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Tea Nutraceuticals: Unveiling Health Benefits and Bioactive Components a Review

Sravya Gopi[1], Dr. Sagar M Chavan[2], Dr. Jayant Ghatge[3], Rasika A[1], Dr. K. Prathapan[4]

[1]MTech student, Department of Agricultural Engineering, D. Y. Patil Agricultural & Technical University, Talsande, Maharashtra, India
[2]Professor of Agricultural Engineering, D. Y. Patil Agricultural & Technical University, Talsande, Maharashtra, India
[3]Associated dean of Agricultural Engineering, D. Y. Patil Agricultural & Technical University, Talsande, Maharashtra, India
[4]Vice Chancellor, D. Y. Patil Agricultural & Technical University, Talsande, Maharashtra, India

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Abstract— *Nutraceuticals are medicinal foods that plays an important role in maintaining well-being, enhancing health, modulating immunity and thus preventing and treating specific diseases. Nutraceuticals can be defined as substances that have physiological benefits or protection against chronic diseases. Nutrients can be used to improve health, slow the aging process, prevent chronic disease, increase life expectancy, and support body structure and function. Camellia sinensis plant provides different types of tea including black, green, oolong, yellow, brick and white tea. Tea is one of the main beverages consumed around the world, but it is only successfully enjoyed with water for fitness and enjoyment. This review article discusses the analysis of tea nutrients and important bioactive compounds. It also describes the important health benefits of tea consumption. Important bioactive compounds in tea include antioxidants that have been shown to manage diabetes and prevent heart health and digestive diseases and polyphenols are known to reduce inflammation and the growth of cancer cells. In addition to the many known facts, future research will include further investigation into the molecular interactions and other therapeutic benefits of its bioactive compounds, so that everyone can better understand its importance.*

Keywords— ***Nutraceuticals, Tea, Bioactive components, Polyphenols, Antioxidants, Caffeine, Dietary supplements.***

I. INTRODUCTION

Approximately 2500 years ago, Hippocrates (460–377 BC), the father of modern medicine, conceptualized the relationship between the use of appropriate health foods and their therapeutic benefits and quoted, “Let food be thy medicine, and medicine be thy food” (Bagchi, 2014). In the past five years, the world has witnessed the explosive growth of the multi-billion-dollar industry known as nutraceuticals. The term “nutraceutical” combines the word “nutrient” (a nutritious food or food component) with the word “pharmaceutical” (medicinal preparation) (Kumar & Kumar, 2015). “Nutraceutical” is a term coined in 1979 by Stephen De Felice, which is defined as “food or parts of food that provide therapeutic or health benefits, including the prevention and treatment of disease” (Rajat *et al.,* 2012). Nutraceuticals are defined as food products, extracts, or food derivatives, such as vitamins, herbs, amino acids, minerals, and enzymes, that may potentially exhibit pharmaceutical benefits in addition to their nutritional value (Santini *et al.,* 2017). They are also commonly referred to as dietary supplements or functional foods and, from a nutritional point of view, they are a source of both nutrients (carbohydrates, proteins, fats, vitamins, minerals) and non-nutrients (e.g. enzyme regulators) (Bergamin *et al.,* 2019).

Nutrients are biologically active substances that can be present in functional foods or individual foods and have beneficial effects on human health through participation in metabolic processes (Morris *et al.,* 2004). Espin *et al.,* (2007) believe that nutraceuticals include pharmaceutical preparations containing first-class dietary phytochemicals as active ingredients. Nutrients as food additives in the United States also have other terms such as

therapeutic foods, phytochemicals, prophylactics, medicinal foods (pharmaceuticals), and functional foods (Błecha and Wawer, 2011 and Morris *et al.,* 2004). The difference between drugs and dietary supplements is a matter of debate among scientists and health officials. It is generally accepted that dietary supplements should only contain lower doses than pharmaceutical products and show a higher level of safety in use (especially long-term) than conventional pharmaceutical products (http://www.nutrition.org.uk). Globally, the use of dietary supplements varies, with more than 50% of adults in some Western countries taking dietary supplements regularly (Burnett *et al.,* 2017 & Binns *et al.,* 2018).

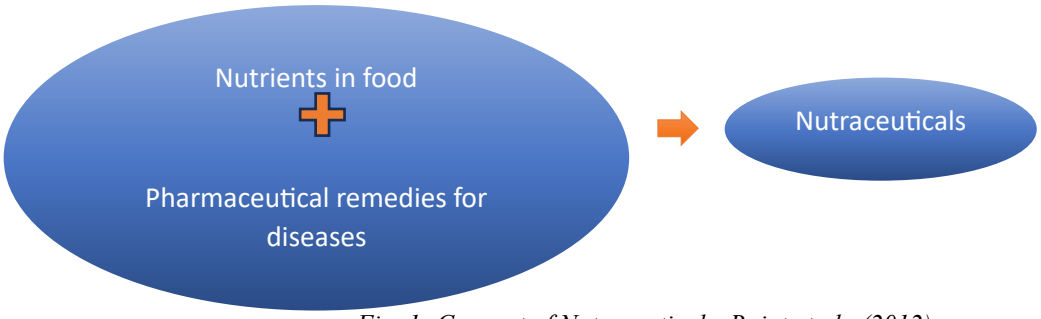

Fig. 1: Concept of Nutraceuticals. Rajat et al., (2012)

Tea, a beverage made from the leaves of the Camellia sinensis plant, originated in ancient China and has become increasingly popular worldwide in recent decades (Guo *et al.,* 2017). Tea derived from the Camellia sinensis plant is one of the most popular and widely consumed beverages worldwide. As it is rich in bioactive compounds, it has many health benefits.

II. HISTORY OF TEA

In Chinese legend, the story of tea begins with Emperor Shen Nong (2737-2697 BC), also known as the Divine Healer, Divine Husband, and Divine Cultivator. To protect the health of his people, the emperor ordered that water should be boiled before drinking. One day while he was boiling water, a leaf blown by the wind fell into the pot. When Shen tasted the finished product, he was not only satisfied with the taste, but also felt energized. Its leaves come from the plant we know today as Camellia sinensis. Shen ordered widespread cultivation and recommended its infusion to his subjects, declaring that "it energises the body, satisfies the mind, and sets the goal" (Saberi, 2010).

PRODUCTON & STATUS OF TEA

With an annual value of USD 9.5 billion, the world's tea trade is valued at USD 9.5 billion, surpassing USD 17 billion in global tea production. This represents a substantial source of export revenue for emerging and low-income economies (FAO, 2022a). The demand for tea has increased by 2.5% per capita over the past ten years, mostly in East Asia, Africa, Latin America and the Caribbean, and the Near East, offsetting declining consumption in Europe, the United States, Canada, and the Russian Federation. Research estimates that global tea production will grow at a compound annual growth rate (CAGR) of 5.7% from 2021 to 2026 (Caro, 2020; Mordor Intelligence, 2023a). The FAO reports that from growing 5 million hectares, tea production increased from approximately 4.3 million tonnes (Mt) in 2008 to 6.3 Mt in 2020 (FAO, 2022a; FAOSTAT, 2021). Over the past decade, tea output has stayed relatively stable, with a CAGR of 2.31% from 2014 to 2020, down from 3.32% from 2008 to 2020. The global tea market is expected to increase at a compound annual growth rate (CAGR) of 7.09% from USD 49.53 billion in 2023 to USD 98.29 billion by 2033, according to a research analysis published by Spherical Insights & Consulting.

Table. 1: Global production of tea from 2004 to 2020

Year	Tea Production (in million metric tons)
2004	3624.61
2006	3845.56
2008	4256.47
2010	4610.75
2012	5025.69
2014	5493.99
2016	6108.84
2018	6650.6
2020	7024.04

Source: M. Ridder (2022)

CONSUMPTION

The global consumption of tea continues to increase in 2013. Total tea consumption increased by nearly

5 percent to 4.84 million tons in 2013, supported by rapid growth in per capita income levels, particularly in China and India and other emerging countries. The demand growth was particularly significant in China. Consumption in recent years shows a significant increase of more than 8% annually, and the total consumption in 2013 reached 1.61 million tons, which increased by 9% compared to the previous year, making it the largest consumption in the world. In India, consumption increased by 2.4% in 2009 and 6.6% in 2013, reaching 1 million tons (Chang, 2015). In 2016, Turkey was the largest tea-consuming country in the world, with a per capita tea consumption of approximately 6.96 pounds per year. In contrast, China had an annual consumption of 1.25 pounds per person. In 2022, global consumption of tea amounted to about 6.7 billion kilograms and is estimated to reach to 7.4 billion kilograms by 2025 (Published by Statista Research Department, Aug 29, 2023). Tea volume "is seeing annual growth of 2.8% and is expected to be higher in the future (Bolton, 2018).

Table. 2: Global Tea consumption from 2013 to 2021

Year	Consumption (Billion litres)
2013	234
2014	242
2015	250
2016	258
2017	266
2018	273
2019	281
2020	289
2021	297

Source: Bolton, (2018)

TYPES OF TEA

According to different processing techniques, there are different types of tea, such as green tea, yellow tea, white tea, black tea, oolong tea, and orange tea (Yang & Kong, 2016). Among these different types of tea, the most consumed tea products are black tea and green tea.

Green tea:

Unfermented and pale green liquor. It is also popular in Japan and China. Although green tea naturally contains caffeine, the content is usually lower than that found in oolong tea, and most of the caffeine content can be removed by decaffeination (Amaresh *et al.,* 2011).

Black tea:

It is known as a fully fermented brown liqueur. It is widely used in Western countries. It is naturally caffeinated and can be decaffeinated to remove most of the caffeine content (Amaresh *et al.,* 2011).

Oolong tea:

Oolong tea is a semi-fermented tea that has characteristics between black tea and green tea. It naturally contains caffeine, usually in lower amounts than black tea, and can be consumed decaffeinated to remove most of the caffeine content (Amaresh *et al.,* 2011).

Table 3: Properties of green tea & black tea.

Properties	Green tea	Black tea
Processing	Involves fixation, rolling & drying processes (Cabrera *et al.,* 2006)	Involves a withering, rolling, fermentation & drying process (Sharma & Rao 2009)
Origin	China (Sinija and Mishra 2008)	Asia and Europe (Skotnicka *et al.,* 2011)
Taste	Bitter (Soni *et al.,* 2015)	Distinct taste (Soni *et al.,* 2015)
Colour	Green or yellow (Soni *et al.,* 2015)	Red to black (Soni *et al.,* 2015)
Nutrients	Epigallocatechin gallate (EGCG)	Theaflavins
Antioxidant	More Polyphenols	More Flavonoids
Caffeine	Less than black tea	More than green tea
Health benefits	- **Heart Health**: Both protect heart health by reducing LDL cholesterol and blood pressure. - **Brain Function**: Caffeine and L-theanine enhance alertness and mood. - **Cancer Prevention**: EGCG in green tea may inhibit cancer cell growth.	- **Heart Health**: Improves blood vessel function in coronary artery disease. - **Bone and Teeth Health**: Provides fluoride for stronger teeth and bones.

Health hazards	- **Caffeine Sensitivity**: Green tea has less caffeine. - **Gastric Issues**: Not recommended for those with gastric problems. - **Pregnancy and Breastfeeding**: Avoid excessive consumption.	- **Caffeine Intake**: Moderate consumption to prevent side effects. - **Hypertension**: Caution for those with high blood pressure. - **Insomnia**: Avoid excessive intake.
Best time to drink	Drink green tea during 10 am to 11 am or evening. Drinking during this time will increase your metabolism.	It's alright to take tea in morning or evening but it is good to avoid taking tea in breakfast or with proper meal.
Quality	Better in fresh	Depend on produced location

Source: Chaudhary, (2023), Sharangi, (2009).

Table 4: Major chemical constituents and their composition in tea

Constituent	Green tea (%)	Black tea (%)
Catechins	30	9
Amino acids	4-5	3
Proteins	15	15
Lipids	3	3
Caffeine	3	3
Organic acids	2	2
Methylxznthines	7-9	8-11
Minerals	6-8	5

Source: Mohanpuria *et al.,* (2010) & Harbowy et al., (1997).

SCOPE

Nutraceuticals play a significant role in modifying and maintaining normal physiological function that maintains healthy human beings (Prajapati & Kumar, 2020). The philosophy behind nutraceuticals focuses on prevention. Most of the time, it can be used in the field of dietary supplements and functional foods (Nwosu & Ubaoji, 2020). The food products used as nutraceuticals can be categorized as dietary fiber, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other different types of herbal natural foods. A dietary supplement is a food or substance in food that has medical or health benefits. They can be used not only because of their nutritional value, but also as medicine. When it comes to tea, the range of uses as a dietary supplement is fascinating, including antioxidant properties, digestive health, cardiovascular benefits, and general health support.

III. CLASSIFICATION OF NUTRACEUTICALS

The food industry consists of three main sectors including functional foods, dietary supplements and herbal/natural products (Błecha and Wawer, 2011).

Functional foods

As defined by the United States of America Institute of Medicine's Food and Nutrition Board, a functional food is "a food or nutrient that has the potential to provide health benefits beyond traditional nutrients." The concept of functional foods is "foods that, when consumed as part of the daily diet, have beneficial effects beyond their basic nutritional functions." Functional foods contain bioactive substances obtained from plant or animal sources (Ernst, 2001 and Nwosu & Ubaoji, 2020).

Dietary supplements

Dietary supplements are products taken in addition to regular meals to provide additional health-promoting nutrients. According to the Dietary Supplement Health Education Act (DSHEA), dietary supplements are products intended to supplement the diet. It contains food components such as vitamins, minerals, amino acids, plants and herbs. It is intended to be taken as a tablet, capsule, pill, or liquid. and labelled as a food supplement (ODS 2011, Ronis *et al.,* 2018, and Hassan *et al.,* 2020). Although dietary supplements are not intended to cure or cure diseases, dietary supplements are more focused on the expected results of these products, such as prevention or treatment of diseases (Nwosu & Ubaoji, 2020).

Herbal products

Medicinal plants are as old as human civilization and have provided a complete stock of therapeutic agents for the treatment of acute and chronic diseases. As herbal knowledge has accumulated over thousands of years, today we have many effective tools to ensure health care (Kumar and Kumar, 2015). Nutrients have great potential to improve health and prevent chronic diseases with the help of plants (Singh & Sinha, 2012). Plants play an important role in maintaining the quality of human life through rich sources of biological components. Plant bioactive compounds are an essential category of food supplements that, in addition to minerals, vitamins and other active compounds, have health-enhancing medicinal properties. Plants contain a wide range of active phytochemicals

including flavonoids, terpenoids, saponins and polyphenols. These plant bioactive substances are commonly used as dietary supplements by people seeking conventional health care (Nwosu & Ubaoji, 2020).

IV. HEALTH FUNCTIONS OF TEA

Antioxidation

Antioxidants are substances that slow or inhibit the oxidation of substrates caused by free radicals. They act as free radical scavengers. Free radicals are molecules or chemical species that contain one or more unpaired electrons and can exist independently and can cause degenerative diseases (Parihar *et al.,* 2022). Antioxidants are known to reduce free radicals that limit the risk of oxidative stress (OS) and related diseases. At the cellular and molecular level, they inhibit or delay oxidative processes by inactivating reactive oxygen species (ROS) and interrupting the radical chain reaction of lipid peroxidation under certain low concentrations (Prakash and Gupta, 2009). Tea has long been of interest as a medicine and health drink, but recently the potent antioxidant effects of tea polyphenols have gained attention. Oxidative stress has been shown to play a role in the development of many diseases, including cancer (Feng *et al.,* 2001, Embola *et al.,* 2002, and Cabrera *et al.,* 2003).

Anti-inflammation

Inflammation is a reflex marker against harmful pathogens and stimuli that disrupt the immune system. Pain, redness, heat and swelling in the infected or damaged area are signs of inflammation. Steroidal and non-steroidal anti-inflammatory drugs are used to treat inflammatory effects. The remarkable anti-inflammatory activity of tea and its bioactive components has been demonstrated with insights into multiple mechanisms of action, suggesting potential in the treatment and management of inflammation-related diseases (Hamer, 2007).

Anticancer

Cancer is a manifestation of malignancy, which results from step-by-step processes that are distinguished by progressively accumulating mutations (Butt & Sultan, 2009). According to the GLOBOCAN 2018 database, there were an estimated 18.1 million new cancer cases and 9.6 million cancer deaths worldwide in 2018, and new cases will reach 20 million globally by 2025 (Ferlay *et al.,* 2019, 2015). Bioactive dietary components rich in nutraceuticals have the potential to prevent cancer (Avrelija & Walter 2010). One of the benefits of drinking green tea is that carcinogenesis in the digestive tract is inhibited by ECGC as expressed in cells. Polyphenols from tea inhibited the growth and lysis of the human gastric cancer cell line KATO III, and also inhibited the release of tumour necrosis factor-a (TNF-a) from the cells (Okabe *et al.,* 1999). It was reported that green tea consumption (5 × 1 cup/day, four weeks) alters oral bacteria, which may be related to oral carcinogenesis (Adami *et al.,* 2018).

Cardiovascular protection

Improper lifestyle, diet, age and many other external factors can lead to the onset of cardiovascular diseases. Tea and its bioactive compounds are capable of showing positive effects on promoting good health. The antioxidants present in tea leaves are known to reduce the amount of oxidative radicals that otherwise damage the heart and vessels connected to the heart. This is also known to increase oxidative stress which subsequently results in heart failure over time (Zhang *et al.,* 2014).

Anti-diabetes

Diabetes is caused by an imbalance in metabolism, where our body is either unable to produce insulin or completely consumes insulin. Many anti-diabetic drugs are expensive and have been reported to cause other types of side effects. Hence, switching to food items with nutraceutical values is a better option. Tea has been discovered as an alternative to prevent the onset of diabetes. Green tea is traditionally used to control blood sugar levels. Animal studies suggest that green tea may help prevent the development of diabetes (type-1) and slow its progression once it has developed (Ratnani and Malik, 2022). Herbal dietary supplements containing nutraceuticals have been proven to provide therapeutic benefits on type 2 diabetes (Rajat *et al.,* 2012).

Anti-obesity

Obesity is a medical condition characterized by the accumulation of excess body fat. Nutraceuticals like conjugated linoleic acid, capsaicin, xylem have excellent anti-obesity properties. Herbal nutraceuticals like chitosan, caffeine, fenugreek, vitamin C, green tea, curcumin, black gram, bottle guard reduce body weight (Rajat *et al.,* 2012). Recent studies have suggested an anti-obesity effect of tea and its components, by improving energy expenditure, lipid metabolism and lipid accumulation (Tang *et al.,* 2019). Tea extracts and their constituents, including polyphenols, caffeine and polysaccharides, have shown anti-obesity effects, including regulation of glycolipid digestion, absorption and metabolism, improvement of energy expenditure, inhibition of lipid accumulation and deposition, and ultimately increase and decrease in body weight. can lean mass (Tang *et al.,* 2019).

Hepato-protection

Tea has shown beneficial effects on dietary- and chemical-induced disorders in the liver, including oxidative

stress damage to the liver, inflammation, steatosis, and fibrosis (Weeravatnakorn, 2015, Braud *et al.,* 2017, Rangi *et al.,* 2018, and Tang *et al.,* 2019). Population-based studies show that those who drink more than 10 cups of green tea per day are less likely to develop liver problems. Green tea also protects the liver from the damaging effects of toxic substances such as alcohol (Yin *et al.,* 2015). Results from several animal and human studies suggest that catechins may help treat viral hepatitis, liver inflammation (Ratnani and Malik, 2022).

Gastrointestinal protection

The beneficial effects of tea on the digestive system may be related to tea polyphenols (TPs, which consist mainly of catechins). Studies have shown that epigallocatechin-3-gallate (EGCG), a catechin, can help regulate the digestive system as it reduces inflammation in the gastrointestinal tract and colitis models (Oz *et al.,* 2013).

Anti-microbe

The presence of phenolic compounds and epigallocatechin-3-gallate in tea is responsible for the antimicrobial nature. The anti-microbes include anti-bacteria, anti-fungal and anti-virus. Tea may modulate gut microbiota composition (increase beneficial microorganisms and decrease harmful microorganisms) and may be beneficial for individuals at risk for obesity, metabolic syndrome, hyperlipidemia, and cardiovascular diseases (Lu et al., 2019, Liu et al., 2019, Zhang et al., 2018, Chen et al., 2018, Zhou et al., 2018, Chen et al., 2018, Ma et al., 2019 & Tang et al., 2019).

BIOACTIVE COMPONENTS

Many bioactive components have been identified in tea and its brews, including polyphenols, pigments, polysaccharides, alkaloids, free amino acids and saponins, and the amount of these compounds can be quite different in different tea varieties (Bi *et al.,* 2016, Guo *et al.,* 2017, Pan *et al.,* 2017 and Wang *et al.,* 2017). Tea contains polyphenolic compounds (catechins and epicatechins), theaflavins, flavanol glycosides, L-theanine, caffeine, theobromine and volatile organic compounds. These bioactive components are responsible for tea's astringency, taste, aroma and flavour as well as its health beneficial effects (Samanta, 2022).

Polyphenols

White, green and yellow teas are rich in polyphenols, especially catechins and their derivatives, including catechin, epicatechin (EC), gallocatechin (GC), epigallocatechin (EGC), catechin gallate (CG), epicatechin gallate (ECG), gallocatechin Contains gallate (GCG), and epigallocatechin gallate (EGCG) (Tang *et al.,* 2019, Zhao *et al.,* 2019, Luca *et al.,* 2016, Satoh *et al.,* 2016, Yang *et al.,* 2018 and Tang *et al.,* 2019). In addition, other polyphenols such as gallic acid, chlorogenic acid, ellagic acid, galloylquinic acid, kaempferol-3-O-glucoside (kaempferol-3-G) and various flavonoids are also found in tea (Tang *et al.,* 2019, Zhao *et al.,* 2019, Bai *et al.,* 2017, Chen *et al.,* 2015, Zielinski *et al.,* 2015 and Tang *et al.,* 2019). In particular, tea polyphenols are one of the most important natural antioxidants (Luca *et al.,* 2016 and Tang *et al.,* 2019).

Table 5: Health benefits of polyphenol content in tea

polyphenol content	Tea	Health benefits
Epicatechin (EC)	Green tea	Anti-hyperlipidemic, Anti-inflammatory, Antioxidative, Anticarcinogenic, Cytoprotective
Epigallocatechin (EGC)		Reducing risks of diabetes mellitus and cardiovascular diseases
Epicatechin gallate (ECG)		Anti-hyperlipidemic, Anti-inflammatory, Antioxidative, Anticarcinogenic, Cytoprotective
Epigallocatechin gallate (EGCG)		Anticarcinogenic, Anti-inflammatory, Antioxidant, Metabolic regulation
Theaflavin (TF1)	Black tea	Antioxidant, Cardiovascular health
Theaflavin-3-monogallate (TF2a)		
Theaflavin-3'-monogallate (TF2b)		
Theaflavin-3,3'-digallate (TF3)		

Source: Musial *et al.,* (2020).

Pigments

Tea catechins are oxidized during fermentation, to theflavins, therubigins and thebrownins, therefore, oolong, black and dark tea are rich in pigments (Lv *et al.,* 2017, Koch *et al.,* 2017, Tang *et al.,* 2018 and Tang *et al.,* 2019). The structures of theflavins, which have been identified with 4 isomers, including theflavin, theflavin-3-gallate, theflavin-30-gallate, and theflavin-3,30-gallate, are simpler than therubigins and thebrownins, which are complex mixtures. polyphenols and their polymers (Sakakibara *et al.,* 2003, Bhattacharya *et al.,* 2011 and Tang *et al.,* 2019). Tea pigments have also been shown to be important bioactive components responsible for the health functions of tea, such as anti-inflammatory, anticancer and hepato-protective effects, although their antioxidant activity may be low when compared to tea catechins (Pan *et al.,* 2017, Ramadan *et al.,* 2017, Weeravatnakorn *et al.,* 2015 and Tang *et al.,* 2019).

Polysaccharides

Tea polysaccharide (TPS) is a non-starch protein-free acidic polysaccharide containing 44.2% neutral sugars, 43.1% glyoxylic acid and 3.5% protein. TPS mainly contains glucose (Glc), galactose (Gal), arabinose (Ara), rhamnose (Rha), xylose (Xyl), galactronic acid (GalA), mannose (Man), ribose (Rib), glucuronide, etc. sugars (GulA) (Lv *et al.,* 2009 and Yao *et al.,* 2022). TPS is another important bioactive component of tea apart from polyphenols. The content of polysaccharides in tea can increase with the maturation of raw tea leaves, which is completely different from the pattern of tea polyphenols (Xiao and Jiang 2015 and Tang *et al.,* 2019).

Alkaloids

Tea is one of the most important sources of alkaloids, usually purine alkaloids (such as caffeine, theobromine, theophylline), which can be converted into flavoalkaloids (Bi *et al.,* 2016 and Li *et al.,* 2018). A possible pathway for deamination of L-theanine, decarboxylation, spontaneous cyclization, and attachment of the product to EGCG to form the flavoalkaloid has been proposed (Li *et al.,* 2018). Caffeine is the most abundant alkaloid among all six types of tea (Bi *et al.,* 2016). The antioxidant, antidiabetic and ant obesity effects of tea alkaloids have been reported in several studies (Luca *et al.,* 2016, Xu *et al.,* 2015, Li *et al.,* 2018, and Tang *et al.,* 2019).

Free amino acids

Amino acids play an important role in creating tea aroma during black tea processing. Meanwhile, aspartic acid, glutamic acid, serine, glutamine, tyrosine, valine, phenylalanine, leucine, isoleucine and luteanine are the main amino acids found in tea leaves, and asparagine is formed from it. L-theanine (γ-ethylamino-L-glutamic acid) is a unique neuroactive amino acid found naturally in tea. It is a free (non-protein) amino acid found almost exclusively in the tea plant (Camellia spp.) and constitutes 1-2% of the dry weight of tea leaves and approximately 50% of the total free amino acids (Juneja *et al.,* 1999).

Flavonol glycosides

Flavonoids have anti-cancer properties by acting as antioxidants. These are found in citrus fruits, soy foods, which are unique dietary sources of isoflavones, green tea, which is rich in epigallocatechin gallate, and curcuma longa, which is rich in curcumin (Neha *et al.,* 2011). The effects of flavonol supplementation on cardiometabolic risk factors showed a significant decrease in triglycerides, total cholesterol, low-density lipoproteins, fasting plasma glucose levels and blood pressure, and a significant increase in high-density lipoproteins (Menezes e*t al.,* 2017 and Rha *et al.,* 2019). The antioxidant effect of flavonol glycosides is weaker than flavonol aglycones (Plumb *et al.,* 1999 and Rha *et al.,* 2019).

L-theanine

L-theanine (γ-glutamylethylamide) is a non-protein amino acid found abundantly in tea. This compound was first isolated by Sakado in the late 1940s. A standard 200 ml cup of black tea contains on average about 25 mg of L-theanine, while typical green tea leaves contain 0.2-2.4% (w/w) (Deb *et al.,* 2019). L-theanine has been shown to contribute to the production of volatile compounds in tea, which may be the main reason for the rice-like crisp aroma and chestnut freshness (Guo *et al.,* 2019, Zhang *et al.,* 2020, Li *et al.,* 2022). L-theanine has antioxidant, anti-inflammatory, neuroprotective, anti-cancer, metabolic regulator, cardiovascular, liver and kidney protection, immunity, and protection of the reproductive system and intestines (Li *et al.,* 2022).

Caffeine

Of the approximately 50,000 known secondary metabolites produced by plants, more than 12,000 are alkaloids. The most common secondary metabolites are anthocyanins, flavonoids, quinine, lignin, steroids and terpenoids. Caffeine is a common purine alkaloid and is found in more than 60 different plant species, including coffee, tea, kola nut, guarana berry, yerba mate, and cocoa beans (Ashihara & Crozier, 1999 & Mohanpuria *et al.,* 2010). Caffeine acts as an adenosine antagonist, thereby reducing the natural decrease in noradrenaline concentration. Caffeine inhibits phosphodiesterases and increases protein kinases. Catechins also inhibit pancreatic and gastric lipase, weakening fat emulsification and thereby reducing fat absorption (Dulloo *et al.,* 2000).

V. FUTURE

Dietary supplements play a big role in food and nowadays humans support quality and healthy food, so until humans do not exist in this world, there is no place to use dietary supplements in the future. The future range of tea nutritional supplements has enormous potential as we continue to discover the health benefits inherent in these delicate tea leaves. Powdered tea containing various bioactive ingredients offers exciting possibilities for nutritional supplements. As science advances, we can expect innovative formulations that take advantage of the properties of tea to promote health.

VI. CONCLUSION

Nutraceuticals have health and disease prevention benefits and should be consumed in recommended and acceptable amounts (Prajapati & Kumar, 2020). People are now focused on changing their normal lifestyle in a healthier direction, so dietary supplements play a very important role in this regard. Advanced research has been done on the use of tea to find its value as a dietary supplement, and researchers are now working on ways to manage many common ailments and restore the ancient value of tea as a better alternative.

In conclusion, polyphenols, pigments, polysaccharides, alkaloids, free amino acids, flavonol glycosides, L-theanine and caffeine in tea can be the main bioactive components involved in the diverse health functions of tea. These bioactive components protect our body against various health conditions and have the ability to protect us against many chronic diseases. Even though tea has all these benefits, more attention should also be paid to its safety, including contamination with heavy metals, pesticides, and mycotoxins, as well as the possible adverse effects of high doses of tea bioactives. Overall, tea is a promising dietary component and its consumption has shown many health functions (Tang et al., 2019).

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