Journal of Agriculture & Forestry Research | JAFR |
Volume no.3, Issue no. 1, Year 2024
www.sarpo.net

Review paper Open access

Tea Production, Composition, Consumption and Prospectives as an Antioxidant and Antimicrobial Beverage for Worldwide Human Community

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ABSTRACT

Tea is the most consumed beverage after water. It is brewed from the leaves of tea (Camellia sinensis, a member of the Theaceae family). The different types of tea made are oolong tea, green tea, black tea, and Ilex tea depending on the post-harvest processing and palatability of the region. The tree was originally native to Southeast Asia (southern China, northern India, Myanmar, and Cambodia), but is today also grown in Sri Lanka, Japan, and other countries. Rich in natural antioxidants, tea is said to be effective against colon, esophageal, and lung cancers, as well as against urinary stones, tooth decay, and more. Tea chemical composition acts as an antioxidant, antibacterial, anti-inflammatory, anti-cancer, and these characteristic properties can be used as an effective preventative agent. Nowadays, healthy foods containing active free radical scavengers are very demanding. The main chemical components of green tea include polyphenols, caffeine, and amino acids. Tea also contains flavonoid compounds that are believed to have antioxidant properties and many beneficial effects. It is widely accepted that phenolic compounds in certain foods have the potential to provide health benefits. The health benefits of green tea for a variety of diseases, including various types of cancer, heart disease and liver disease, have been reported. Many of the beneficial effects of green tea are related to its catechin content, especially (-)-epigallocatechin-3-gallate. There are also human studies using green tea catechins to treat metabolic syndrome, such as obesity, type II diabetes, and cardiovascular risk factors. There is evidence from in vitro studies on the basic mechanism of green tea catechins and their biological activity. Tea is associated with beneficial effects on human health, with polyphenols being the responsible constituents. India is one of the largest producers, exporters, and consumers of all types of tea. The present review focuses on the production process, composition, and beneficial effects of tea consumption on human health.

Keywords: Tea, Production, Consumption, Antioxidant, Antimicrobial, Human

- **Received:** 22.12.2023
- **Received in revised form:** 20.01.2024
- **Accepted:** 22.01.2024

To cite this article: Tanwie, C.N.; Ambebe, T.F. Tea Production, Composition, Consumption and Prospectives as an Antioxidant and Antimicrobial Beverage for Worldwide Human Community. *J. Agric. For. Res.,* 2024, 3(1), 40-60.

1. INTRODUCTION

Tea is an aromatic beverage prepared by pouring hot or boiling water over dried, cured, or fresh leaves of *Camellia sinensis*, an evergreen shrub native to East Asia and probably native to the southwestern border regions, China, and northern Myanmar (Yamamoto, 1997; Heiss, 2007). Tea is the world's oldest and most popular caffeinated non-alcoholic beverage and is prepared by steeping the processed leaves of the tea plant, Camellia sinensis (Kumar, 2014). Tea is also made, but rarely, from the leaves of the *Camellia taliensis* plant. After plain water, tea is the most consumed beverage in the world (Macfarlane and Macfarlane, 2004). There are many types of tea; some have a refreshing, cooling, slightly bitter, and astringent flavor (Penelope, 2000), while others have sweet, nutty, floral, or herbal, grassy flavors. Tea has a stimulant effect in humans mainly due to its caffeine content (Cappelletti et al. 2015). The first reliable record of tea drinking dates to the third century AD, in a medical text written by the Chinese physician Hua Tuo. It was popularized as a recreational drink during China's Tang Dynasty, and tea drinking later spread to other East Asian countries. Portuguese priests and merchants introduced it to Europe in the 16th century (Weinberg and Bealer, 2001). Weinberg and Bealer The term herbal tea refers to beverages that are not made from Camellia sinensis. These are infusions from fruits, leaves, or other plant parts, such as infusions from rose hips, chrysanthemums, or rooibos. This may be called tisanes tea or herbal infusions to avoid confusion with tea made from the tea plant.

The most consumed teas are black tea, green tea, and oolong tea, all of which come from the *Camellia sinensis* plant. Around 3.0 million tons of dry tea are produced each year, of which 20% is green tea, 2% is oolong tea and the remaining is black tea. Green tea and oolong tea are mainly consumed in Asian countries, while black tea is widely consumed in India and Western countries (Anonymous, 2002). Tea is grown in 16 states of India, 4 of which are Assam, West Bengal, Tamil Nadu and Kerala, accounting for about 96% of the country's total tea production, while the pattern of tea use for tea cultivation shows that East North India accounts for 78 % of the total tea growing area in India. Teas originating and are famous from Darjeeling, Assam and Nilgiris are famous all over the world for their exceptional quality. Tea exports contribute significantly to a country's foreign exchange resources. Assam is the only region in the world that has its own type of tea, called *Camellia assamica*. It has a malty sweetness and an earthy taste, not unlike the floral aroma of highland teas (Darjeeling, Taiwan). The chemical composition of tea has anticariogenic, antibacterial, anti-inflammatory and antioxidant properties etc. Due to these major beneficial features, tea can be used as an effective infection-prevention and immunity-boosting agent. This review provides an overview of the myriad uses of tea as a preventative and anti-infective agent in addition to its production and consumption.

2. Etymology of Tea

The etymology of the various words for tea reflects the history of the transmission of tea culture and trade from China to countries around the world. Almost all words for tea in the world belong to three large groups: tea, cha, and chai, in English the names are tea, cha or char, and chai. The first of these three words to enter English was cha, which appeared in the 1590s via the Portuguese, who traded in Macau and adopted the Cantonese pronunciation of the word. The most popular type of tea appeared in the 17th century through the Dutch, who adopted it indirectly from the Malay teh or directly from the Chinese Min pronunciation of numb (Mair and Hoh, 2009). The third form chai (meaning "spiced tea") comes from the northern Chinese pronunciation of cha, which traveled overland to Central Asia and Persia, where it acquired the Persian ending yi.

3. Origin of Tea

The tea plant is native to East Asia, where tea probably originates near the headwaters of the Irrawaddy River, from where it persists out into southeastern China, Indochina, and Assam. Therefore, the homeland of the tea plant is a relatively small fan-shaped region between Nagaland, Manipur, and Mizoram along the border with Burma in the west, through China to the Chekiang province in the east, and from there generally south to the hilly region. It is an area that extends through the zone to Burma. and Thailand to Vietnam. The west-east axis indicated above is about 2,400 km long extending from longitude 95°-120°E. The north-south axis covers about 1,920 km, starting from the northern part of Burma, latitude 29°N

passing through Yunnan, Tongkin, Thailand, Laos and on to Annan, reaching latitude 11°N (Kumar, 2021) Chinese (small leaf) type tea (*C. sinensis var. sinensis*) may have originated in southern China possibly with hybridization of unknown wild tea relatives. However, wild populations of this tea are unknown, and its origin remains speculative (Meegahakumbura et al. 2016; Meegahakumbura et al. 2018). There may be two distinct lineages of Assam-type Chinese tea (C. sinensis var. assamica) due to genetic differences forming distinct clades. One is found in southern Yunnan (Xishuangbanna, Pu'er City) and the other in western Yunnan (Lincang, Baoshan). Many types of Southern Yunnan Assam tea have been hybridized with the closely related species Camellia taliensis. Unlike Southern Yunnan Assam tea, Western Yunnan Assam tea shares many genetic similarities with Indian Assam-type tea (*C. sinensis var. assamica*. Therefore, Western Yunnan Assam tea and Indian Assam tea may both be obtained from the same mother plant located in the region where southwestern China, Indo-Burma, and Tibet meet. However, since Assam tea from India does not share a haplotype with Assam tea from western Yunnan, it is likely that Assam tea from India originates from its own domestication. Some Indian Assam teas appear to have been hybridized with *Camellia pubicosta* species. Assuming a generation of 12 years, it is estimated that Chinese small leaf tea diverged from Assam tea about 22,000 years ago, and Chinese Assam tea and Indian Assam tea diverged about 2,800 years ago. The divergence of Chinese small-leaf tea and Assam tea would correspond to the last glacial maximum (LGM) (Meegahakumbura et al. 2018).

4. **History of Tea**

Historical events associated with the proliferation and development of tea are: 1. In the fourth century, 650 AD 'T Sang dynasty' is the period for the emergence of the tea industry in China. 2. The origin of the tea bush has been contested by scholars. It is native to certain areas ranging from the interior of Southern China to the border of Assam. 3. Tea has only one species which is called Camellia sinensis. 4. The Dutch Merchants established a trading base at Benton by 1596. 5. The first consignment of tea from China was transported to Benton in 1606, and then onwards tea reached non-tea-conscious Europe. 6. In India, the tea industry originated after 1823 because of the discovery of a tea plant in Assam. The discovery of indigenous tea in Assam in 1823 led to the origins of the tea industry in India.7. It is important to mention here that one of the most famous teas is cultivated and manufactured in the North-east region of India and known as Darjeeling tea which is registered under geographical indicator by the Government of India. 8. It has consistently been held that in the early 1700s, the ships of the East India Company frequently brought tea plants into the country by way of curiosity. Col. Kyd, a Resident of Calcutta, and a famous botanist, saw tea plants growing in his garden in 1780. In 1788, Sir Joseph Bank recorded the existence of indigenous tea growing wild in the Coochbehar and Rangpur districts of Bengal and suggested the cultivation of this plant. The wild teas of Coochbehar confirmed the first discovery of indigenous tea in India (Karmakar and Banerjee, 2005). 9. Literature shows that tea is indigenous to eastern and northern India and was cultivated and consumed there for thousands of years. 10. In the early 1820s, the British East India Company began large-scale tea production in Assam. In 1837, the first English tea estate was established at Chabua in Upper Assam. In 1840, the Assam Tea Company began commercial production of tea in the region, after which the tea industry rapidly expanded to other parts of the country. 11. Today, India is one of the largest tea producers in the world and about 70% of tea produced is consumed within India itself. By the turn of the century, Assam became the leading tea-producing region in the world. 12. The planted group of tea contains three leading natural hybrids. They are *C. sinensis* (L.) O. Kuntze or China type, *Camellia assamica* (Masters) or Assam type and *C. assamica subspp. Lasiocalyx* or Cambod southern type. Two types, which are well known, are China and Assam, less common is the Cambod (Yemane, 2008). In south India tea growing was first trial by Dr. Christie in the Nilgiris in 1832 and distributed to another part of Nilgiris Hill for trial. Plantation from seed that was brought from China started in 1834. In Kerala, during 1875 planting started commercial. James Finlay and Co. started the development of Kanan Devgan Hill as a landmark for mass cultivation. Currently, cultivation covers a large scale in Wayanad as started in 1889 for the first time. The first actual tea estate was opened around 1897 in the Anamallais (Coimbatore Dist.). Recently Karnataka came into feature as a tea production state.

5. Development in Tea Industry

The birth of the Indian tea industry was marked by the discovery of an indigenous tea plant in Assam in 1823 by Robert Bush. Tea production entertained momentum when the East India Company in 1833 lost the tea trading monopoly in China. In 1835, a scientific deputation was sent to Assam to report on prospects of the tea industry and the team saw tea plants in numerous parts in the hills between Assam and Burma. In 1836, C.A. Bruce was made the Superintendent of Tea Forests. In 1839, the first shipment of tea from India (eight chests) was shipped to London and sold at auction for prices ranging from 6 to 34 shillings per pound. In 1840, two-thirds of experimental teas were handed over to the new company. In 1852, the first tea company in India paid its final dividends. The second private limited company was established in Assam in 1859 under the name Jorhat Company. Between 1862 and 1867, tea cultivation began in Chittagong and Chotta Nagpur. Tea cultivation was commissioned in several districts in India where there was a certain hope of success. Within a few months, India along with Sri Lanka dominated the world tea trade/market (Karmakar, 2015). Further, the regions that are associated with small businesses in this industry are Karnataka, Tripura, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Manipur Sikkim, Nagaland, Meghalaya, Mizoram, Bihar, and Odisha. A different variety of tea though of a small quantity comes from small growers of Kangra Valley in the picturesque Himachal Pradesh. This valley is famous for its green tea, a specialty of the region. The tea industry contributes a substantial proportion of foreign exchange in the agriculture sector. As a result, an increase in the number of tea-producing countries has taken place since 1950 at a global level. It is important to mention here that India ranked first in terms of area under tea plantations at the international level (Arya, 2013).

6. Health Effects of Tea

Consumption of *Camellia sinensis* has historically been thought to have health benefits, but there is no evidence that tea consumption has any significant effects other than increased alertness, an effect caused by the caffeine present in tea leaves. There is no high-quality evidence to suggest health benefit after its usage (Inoue-Choi et al.2022). In clinical research conducted in the early 21st century, it was found there is no scientific evidence to indicate that consuming tea affects any disease or improves health (Wang, 2021). Black and green teas contain no essential nutrients in significant amounts, with the exception of the dietary mineral manganese, at 0.5 mg per cup or 26% of the Reference Daily Intake (RDI) (Zhang et al. 2021). Fluoride is sometimes present in tea; certain types of "brick tea", made from old leaves and stems, have the highest levels, enough to pose a health risk if much tea is drunk, which has been attributed to prominent levels of fluoride in soils, acidic soils, and long brewing (Fung et al. 1999).

7.Tea Production

Global tea production (black, green, and Instant) increased significantly in 2021, adding 6.5 million tons from 6.3 million tons in 2020, with black tea production recovering from the 2020 deficit in some major producing countries, such as India and Sri Lanka. Tea is grown in Asia and Africa, but it is also grown in South America and around the Black and Caspian Seas. The four largest tea-producing countries are China, India, Kenya, and Sri Lanka, together accounting for 75% of global tea production. China produced about 3.12 million tons of tea in 2021, compared with about 2.74 million tons in 2020. India, China, Sri Lanka, and Kenya rank as the world's largest tea exporters. Smaller production centers include locations such as the island of São Miguel, Azores, Portugal and Guria, Georgia. In 2020, global tea production was 7.0 million tons, led by China with 42% and India with 20% of total global production. Kenya, Argentina, and Sri Lanka are secondary producers (Figure 1). Growth in global tea production is driven by significant increases in major tea-producing countries. China remains the largest tea producer with an output of 2.97 million tons, accounting for more than 42% of the total world output, while output in India, the second largest producer, also increased to 1.2 million tons by 2022. Production also increased in the two largest exporting countries with output reaching 0.43 million tons in Kenya and 0.34 million tons in Sri Lanka. Vietnam at 0.214 million tons, Indonesia at 0.14 million tons, Uganda at 58,300 tons; Malawi at 46,500 tons; Tanzania at 32,400 tons; and Rwanda at 25,200 tons. Other producers in Africa recorded slight increases. Burundi at 8,800 tons; Zimbabwe at 8,500 tons; and South Africa at 2,500 tons (Guan et al. 2008; Chang, 2015).

8. Tea Importers

Numerous countries, including Vietnam and Morocco, import massive quantities of tea from China. Hong Kong is the leading export market with an export value of over 290 million USD in 2021. The world's top tea-importing countries include the United States, UK, and Egypt in 2022. With a trade value of 559 million US dollars, the United States topped the list that year.

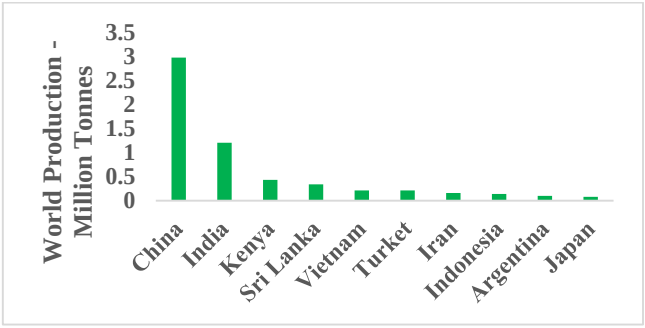

Figure 1: World tea production (Million tonnes) Source: World atlas

9. Consumption

Chang (2015) reported that global tea consumption continued to increase in 2013. Total tea consumption increased by 5% in 2013 to 4. 84 million tons, supported by rapid growth in per capita income, especially in China, India, and other emerging economies. The growth in demand is particularly pronounced in China. After consumption increased sharply in recent years, exceeding 10% per year, total consumption increased by 10-15% by 2023, on an annual basis, reaching 1. Sixty-one million tons, the largest in the world. In India, consumption increased by 2.4% in 2009, 6. 6% in 2013 and 2023 to reach 1.37 billion kg kilograms.

10. Varieties of Tea

The natural habitat of the tea plant is the fan-shaped region between the Nagaland, Manipur and Lushai hills, along the Assam-Myanmar (Burma) border in the west; as far as China, as far as Zhejiang province in the east; and from this route south through the hills of Myanmar and Thailand to Vietnam. The three main varieties of tea plants are Chinese, Assam and Cambodian, each of which appears in its most distinct form at the end of the fan-shaped area. There are countless hybrids between varieties. Such hybrids can be seen in most tea fields.

The Chinese variety, a multi-stemmed shrub that can grow up to 2.75 meters tall, is a hardy tree that can withstand cold winters and has an economic life of at least one hundred years. When grown at altitudes close to those of Darjiling (Darjeeling) and Sri Lanka (Ceylon), it produces flavorful teas that are valuable during the second flush of the season or the growth of new shoots. The Assam variety, a single-stemmed tree that grows 6 to 18 meters tall and includes several sub-varieties, has an economic lifespan of 40 years if pruned and picked regularly. Tea growers recognize five main sub-varieties: Light-leafed Assam, less tender dark-leafed Assam, hardy Manipuri, and Burmese varieties and very large-leaved Lushai. In Upper Assam, the dark-leaved Assam plant, when its leaves are still very pubescent, produces very good quality “golden head” tea in its second flowering. (The Chinese word pekho, meaning "white hair" or "fluff", refers to the "head" of the tea, correlating with quality. The Cambodian variety is a single-stem tree about 5 meters tall, not cultivated but naturally hybridized with other varieties. The mature leaves of the tea plant, which vary in shape depending on the variety, range from 1.5 to 10 inches (3.8 to 25 cm) long, the smallest being the Chinese variety and the largest being the Lushai sub-variety. When harvesting or picking, the removed shoots usually include the bud and the two youngest leaves. The weight of 2,000 freshly picked bamboo shoots can be 1 pound (0.45 kg); the same number of Assam sprouts can weigh 2 pounds (0.9 kg). Tea leaves can be jagged, bubbly, or smooth; hard or mushy; Leaf position ranges from upright to drooping; and the degree of puberty varies from plant to plant.

11. Pest and Diseases of Tea

Tea plants can be attacked by at least 150 species of insects and 380 types of fungal diseases. In northeast India, where 125 species of pests and 190 species of fungi are found, losses from pests are estimated at 67 million pounds (30 million kg) of tea per year. Beyond one hundred types of pests and 40 types of diseases are present in Japan's tea fields. Sri Lanka, where various properties are located close to each other or adjacent, has experienced several epidemics and suffered heavy losses. Africa has no problems with epidemics; The tea mosquito (*Helopeltis theivora*) is the only serious pest. The Caucasus region, with a climate like Japan, grows many

Chinese plants and is free from pests and serious diseases. The fight against late blight has become very advanced. Scientists from north-east India have published a list of 40 approved proprietary pesticides. Some of these pesticides cannot be used during the harvest season; others asked for the next two weekly picks to be discarded.

12. Processing and Classification of Tea

Tea is often divided into categories based on how it is processed (Liu, 2005). At least six diverse types of tea are produced:

1. White Tea: Wilted and unoxidized.
2. Yellow tea: Tea that has not withered or oxidized but has turned yellow.
3. Green: Unwilted and unoxidized.
4. Oolong: Wilted, bruised, and partially oxidized
5. Black: Wilted, sometimes crushed, and completely oxidized (called "red tea" in Chinese and other East Asian tea cultures).
6. Post-fermented (Dark black): Green tea that has been allowed to ferment/compost (called Pu'er if it comes from southwest China's Yunnan district, or "black tea" in Chinese tea culture). Once picked, *C. sinensis* leaves quickly begin to wilt and oxidize unless they are dried immediately. Enzymatic oxidation triggered by the plant's intracellular enzymes causes leaves to gradually become darker as chlorophyll is broken down and tannins are released.

This blackening process is stopped at a predetermined stage by heating, which inactivates the enzymes responsible. In the production of black tea, heating is done simultaneously with drying. Without careful control of humidity and temperature during production and packaging, the growth of unwanted mold and bacteria can make the tea unsafe to drink.

13. Additional processing and additives of Tea

After basic processing, tea can be transformed with additional processing steps before being sold (Tony, 2016) and is often consumed with the addition of basic tea leaves and water added during the processing or consumption. Additional processing steps that take place before tea is sold are tea blending, flavoring, aromatization, and decaffeination. Examples of additives added at the time of consumption include milk, sugar, and lemon. Making tea is the combination of many diverse types of tea to obtain the final product. These teas may combine other teas from the same growing area or from several different teas. The goal is to achieve consistency, better flavor, higher price, or a combination of all three. Scented and flavored tea will add aroma and flavor to the basic tea. This can be done by directly adding flavoring agents, such as ginger, cloves, mint leaves, cardamom, bergamot (found in Earl Grey), vanilla and mint. Additionally, because tea easily retains its odor, it can be placed near an aromatic ingredient to absorb its aroma, as in traditional jasmine tea (Gong, 2016).

Adding milk to tea was first mentioned in Europe in 1680.In cultures that consume dairy products, many teas are traditionally drunk with milk. These include Indian masala chai and British black tea blends. These teas are often extraordinarily strong black teas that can be enjoyed with milk, such as Assam's or East Frisian blends. Milk is thought to neutralize residual tannins and reduce acidity (Tierra, 1990). The Han Chinese did not usually drink milk with tea, but the Manchus did, and the Qing elite of Imperial China continued to do so. Hong Kong-style milk tea is based on British propensities. Tibetans and other Himalayan people groups customarily drink tea with drain or yak butter and salt. In Eastern European countries, Russia and Italy, tea is often served with lemonade. In Poland, tea is traditionally served with a slice of lemon and sweetened with sugar or honey; Milk tea is called bawarka ("Bavarian style") in Polish and is also extremely popular (Glosbe, 2019). In Australia, milk tea is called "white tea." The order of steps to make a cup of tea is a controversial topic and can vary between cultures or even between individuals. Some people believe that it is best to add milk to the cup before brewing tea, because the hot temperature of freshly brewed tea can denature the proteins in fresh milk, like the change in taste of UHT milk, leading to drinks that taste worse (BBC News, 2003). Others insist that it is best to add milk to the cup after drinking the tea, as black tea is usually brewed as close to boiling as possible. Adding milk will cool the drink during the crucial tea-making stage, which, if brewed in a cup rather than a teapot, means the delicate flavors of good tea cannot be fully appreciated. Adding milk then makes it easier to dissolve the sugar in the tea and ensures the desired amount of milk is added and the color of the tea can be observed (Kruszelnicki and Karl, 2000). Historically, the order of steps was considered a sign of class: only those wealthy enough to buy excellent quality porcelain were sure that it could withstand

exposure to boiling water without milk (Dubrin, 2010). A higher temperature difference means faster heat transfer, so the sooner milk is added, the cooler the drink. A 2007 study published in the European Heart Journal found that some of the beneficial effects of tea may be lost when milk is added (Lorenz et al. 2006).

14. Indian tea in Global Scenario

India is the largest consumer of tea, India is also the largest producer of black tea in the worldwide. At present, India produces 23% of the total global production and consumes about 21% of the total global tea consumption. This shows that 80% of tea produced is consumed domestically. Over the past 20 years, India's global export ranking has slipped from first to fourth, amid intense competition from Sri Lanka, Kenya, and China. Because of the increase in population, income, and consumption of this beverage in India, tea exports are declining (Wagh, 2014).

Table 1: Indian Tea Scenario

Particulars	World	India	Rank	% of Share
Area under Tea (Million hectors)	4.9	0.58	2nd	15
Production (Million tons)	5.96	1.27	2nd	23
Yield (Kg/Hector)	2000	1790	1st	-
Export (Million Kg)	2200	231.08	4th	11
Consumption (Billion Kg)	6.7	1.2	2nd	21

15. Chemical Composition of Tea and Activities of Polyphenols

Fresh tea leaves are rich in water-soluble polyphenols, especially flavanols, flavanol gallates and flavanol glycosides (Graham, 1992; Bors et al. 196). Foremost tea catechins are α-epigallocatechin-3-gallate (EGCG), α-epigallocatechin (EGC), α-epicatechin-3-gallate (ECG), α-epicatechin (EC), α-epicatechin-3-gallate (ECG), α-epicatechin (EC), α-gallocatechin and β-catechin; accounts for 30–42% of green tea solids by weight (Chung et al. 2005). Caffeine accounts for 3 to 6%. Nonetheless, the composition varies depending on growing conditions and subsequent tea processing (Table 2).

16. Global Tea Consumption Scenario

Global per capita tea consumption has increased by 2.5% over the past decade, with marked expansion in tea-producing countries. Developing and emerging economies are driving demand growth, with East Asia, Africa, Latin America, the Caribbean, and the Middle East leading the expansion (Figure 2). However, in more mature European markets as well as other advanced countries, tea consumption has decreased. The desire to innovate is evident as consumers increasingly demand natural and organic ingredients with diverse blends, flavors, and environments. There is also a growing interest in higher quality flavored specialty teas. At the same time, green tea as well as herbal and fruit teas are gaining popularity in various markets, especially in Europe, due to their real or perceived health benefits. At the same time, public interest in premium, organic and locally sourced specialty teas have also increased. Innovation and “premiumization” characterize the market, attracting increasingly young customers from the emerging middle class. However, tea faces several challenges. It is essential that the industry successfully balances the need for expansion and sustainability requirements at all stages of the value chain. Several factors influence the demand for tea, including price and income variables, and demographics such as age, education level, occupation, and cultural background. Increasing tea consumption in producing countries, driven by population and income growth, has led to a decline in exportable tea production over the past two decades (Figure 2). Nevertheless, per capita consumption in these countries remains low compared to import markets and more efforts are needed to increase demand to explore existing market opportunities.

17. Health Benefits of tea in Humans

17.1 Green Tea

Studies using animal models show that green tea catechins have a protective effect against degenerative diseases. Several studies have shown that green tea has antiproliferative and lipid-lowering activity in rats treated for liver cancer, as well as

preventing hepatotoxicity and as a preventative agent for breast cancer after treatment initiation (Vanessa and Gary, 2004). Green tea catechins may also function as anticancer agents (Room et al. 2007) and as immunomodulators of tumor-implanted or cancer-induced treatment--induced immune function. In addition, green tea and its extracts and other isolated components have also been shown to be effective in preventing oxidative stress and neurological problems (Unno et al. 2007).

Table 2: The main Chemical Composition (%) of leaf

Chemical	Dry weight	Water soluble
Cellulose Hemi Cellulose	14-22	
Pectin	6-7	2-3
Proteins	17-18	
Fats (Lipids)	8-9	
Starch	0.5-2.0	
Phenolics	20-30	20-30
Caffeine	3-4	3-4
Amino acids	3-4	3-4
Soluble sugars	2-4	2-4
Organic acids	3-4	3-4
Ash	4-5	4-5
Pigments	0.5	-
Volatiles	0.1	-
Vitamins	Traces	-
Various enzymes	-	-

(Source: Tea Research Association (https://www.tocklai.org/).

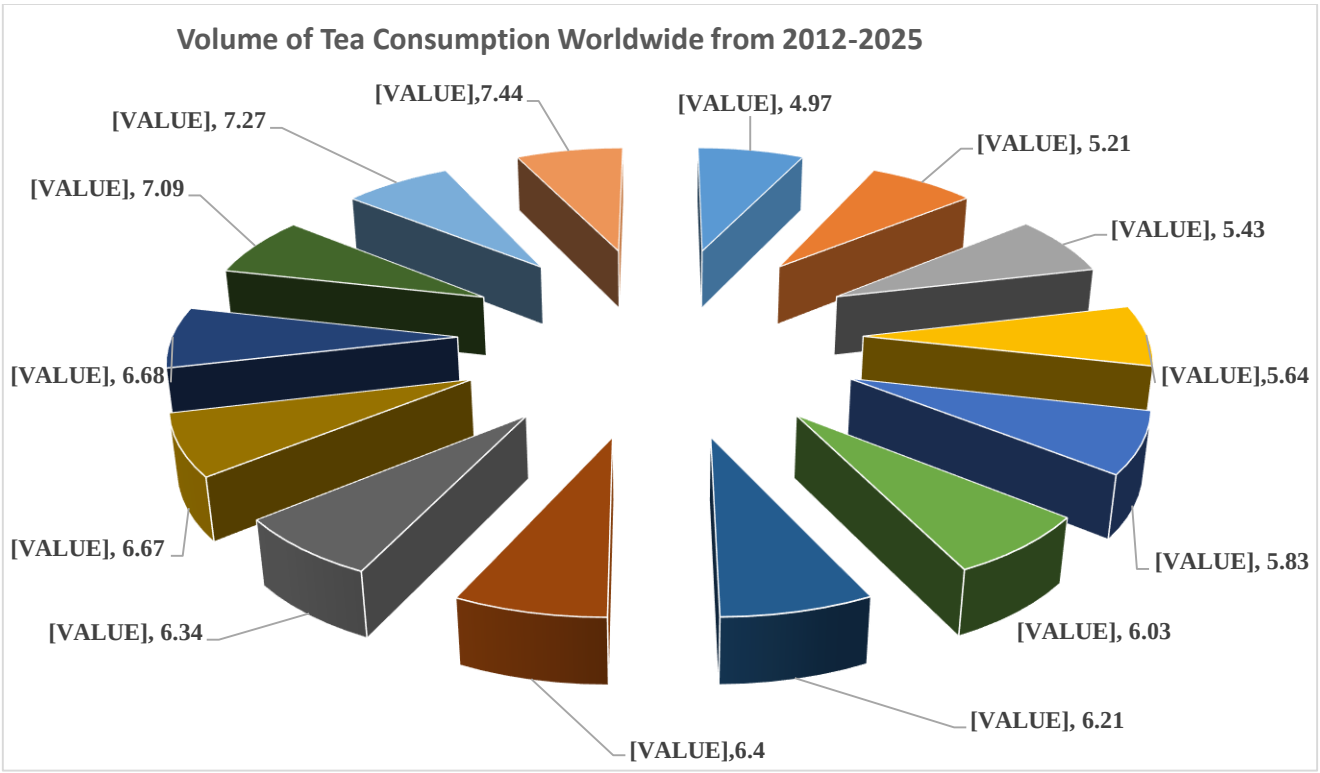

Figure 2: Volume of Tea Consumption in worldwide in Billion kg (Source: Statista 2023

Green tea consumption has also been linked to the prevention of many types of cancer, including lung, colon, esophageal, mouth, stomach, small intestine, kidney, pancreas, and mammary glands (Koo and Cho, 2004). Several epidemiological studies and clinical trials have shown that green tea (and to a lesser extent black and oolong tea) may reduce the risk of many chronic diseases (Zaveri, 2006). This beneficial effect is due to the presence of substantial amounts of polyphenols and powerful antioxidants. Green tea can significantly reduce blood pressure and thereby reduce the risk of stroke and coronary heart disease. Some animal studies suggest that green tea may protect against the development of coronary heart disease by reducing blood sugar and body weight (Tsuneki et al. 2004). However, all these data are based on middle-aged animal populations and not older human populations, whose nutritional status tends to be more negatively affected by biological factors, age-related educational and socioeconomic factors (Meydani, 2001). Components in tea have antioxidant, anti-mutagenic and anti-cancer effects that can protect humans against the risk of cancer caused by environmental agents (Mukhtar et al. 1992). Sano et al. (1995) reported an inhibitory effect of green tea leaves against tert-butyl hydroperoxide-induced lipid peroxidation and a similar antioxidant effect on the kidney was observed after oral administration of the main polyphenol of tea, 'EGCG. The antioxidant capacity of crude catechin powder and individual catechin was assessed in experiments using the active oxygen method. Crude catechins reduce peroxide formation much more effectively than dl-a-tocopherol (Hara, 1990). Shim et al. (1995) studied the cancer-preventing effect of green tea in smokers and found that it could prevent the increase in sister chromatid exchange frequency caused by tobacco.

The effectiveness of green tea in treating all types of diarrheas and typhoid has been known in Asia since ancient times (McKay and Blumberg, 2002; Lu et al. 2003). Catechin in green tea inhibits *Helicobacter pylori* infection (Takabayashi et al. 2004; Yee, 2002). The effect of green tea against influenza virus, especially in the initial stages, as well as against Herpes simplex virus has also been demonstrated (Toda et al. 1989; Mukoyama et al. 1991; Yama et al. 1997). Additionally, Weber et al. (2003) observed that adenovirus infection was inhibited in vitro by the antifungal activity of green tea catechins against *Candida albicans* and by the convenience of combination treatment with catechins and lower doses of antifungal drugs, which can help avoid side effects of antifungal medications. Green tea consumption is also associated with increased bone mineral density and has been identified as an independent protective factor against hip fracture risk; this effect is considered independent of smoking, hormone replacement therapy, drinking coffee, and adding milk to tea (Weber et al. 2003). Park et al. (2003) observed positive effects of green tea extract and GTP on bone cell growth and activity. The proliferation of hepatic stellate cells is closely related to the progression of liver fibrosis in chronic liver diseases, and EGCG can have an inhibitory effect on the proliferation of these cells (Dorchies et al. 2003; Sakata et al. 2004). Green tea enhances the functioning of the immune system as it protects it against oxidants and free radicals. Recent studies suggest that GTP may protect against Parkinson's and Alzheimer's diseases as well as other neurodegenerative diseases (Pan et al. 2003; Weinreb et al. 2004). Studies have demonstrated neuroprotective activity of GTP in cell cultures and animal models, such as preventing neurotoxin-induced cell damage. Green tea is useful for insect bites due to its anti-inflammatory effects and hemostatic properties (Sagesaka-Mitane et al. 1988, Dvorakova et al. 1999). Several studies have suggested an inverse association between green tea consumption and the risk of kidney stone formation (Ishizuk et al. 2003). In an experimental cataract formation system, green tea acted by preserving the antioxidant defense system of the lens (Gupta et al. 2022). Skrzydlewska et al. (2002) pointed out the beneficial effects of green tea in alcohol detoxification.

In addition to all these reported properties, which have contributed to the recognition of green tea as a functional food by some authors (Ferrari and Torres, 2003), green tea is now also used in the preparation of a variety of foods, pharmaceutical preparations, toothpaste, and cosmetics (Arburjai and Natsheh, 2003). Experimental studies have demonstrated that tea has anti-breast cancer effects. However, epidemiological evidence that tea has an anti-breast cancer effect is inconsistent (Min et al. 2005). A case-control study was conducted in southeastern China from 2004 – 2005 (Zhang et al.2011). Cases included 1,009 patients aged 20 - 87 years with histologically

confirmed breast cancer and 1009 age-matched controls who were healthy women randomly recruited from breast examination. Information on duration, frequency, quantity, preparation, and type of tea consumed as well as diet and lifestyle were collected in face-to-face interviews using a validated and reliable questionnaire. Compared with non-tea drinkers, green tea drinkers tend to live in urban areas, have higher levels of education, and consume more coffee, alcohol, soy, vegetables, and fruits. After adjusting for known and potential confounders, green tea consumption was associated with a reduced risk of breast cancer. Similar dose-response relationships were observed for duration of green tea consumption, number of cups consumed, and new batches brewed each day. Hsu et al. (2007) demonstrated the effects of decaffeinated green tea extract (catechins) supplementation on hemodialysis-induced reactive oxygen species, atherosclerotic disease risk factors, and proinflammatory cytokines. The pharmacokinetics of oral doses of catechins were compared between healthy subjects and hemodialysis patients. The authors compared the antioxidant effects of three different doses of oral catechins (0, 455, and 910 mg) with oral vitamin C (500 mg) during a hemodialysis session. In patients, catechin supplementation reduced hypochlorous acid activity in dialysis-enhanced plasma more effectively than placebo or vitamin C. Between treatments with 455 and 910 mg of catechin, no difference was observed. any significant difference in the reduction of hypochlorous acid activity in plasma. Catechins also significantly reduced the expression of proinflammatory cytokines, which were enhanced by hemodialysis.

17.2 Black tea

Black tea extracts suppress inflammatory diseases by reducing lipopolysaccharide (LPS)- induced NO and O2 production (Sarkar and Bahauri, 2001). It is also observed that black tea helps to maintain skeletal health through reduction of active osteoclasts, inflammatory cytokines production and oxidative stress. Karmakar et al. (2011) reported that black tea extracts provided protection against high fat diet (HFD). Antioxidants constituent of black tea extracts inhibited 7,12-dimethylbenz(a) anthracene (DMBA)-induced skin tumorigenesis through activation of superoxide dismutase (SOD), catalase (CAT) as well as induced apoptosis in mouse skin tumors (Saha and Das, 2002), induced of apoptosis by tea polyphenols mediated through mitochondrial cell death pathway in mouse skin tumors (Roy et al. 2009), suppressed 1,2-dimethylhydrazine (DMH)-induced colonic tumorigenesis by inhibition of cyclin D1, c-myc and cyclooxygenase-2 (COX-2) gene expression through blockage of Wnt/β-catechin pathway. Black tea extract minimizes the risk of coronary heart disease and myocardial infarction (Arts et al. 2001; Geleijnse et al. 2002). Black tea consumption can help as Anti-obesity and metabolic syndrome such as increased blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol or triglyceride levels that increases the risk of heart disease, stroke, and type 2 diabetes.

Black tea constituent theanine can positively affect the immune system to bolster the body's natural response to infection. L-theanine is a primary constituent, which primes the immune system in fighting infection by bacteria, viruses, and fungi. Kamath et. al. (2003) reported that majority of the tea drinkers exhibited increased γ-interferon production, an important part of the body's immune defense within 2-4 weeks of tea consumption, in response to the secreted bacterial antigens isobutylamine and ethylamine. Consumption of the same amount of coffee for the same duration did not affect interferon levels.

18 Other Beneficial Properties

18.1 Tea with Antioxidant Property

In the human body there are many different protection mechanisms to fight free radicals. Furthermore, there is a balance between antioxidant and antioxidant processes, and when this balance is disrupted in favor of free radicals, oxidative stress results (Kamath et al. 2003; Rohdewald, 1998). Lipoprotein oxidation plays a key role in the development of atherosclerosis through the oxidation of low-density lipoprotein (LDL) in the vessel wall. LDL is rich in cholesterol, causing changes in the structure of blood vessel walls. These structural changes encourage macrophages to accept oxidized LDL, thereby promoting their transformation into foam cells. This collection of cells in the vessel wall leads to the first noticeable change in the cell tissue, called fatty streaks. These changes can cause the artery to close completely, causing angina or blood vessel blockage. It has been clearly demonstrated that other disease states such as cancer, rheumatoid arthritis, ischemic reoxidation

injury of the liver and other organs are triggered by oxidation (Cross et al. 1987; Severino et al. 2009). Tea's powerful antioxidant properties are often due to its flavonoid components; theaflavin, bisflavanols and theaflavic acid (Rice-Evans, 1999). These compounds are all potent antioxidants in vitro and when consumed, they function as free radical scavengers that scavenge endogenously generated superoxide, peroxyl and hydroxyl radicals. The antioxidant properties of tea are also related to several other mechanisms, such as electron depolarization, intramolecular hydrogen bond formation, and molecular structural rearrangement (Jovanovic et al. 1994; Salah, 1995). These compounds can also prevent oxidation reactions by chelating free copper and iron, which can catalyze the formation of reactive oxygen species in vitro (Halliwell, 1997). Antioxidant flavanoids appear to be readily absorbed through the human gastrointestinal tract. Van het Hoff et al. It was demonstrated in 1999 that catechins in tea, both green and black tea, occur in human plasma and in circulating lipoprotein fractions. In a UK study, five cups of tea taken 2 hours apart were enough to increase plasma catechin concentrations up to 12-fold. Consuming black tea with milk does not change the bioavailability of catechins in the tea. In contrast, Serafini et al. (1996) reported that green and black tea significantly increased the antioxidant capacity of plasma, measured by fluorescence assay. Tea drinks, rich in antioxidant polyphenols, affect host biochemistry and cause cancer in important target organs such as the colon or mammary gland in mice (Chen et al. 1998). This decrease in antioxidant capacity was observed in soy milk as well as cow's milk but less so in skim and semi-skim milk. This suggests that the reduced antioxidant effect is due to the relationship between tea flavanoids and milk fat rather than protein (Langley-Evans, 2000). Anticancer properties of tea Catechins from tea leaves have been attributed to various pharmacological activities. Among them, the antioxidant capacity of catechins has been used in practice to prevent tooth decay. In Japan, green tea extract containing catechins has been widely added to candy, gum, food, and mouthwash as a caries preventive additive (Tsuchiya et al. 1997). Black tea extract administered to hamsters on a cariogenic diet significantly reduced caries formation by 63.7%, suggesting that regular consumption of black tea can significantly reduce caries formation. Teeth even when sugar is present in the (Linke and LeGeros, 2003).

19 Anti-microbial Activity of Tea

Catechins derived from green/black tea have been shown to have inhibitory and bactericidal effects against *S. mutans* or *S. sobrinus*. The minimum inhibitory concentration of individual catechins was found to be between 50 and 500 mg/L, leading to a consensus that the concentration of catechins in a cup of tea is inhibitory and often bactericidal (Hamilton-Miller, 2001). Oolong tea extract has been found to reduce the rate of acid production by *Streptococcus mutans*, accompanied by slowing its growth rate. When used as a mouthwash, green tea extract can significantly inhibit both streptococci and lactobacilli, proving to be an effective addition to daily oral hygiene routines, especially in patients with a substantial risk of tooth decay (Matsumoto et al. 1999). There are four main catechins (polyphenols) in green tea, but three of them are (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC), EGCG), (-)-epigallocatechin (EGC). It has been shown to have an antibacterial effect against a variety of microorganisms. These catechins exhibit various antibacterial mechanisms. Green tea has been shown to have antibacterial effects against gram-negative and gram-positive bacteria (*E. coli*, *Salmonella spp, Staphylococcus*, *Enterococcus spp*.).

20 Anti-cancerous activity of Tea

Polyphenols in green tea have been widely studied as cancer-preventing agents. Catechins are major polyphenols including (-)-epigallocatechin-3-gallate (EGCG), (-)-epigallocatechin (EGC), (-)-epicatechin-3-gallate (ECG) and (-)-epicatechin (EC), among these, EGCG is the most active and abundant compound capable of suppressing cancer progression (Kuchari et al. 2006). According to a case study by Xue-Jun Wang et al. (2012), there is an association between green tea and colorectal cancer risk. A meta-analysis of 13 case-control studies showed a low trend of developing colorectal cancer with green tea consumption, but the available epidemiological data are insufficient to conclude that green tea may protect against colorectal cancer in humans. The anti-cancer activity of tea polyphenols is often thought to be related to their antioxidant properties.

Tea may also influence the metabolism of carcinogens through induction or inhibition of various cytochrome P450s. Table 4 summarizes the effects of tea consumption in fighting distinct types of cancer.

Table 4: Effect of consumption of tea on combating diverse types of cancer

S. No.	Type of Cancer	Effect of consumption of tea	Reference
1	Lung cancer	One population-based study found that Okinawan tea (like green tea but partially fermented) was associated with decreased lung cancer risk, particularly among women	Ohno, 1995
2	Pancreatic Cancer	Most important tea drinkers were less likely to develop pancreatic cancer compared to nondrinkers. However, further studies are needed to recommend it strongly	Ji et al. 1995; Lyn-Cook et al. 1999
3	Stomach cancer	Two studies comparing green tea drinkers and non-drinkers found that those who drank green tea were about half as likely to develop stomach cancer and gastritis (inflammation of the stomach) as those who did not drink green tea. However, a recent study conducted in Japan found no association between green tea consumption and stomach cancer risk. Further research in this area can only confirm whether green tea reduces the likelihood of developing this disease.	Yu et al. 1995; Setiawan et al. 2001
4	Esophageal cancer	Large population-based studies have shown that green tea significantly protects against the development of esophageal cancer, especially in women. Another population-based study found just the opposite result. In fact, the stronger and hotter the tea, the greater the risk. Therefore, further research is needed before green tea can be recommended for the prevention of esophageal cancer.	Tsubono et al. 2001; Hu et al. 1994; Gao et al. 1994
5	Prostate Cancer	Clinical studies have shown that green tea extract prevents the growth of prostate cancer cells *in vitro*. Nevertheless, neither black nor green tea should be taken while receiving chemotherapy as both were less sensitive during that period	Lyn-Cook et al. 1994

21 Additional Impacts of Tea

Tea is a rich source of natural fluoride and other compounds, including aluminum. Tea plants absorb fluoride and aluminum from acidic soils by passive diffusion, which accumulate in the leaves throughout the plant's life cycle (Hayacibara et al. 2004). Oral retention of fluoride from black tea is thought to be significant. About 34% of fluoride is retained in the oral cavity after rinsing. Fluoride tea also showed strong binding to yeast particles, which were only partially dissociated by solutions with significantly higher ionic strength than saliva. Therefore, fluoride absorbed from tea would have both local effects in the oral cavity and more general systemic effects due to absorption through the gastrointestinal tract (Simpson, 2001). A study conducted by Lung et al. (2008) to evaluate the level of infused fluoride in popular teas sold in Taiwan and potential exposure factors, concluded that among six tea types, black tea has the highest fluoride concentration (8, 64 ± 2.96 mg/L), while pure tea (1.97 ± 2.70 mg/L). L) has the lowest level. Additionally, it was found that the key step in the manufacturing process that affects the age rate of infused fluoride is pellet rolling rather than fermentation. Each gram of tea exposes the

human body to 3.88 - 137.09 µg of fluoride with a mean value of 63.51 µg while the same amount of toothpaste exposes the human body to 53.5 - 338.5 µg with a mean value of 183.78 µg. Therefore, on average, a person who brushes their teeth once a day (2 g per brushing) and drinks two cups of tea (2 g per cup) will be exposed to 621.6 µg/day of fluoride. Of this, 327.55 µg/day is ingested, i.e.,100% fluoride for tea and 20% for toothpaste (Yadav et al. 2006).There is also evidence that maintaining a green tea solution in the oral cavity or chewing green tea leaves results in a dose-dependent production of H_2O_2 due to the oxidative polymerization of EGCG in the mouth, which may play an important role in preventing oral cancer (Lambert et al. 2007). A cross-sectional study of 1276 women aged 65 - 76 years in the United Kingdom found that tea drinkers had significantly higher bone mineral density (BMD) at the lumbar spine and hip than non-tea drinkers (Hegarty et al. 2000). The oxidative stress-responsive transcription factor, NF-κB, was recently found to play a role in bone resorption and increased urinary levels of 8-iso-PGF2α, a biomarker of oxidative stress, was significantly associated with reduced lumbar spine and total body BMD in a cross-sectional study of 101 men and women (Basu et al. 2001). Drinking plenty of fluids, including drinking tea, is considered the most effective and economical way to prevent kidney stones (Borghi et al. 1999). However, tea consumption has been shown to increase urinary oxalate concentrations in healthy individuals and some experts continue to advise those susceptible to oxalate stone formation from Calcium should limit tea consumption (Massey, 2000).

22 Impacts on Antioxidant Markers and Oxidative Stress of Green Tea

Green tea is a popular nutritional food as an antioxidant. Antioxidants are compounds that protect cells against the harmful effects of reactive oxygen species, such as singlet oxygen, superoxide, peroxyl radical, hydroxyl radical, and peroxynitrite. An imbalance between antioxidants and reactive oxygen species leads to oxidative stress, leading to cell damage (Halliwell and Gutteridge, 1985). Catechins are thought to help protect against these diseases by contributing, along with antioxidant vitamins (vitamins C and E) and enzymes (superoxide dismutase and catalase), to the total antioxidant defense system (Abdel-Raheim et al. 2009).

In vivo studies have shown that green tea catechins increase total plasma antioxidant (Yokozawa et al. 2002; Skrzydlewska et al. 2002). Green tea extract consumption also increased serum superoxide dismutase activity and catalase expression in the aorta; these enzymes participate in protecting cells against reactive oxygen species (Negishi et al. 2004). This action is combined with a direct effect on reactive oxygen species through a reduction in plasma nitric oxide levels. Malondialdehyde, a marker of oxidative stress, was also reduced after green tea consumption (Yokozawa et al. 1999). These results suggest that catechins may have direct (antioxidant) or indirect (increased activity or expression) effects. Because catechins can function as antioxidants in vitro, they can prevent the oxidation of other antioxidants, such as vitamin E. However, ingestion of green tea catechins does not change the alter the plasma status of vitamins E and C *in vivo* (Alessio et al. 2003). However, one study reported that catechins increase vitamin E concentrations in low-density lipoprotein and thus may protect protects low-density lipoprotein against peroxidation. Pilipenko et al., 2008 evaluated the tolerance of green tea tablets and its effect on antioxidant status indices. Twenty-five patients with various gastrointestinal diseases were included in the study and divided into treatment and control groups. Tolerability of green tea tablets was good in the treatment group, which showed better changes in quality-of-life indicators, especially in terms of physical pain and social activity scale. There were no significant differences in biochemical analysis between groups, which may indicate the safety of this product. The analysis showed that the treatment group showed a decline in all indicators of antioxidant status, as evidenced by a significant decrease in lipid peroxidation index from 4.63 to 4.14.

23 Difference between green tea and black tea:

The main chemical difference between green tea and black tea is that green tea contains simple catechins (polyphenols with molar weight < 450 > 1 kDa) whereas in the latter, many of these have been oxidized and condensed, during the manufacture process, to larger, dark-colored molecules including theaflavins (500-1000Da) and thearubigins (> 1 kDa) (Hamilton -Miller, 2001). It is now noted that 50% of the unreacted precursor consists of theasinenins (bisflavonols) formed by oxidative conjugation of EGC

or EGCG (Haslam, 2003). However, black tea still contains simple catechins, including epicatechin (EC), epicatechin gallate (ECG), and epigallocatechin gallate (EGCG). A typical cup of prepared green tea contains 0.5 to 1 g of catechins/L and black tea contains about one-third of the 0.5 to 1 g of catechins/L. Differences in visual ability were also reported by Sharangi (2009) in Table 3.

24 Additional Types of Tea

24.1. White tea: Another form of tea is prepared from young shoots and leaves that have been steamed to neutralize polyphenol oxidation and then dried. White tea is considered one of the most expensive teas for consumers and the most profitable for producers. Since white tea is made from unopened tea buds whose pubescence imparts a silvery appearance to the final product, it is called white tea. The percentage of polyphenols is highest in shoots and gradually decreases with leaf age, due to the highest percentage of polyphenols in shoots. White tea is considered to have high medicinal value. Due to this characteristic, white tea is incredibly famous among health-conscious people, especially in America and Europe.

Table 3: Difference between green tea and black tea

S. No.	Particulars	Green Tea	Black Tea
1.	Process	Short, no fermentation	Longer Fermentation
2	Colour	Green or yellow	Red or black
3	Taste	Sweet after bitter	Distinct flavour, added in sugar and/ or milk
4	Antioxidant	In general, More Polyphenols	More Flavonoid
5	Caffeine	Less	More
6	Quality	Better in fresh	Depend on produced location
7	Health benefits	More in general, may irritate to empty stomach	Cardiovascular system

24.2. Oolong Tea: Oolong tea is a “semi-fermented” tea and is known as a hybrid between black tea and green tea. Oolong tea has the properties of black tea and green tea.

24.3. Brick tea: Brick tea is made from old, dead leaves that are fermented and pressed into bricks and is not considered quality tea. There is nothing lacking in commercial value in the tea garden. During the dormant period, when the tea plantation is maintained by various forms of cleaning and pruning, the old leaves or pruned shredded leaves will be used to make black tea or green tea and then compressed into bricks. Although brick tea cannot be compared in quality, appearance, and marketing with regular black/green tea. But this tea is loved by some people in certain regions, especially in African countries.

25. Manufacturing Process

The process of making semi-fermented oolong tea includes solar withering, winnowing, rolling, and drying. During this process, the characteristic floral aroma of oolong tea is created. White tea is a rare specialty tea that gets its name from a specific type of tea plant, as well as a special post-harvest processing method that causes small silver hairs to appear on the dried buds. White tea contains a higher percentage of buds covered with fine“silver” hairs that give the tea a pale white color. White tea infusion is pale yellow without the “herbal” undertones sometimes associated with green tea. White tea is lightly fermented, steamed, and dried quickly, leaving behind "fresh"leaves. Unlike black tea, green tea, and oolong tea, white tea is not rolled or crushed but is rapidly steamed and air-dried to

preserve most of the polyphenols. This unique process creates a rare and expensive yet very refreshing drink. Differences between different manufacturing processes lead to differences in polyphenol composition between black tea, green tea, oolong tea, and white tea. Figure 3 describes the tea processing process in more detail. In terms of tea processing, green tea, black tea, white tea, and oolong tea are distinguished by the degree of oxidation, called fermentation in the tea industry. Green tea is the least susceptible to oxidation or fermentation; 100% oxidized or fully fermented black tea; and semi-fermented oolong, with an oxidation range from 10- 70% (Manil, 2001)

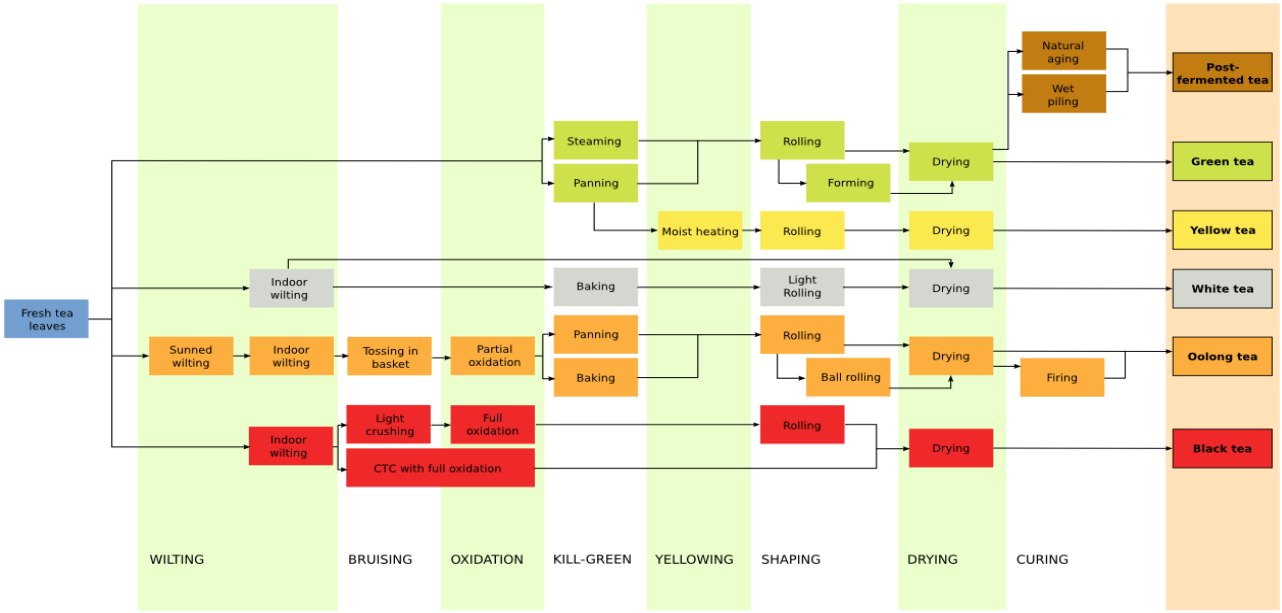

Figure 3: Schematic diagram of the conventional manufacture Tea Processing for green, White, Oolong and Black Teas

(Source: Source: Wikipedia, the free encyclopedia)

White tea is made from the new shoots or young leaves of the tea plant and may or may not be slightly oxidized. The fermentation process changes the chemical compounds in the tea leaves and contains a variety of flavors. During oxidation, enzymes present in tea leaves convert most of the catechins (antioxidants in tea) into theaflavins and thearubigins. These impart a variety of flavors and aromas, giving the tea an unusual color, strength, and vibrancy. In contrast, green tea is prepared by steaming fresh tea leaves, which inactivates enzymes, preventing further oxidation. Thus, green tea (low oxidation) and white tea (light oxidation or no oxidation) contain excessive amounts of catechins, while black tea and oolong tea contain lower amounts of catechins but more theaflavins and the arubigins.

26. Disadvantages of Tea Consumption

Consuming excessively tea can lead to teething problems. Such coloration may be due to the interaction of tea components with surface integrins such as the resulting salivary film and the mineral crystals of tooth enamel (Simpson et al. 2001). Coffee and tea are considered coloring solutions for cosmetic restorative materials due to their content and frequency of consumption. In particular, the discoloration caused by tea is due to the adsorption of polar dyes on the surface of the material, which can be removed by brushing.

27. Storage of Tea

Storage conditions and forms determine the shelf life of tea; black tea is higher than that of green tea. Some varieties, like camellia, can only last about a month. Others, like Pu-erh, improve with age. To stay fresh and avoid mold, tea needs to be stored in a place away from heat, light, air, and humidity. Tea should be stored at room temperature in an airtight container. Black tea bagged in an airtight container can be stored for two years. Green tea spoils faster, usually within a year. Tightly rolled Gunpow tea leaves last longer than Chun Mee tea, which has

more open leaves. The shelf life of all teas can be extended by using desiccant or oxygen-absorbing bags, vacuum sealing them, or storing them in the refrigerator in an airtight container (except green tea, which should be refrigerated or freeze discreetly and keep temperature changes to a minimum (Almomen et al. 2021).

28. CONCLUSION

Tea is a natural health drink consumed around the world and proven by many scientific studies around the biosphere. The encouraging scientific results of drinking tea on human health make tea popular in human society. Although tea has not been recognized as a medicinal agent, it is one of the most researched herbal remedies. A growing number of in vitro studies are identifying the potential for oral health benefits. Tea is more than just a pleasant, mildly stimulating beverage, due to its medicinal value in preventing tooth decay and periodontal disease. However, in the long term, well-controlled human trials are needed before firm conclusions can be drawn. Meanwhile, it is reasonable to conclude that the consumption of tea, without added sugar, can be part of dietary advice aimed at preventing dental diseases, thereby promoting health and spirit in general in the most economical way. Now that we have rediscovered this ancient wonder, we must embrace it and use it to our advantage. Overall, tea is an affordable beverage that has natural medicinal value compared to modern hard drinks that have low value in terms of human health. Laboratory studies have shown the health effects of green tea. As clinical evidence in humans remains limited, future research will need to determine the true extent of the health benefits, establish the safe range of tea consumption associated with these benefits, and clarify show the mechanism of action. The development of more specific and sensitive methods with more representative models as well as the development of well-predicted biomarkers will help better understand how green tea interacts with endocrine systems. Definitive conclusions about the protective effects of green tea must come from observational epidemiological studies and well-designed intervention trials. The development of biomarkers for green tea consumption as well as molecular markers of its biological effects will facilitate future research in this field.

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