaching around 800 to 1,400 mL/day would be the most appropriate to obtain the expected health benefits. Evidence suggests that green tea extract containing 25% EGCG may reduce appetite and increase fat catabolism (Beltran et al., 2014)

The *Camellia sinensis* teas can be classified into three basic types: black, green and oolong, being differentiated only by their leaf benefits. The composition of tea leaves depends on several factors such as: climate, season, process used in horticulture, in addition to the type and age of the plant. The tea produced from the green or fresh leaves of the plant, after a rapid inactivation of the polyphenol oxidase enzyme, by the use of vaporization and drying, remains preserved its polyphenol content and becomes richer in catechins. The oolong or "partially oxidized" tea is obtained through the leaves at rest for two to four hours, then heated so that the oxidative process is interrupted. Black tea is derived from aged leaves by aerobic oxidation of catechins, catalyzed enzymatically (Nishiyama et al., 2010; SEnger; Schaeanke and Gottlieb, 2010).

The functional activity that green tea has is higher in the amount of bioactives than other beverages of the genus. It contains polyphenolic components, which include flavanols, flavandiols, flavonoids and phenolic acids. Most polyphenols present as flavanols, and catechins predominate among these. And there are four main types of catechins in green tea that are (-) epicatepthequine (EC), (-) 3-thaping (GEC), (-) epigallocatechin (EGC) and 3-epigallocatequine gallate (EGCG) (Lamarão and Fialho, 2009). The physiological effects beneficial to human health have been attributed to catechins. The Table 1 presents studies of the use of green tea as a medicinal plant, showing its biological effect.

Table 1 - Bioactivity of *Camellia Sinensis*.

Composition	Study design	Bioactivity	Authors
EGCG	Mice C57BL/6J	Reduction body weight and reduction weight of liver and kidney	Sampath et al., 2017
EGCG	Randomized, double-blind trial	Weight Reduction; decrease Waist circumference; Total Cholesterol and Plasma LDL Levels	Chen et al., 2016
Green tea "Benifuuki"	Randomized, double-blind, placebo-controlled trial	Reduction of LDL Cholesterol Levels; Reduction of Receptor-1 Levels of Oxidized LDL similar to Lectin containing LAB Level	Imbe et al., 2016
Black tea	Randomized, double-blind, crossover trial	Reduction in LDL/HDL Ratio Reduction in Total Cholesterol Levels	Troup et al., 2015
Black tea	Randomized, double-blind, placebo-controlled study	Reduction of Total Cholesterol Levels; LDL and Oxidative stress index increase the total antioxidant state	Orem et al., 2017
Green tea extract	Randomized, double-blind, placebo-controlled study	Decrease in lipid peroxidation	Spadiene et al., 2014
Green tea extract	Randomized, double-blind, placebo-controlled study	No effect on total antioxidant capacity, glycemic control markers and renal function increase in SOD activity	Vaz et al., 2018
Green tea	In vitro	Antioxidant (DPPH)	Nishiyama et al., 2019
EGCG	Randomized, double-blind and parallel design	No changes in body weight and changes in adiposity	Mielgo-ayuso et al., 2014
EGCG	Longitudinal intervention study	HIF1- α expression increase	Nicoletti et al., 2019
Black tea infusions	Randomly assigned	Reduction HbA1c levels reducing regulatory T cells decrease of pro-inflammatory cytokines	Mahmoud et al., 2016
Epigallocatechin galat	Wistar Cardiotoxicity Rats Mediated by Fluoride-Induced Oxidative Stress	Decrease in Peroxidative Lipid Markers; Reduction Total Plasma Cholesterol; Triglycerides; Phospholipid; LDL Cholesterol and increase in HDL Cholesterol	Miltonprabu and Thangapandiyam, 2015
Galocatequina galato Epigallocatequina galato	In vitro	Anti-adipogenic activity decrease of intracellular lipid droplets (GCG, EGCG) reduction of adipogenic transcription factors PPAR γ , SREBP-1c and C/EBP α (GCG, EGCG); ROS (GCG) levels; Activation of NF- κ B (GCG) and IL-6 production (GCG)	Li et al., 2017
EGCG and Total Green Tea	In vitro	Reduction of adipogenic transcription factors PPAR γ , SREBP-1c and C/EBP α	Lao et al., 2017

Legends - GCG: galocatechin gallate; EGCG: epigallocatechin-3-gallate; LDL: low density lipoprotein; HDL: high density lipoprotein; IL-6: interleukin-6; NF-Kb: nuclear factor kappa-b; ROS: reactive oxygen species; SOD: superoxide dismutase. Source: Own authorship.

The *Camellia sinensis* has activity in decreasing inflammatory cytosines such as IL-6 and NF- κ B, antioxidant effect by decrease of reactive oxygen specieand Lipid Peroxidation (Spadiene et al., 2014; Li et al 2017) The antioxidant, anti-inflammatory and immunomodulatory properties help in the treatment of several diseases.

The *Camellia sinensis* has been widely used as an aid in weight loss and maintenance strategy, as it has thermogenic properties characterized by heat production (Faria; Escher and França, 2010). Thus, it is believed that the use of green tea, combined with nutritional therapy, can encourage treatment for weight loss successfully, as well as improve lipid profile by decreasing the concentration of total cholesterol, low density lipoprotein (LDL), triacylglycerol and increased high density lipoprotein (HDL) (Miltonprabu and Thangapandiyam, 2015; Orem et al., 2017).

The effects of green tea intake are, in the short term, specifically targeted, the EGCG will act on fat metabolism. Studies show that catechin EGCG has a direct influence on the inhibition of Catecol-O-methyltransferase (COMT). COMT is an intracellular enzyme present in mammalian tissues, including skeletal muscle and adipose tissue. With its inhibition, consequently, there is an increase in catecholamine levels and increased activity of the sympathetic nervous system, stimulating lipolysis (Santana et al., 2015).

The EGCG and total green tea have properties in decreasing transcriptional factors of adipogenesis such as C/EBP α , SREBP-1c and PPAR γ in cells treated with EGCG and total tea. Although EGCG is the main functional compound of green tea, total tea showed the highest inhibiting effect of transcriptional factors (Lao et al., 2015).

These results are contrary to Mielgo-Ayuso et al., (2014) who found no changes in body weight and changes in adiposity. Therefore, we can conclude that more studies are needed to better understand the bioactive effect of *Camellia sinensis*, suggesting its use combined with the nutritional diet as an adjunct in the treatment of obesity and its use as thermogenic.

There are other substances in the composition of green tea such as water, protein, carbohydrate, vitamins (mainly C and K), mineral salts and fluoride, and can also be found tannins and methylxanthenas that can cause adverse effects and/or drug interactions. Another representative of the class of contraindications related to tea is caffeine, because it is a stimulant of the central nervous system. However, even with some contraindications, green tea has the ability to promote numerous health benefits, which arouses interest in research on its consumption. Most studies show satisfactory results, indicating that the drink offers benefits in the treatment of various pathologies, especially obesity and overweight (Saigg; Silva, 2009).

4. Final Considerations

Studies investigating the benefits of green tea related to obesity suggest that the drink has mechanisms capable of acting to aid in weight loss. It is noted that the predominance of increased thermogenic effect due to the presence of compounds such as Catechin EGCG has a direct influence on the inhibition of the intracellular enzyme Catecol-O-methyltransferase (COMT). This enzyme is present in tissues such as skeletal muscle and adipose tissue. With this inhibition, there is an increase in catecholamine levels and increased activity of the sympathetic nervous system, stimulating lipolysis, with weight loss.

In addition to weight loss, green tea and its by-products are also effective in preventing and treating obesity-associated diseases such as dyslipidemia, cardiovascular diseases and diabetes, by decreasing triacylglycerol, total cholesterol, oxidized LDL and transcriptional factors of adipogenesis.

Other studies present negative results against obesity, suggesting its use combined with the nutritional diet as an adjunct in the treatment of obesity and its use as thermogenic.

As future prospects, we suggest the study of modification of genic expressions regarding the use of green tea in the treatment of obesity.

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