



Study of chemistry and pharmacology of *Camellia sinensis* leaves

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ABSTRACT

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Tea has long been utilized in Southern Asia for therapeutic benefit. it's a preferred beverage in this world. varied active ingredients are gift in tea tannins and caffeine to call. The article tries to produce know-how on chemistry and pharmacology of tea leaves and also the method of extraction of active pharmaceutical content.

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Introduction

Tea is an aromatic beverage unremarkably ready by gushing hot or boiling water over cured leaves of the *Camellia sinensis*, an evergreen bush (bush) native to Asia. after water, it's the foremost widely consumed immerse the planet. There are many various sorts of tea; some, like Darjeeling and Chinese greens, have a cooling, slightly bitter, and astringent flavour, whereas others have immensely completely different profiles that embody sweet, nutty, floral or grassy notes. Tea plants are native to East Asia, and doubtless originated within the borderlands of north Union of Burma and southwestern China. There seems to own been a minimum of 3 separate domestication events of tea and presumably four. Tea could have originated in southern China presumably with interbreeding of unknown wild tea relatives. However, since there are not any familiar wild populations of this tea, the precise location of its origin is speculative. The western Yunnan tea shares several genetic similarities with Indian Assam kind tea (also *C. sinensis* var. *assamica*)

Plant Morphology:

The tea plant is native to Southeast Asia; cultivated in tropical and semitropical altitudes from water level to 7,000 feet. The plant is continually cropped to a height of regarding three feet to encourage new growth. The tea plants manufacture verdant foliage, a yellow-white, camellia-like flower, just about 2-4 cm in diameter, producing 7-8 petals and a berry. The growth of recent shoots, known as a flush, will occur each week at lower altitudes however takes many weeks at higher ones. it's a powerful taproot and also the seeds ar ironed for oil. The leaves are from 3 to 14 cm long and 2-5 cm in breadth, light-weight green once young with short white hairs on the bottom, turning into darker in maturity.

The quality of the tea strength is set on the age of the leaf with the youngest leaves and bud containing the foremost efficiency.



Fig 1. Tea Cultivation in Asia

Different types of tea

Black Tea

Black tea is allowed to wither, that precedes a method known as oxidization throughout that water evaporates out of the leaf and also the leaf absorbs a lot of oxygen from the air. Black teas typically bear full oxidization, and also the results are the characteristic dark brown and black leaf, the typically a lot of robust and pronounced flavors of black teas, and once brewed suitably, a better caffeine content compared to different teas (50-65% of coffee, depending on the kind and production technique)

Green Tea

Green tea is allowed to wither solely slightly once being picked. Then the oxidation method is stopped terribly quickly by rapidly heating the leaves. Therefore, once brewed at lower

temperatures and for fewer time, green teas tend to own less caffeine (10-30% of coffee). Greens additionally tend to provide a lot of delicate flavors with several undertones and accents that connoisseurs treasure.

Yellow Tea

Yellow may be a rare class of tea that's almost like tea in look and flavor. Yellow tea, however, generally doesn't have the grassiness of some green teas. Yellow teas generally bear a lot of oxidization than green teas and a extended, slower drying amount. All yellow teas come back from China

Dark Tea

Dark tea is from Hunan and Sichuan provinces of China and may be a flavorsome aged probiotic tea that steeps up terribly smooth with a natural slightly sweet note.

Oolong Tea

Oolong tea (also called wulong tea) is allowed to bear partial oxidization. These teas have a caffeine content between that of inexperienced teas and black teas. the flavour of tea (wulong) teas is usually not as strong as blacks or as delicate as greens, however has its own extraordinarily odorous and intriguing tones. Oolongs (wulongs) ar usually compared to the style and aroma of recent flowers or recent fruit. examples of this are China tea, Formosa tea Bay jong, and Ti Kuan Yin.

Table 1: Caffeine content in various type tea

<u>Tea Type</u>	<u>Caffeine Concentration</u>
White Tea	30-55 mg
Green Tea	35-70 mg
Oolong Tea	50-75 mg
Black Tea	60-90 mg
Coffee	150-200 mg

Production of tea

General

Although every kind of tea has completely different taste, smell, and visual look, tea process for all tea varieties consists of a really similar set of ways with solely minor variations. While not careful wet and temperature management throughout its manufacture and life thenceforth, fungi can grow on tea. This kind of plant life causes real fermentation that may contaminate the tea and should render the tea unfit for consumption.

Plucking:

Tea leaves and flushes, which incorporates a terminal bud and 2 young leaves, are picked from tea bushes usually doubly a year throughout early spring and early summer or late spring. When temperature drops or winter pickings of tea flushes are abundant less common, though they occur once climate permits. Selecting is finished by hand once a better quality tea is required, or wherever labour prices aren't preventative. Looking on the ability of the picker, hand-picking is performed by propulsion the flush with a snap of the forearm, arm, or maybe the shoulders, with the picker grasping the tea shoot mistreatment the thumb and index, with the center finger generally utilized in combination. Tea flushes and leaves may be picked by machine, though there'll be a lot of broken leaves and partial flushes reducing the standard of the tea. However, it's additionally been shown that machine plucking in properly regular harvest home periods will turn out sensible leaves for the assembly of top quality teas.

Withering / Wilting:

The tea leaves can begin to wilt presently when selecting, with a gradual onset of protein reaction. Withering is employed to get rid of excess water from the leaves and permits a really slight quantity of reaction. The leaves are either put under the sun or left in an exceedingly cool breezy space to tug moisture out from the leaves. The leaves generally lose over 1 / 4 of their weight in water throughout withering. The method is additionally vital in promoting the breakdown of leaf proteins into free amino acids and will increase the supply of freed alkaloid, each of that amend the style of the tea.

Disruption:

renowned within the Western tea trade as "disruption" or "leaf maceration", the teas are contusioned or torn so as to push and quicken reaction. The leaves could also be gently contusioned on their edges by shaking and moving in an exceedingly bamboo receptacle or tumbling in baskets. More in depth leaf disruption is done by kneading, rolling, tearing, and crushing, typically by machinery. The bruising breaks down the structures within and outdoors of the leaf cells and permits from the co-mingling of oxidative enzymes with varied substrates, that permits for the start of reaction. This additionally releases a number of the leaf juices, which can aid in reaction and alter the style profile of the tea.

Oxidation / Fermentation:

For teas that need reaction, the leaves are left on their own in an exceedingly climate-controlled space wherever they flip more and more darker. this is often in the course of agitation in some cases. during this method the pigment within the leaves is enzymatically softened, and its tannins are free or remodeled. This method is usually mentioned as "fermentation" within the tea trade. The tea producer might opt for once the reaction ought to be stopped, that depends on the specified qualities within the final tea similarly because the climate (heat and humidity). For light tea teas this could be anyplace from 5-40% reaction, in darker oolong teas 60-70%, and in black teas one hundred reaction. reaction is very vital within the formation of the many style and aroma compounds, that provides a tea its liquor color, strength, and sprightliness. looking on the sort of tea desired, beneath or over-oxidation/fermentation may end up in grasslike flavours, or excessively thick tasteful flavours.

Fixation / Kill-green:

Kill-green or shāqīng is finished to prevent the herb reaction at a desired level. This method is accomplished by moderately heating tea leaves, therefore deactivating their aerophilic enzymes and removing unwanted scents within the leaves, while not damaging the flavour of the tea. historically, the tea leaves ar panned in an exceedingly pan or steamed, but with advancements in

technology, kill-green is usually done by baking or "panning" in an exceedingly rolling drum. In some white teas and a few black teas appreciate ctc blacks, kill-green is finished at the same time with drying.

Transcriptions

1. Sweltering / Yellowing: distinctive to yellow teas, heat and damp tea leaves from when kill-green are allowed to be gently heated in an exceedingly closed instrumentation, that causes the antecedently inexperienced leaves to show yellow. The ensuing leaves turn out a drinkable that includes a distinctive yellowish-green hue because of transformations of the leaf pigment. Through being sweltered for 6–8 hours at getting ready to body temperatures, the amino acids and polyphenols within the processed tea leaves undergo chemical changes to allow this tea its distinct liveliness and mellow style.

2. Rolling / Shaping: The damp tea leaves are then rolled to be shaped into wrinkled strips, by hand or employing a rolling machine that causes the tea to wrap around itself. This rolling action additionally causes a number of the sap, essential oils, and juices within the leaves to egest, that more enhances the style of the tea. The strips of tea will then be shaped into alternative shapes, appreciate being rolled into spirals, kneaded and rolled into pellets, or tied into balls, cones and alternative elaborate shapes. In many sorts of tea, the rolled strips of herb are then rolled to spheres or [*fr1] spheres and is usually done by inserting the damp leaves in massive material luggage, that are then kneaded by hand or machine in an exceedingly specific manner. The tea may be ironed into bricks through the utilization of serious stones or presses.

3. Drying: Drying is finished to "finish" the tea purchasable. this could be tired a myriad of how together with panning, sunning, air drying, or baking. Baking is sometimes the foremost common. tutelage should be taken to not over-cook the leaves. The drying of the created tea is accountable for several new flavour compounds significantly vital in inexperienced teas.

4. Aging / Curing: whereas not continuously needed, some teas needed further aging, secondary fermentation, or baking to achieve their drinking potential. maybe, a tea puerh, before action into a post-fermented tea, is usually bitter and harsh in style, however becomes sweet and mellow through fermentation by age or damp. Additionally, tea will get pleasure from aging if dismissed over charcoal. flavored teas are factory-made during this stage by spraying the tea with aromas and flavours or by storing them with their flavorants.

The initial part for this method is manually harvest home the tea leaves from the branches which can yield a Decaffeinating tea product.

The trade developed techniques to scale back the caffeine content within the tea product to supply shoppers with completely different caffeine content appropriate for every individual wants. The term "decaf" can be misunderstood for a tea product from that alkaloid is solely isolated; but, that's not continuously the case since coffee typically suggests that taking simply a particular concentration of alkaloid out of the product.

The following are the methods used to obtain decaffeinated tea:

Ethyl acetate methodology

Indirect application of this technique involves wetting the leaf either with steam or with water. Next is that the application of ester that interacts with the moistened leaf and binding that bind with the alkaloid. Finally, the leaf is rinsed once more to clear all the ester residues. Direct methodology is completely different from the indirect methodology since it's dole out directly through the dry leaf.

CO₂ a pair of methodology

This methodology is dole out solely indirectly through the employment of pressurised CO a pair of that's applied on the moistened tea leafs in a very sealed chamber that develops a reaction resulting in the formation of a solvent that is liable for each binding and extracting the alkaloid from the leafs.

Both ways if followed accurately may provides a final product that is 2.6% alkaloid free.

Methylene chloride method

Methylene chloride has the power to extract alkaloid by forming a bond. This methodology is carried within the same manner because the ester method directly and indirectly.

Tea constituents

Tea consists of the many compounds apart from alkaloid that offer the various effects that arise from its uptake. These parts may need numerous effects supported the individuals' consumption and therefore the quality of the tea. the subsequent are a number of the tea parts with a short explanation:

Tannins

One of the chemical constituents of tea is tannic acid. This compound is that the reason behind the dry following the intake of tea. These compounds posses the property of protein-precipitating that causes the formation of a stable, coherent membrane thanks to the deposition of protein on the animal tissue layer whenever applied on the secretion membrane. This result would result in the formation of a protecting layer on the alimentary canal which might hamper the absorption of harmful toxins on the permeable membrane. This property explains the employment of tea as a remedy for the self-treatment of symptom.

Catechins

A recent herb is entrenched of twenty fifth of this compound. This compound tried to possess useful result on completely different health considerations, starting from serious health risks equivalent to the hindrance of stroke, cardiopathy, diabetes, and cancer. alternative shorter

benefit found was having the power to reinforce the reduction of weight once attended with exercise.

Theophylline

This component is extremely important within the medical industry; so, it's synthetically factory-made. This compound is that the active ingredient in medicines used for the treatment of metabolism disorders equivalent to chronic obstructive pulmonary disease (COPD) and bronchial asthma.

Vitamin B complex

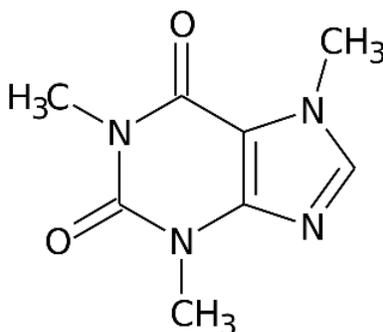
This is a mixture of eight soluble vitamins numbered from one to eight. These are essential to support body functions of traditional growth, maintenance of body tissues, and coenzymes supporting the conventional functioning of enzymes to produce energy-producing reactions. Therefore, inadequate intake of vitamin B complicated would have an effect on numerous body systems equivalent to the organic process, systema nervosum, skin, and blood.

Caffeine content in tea

Most of the tea product are extracted from the leaves of camellia sinensis. All the tea product extracted from this tree contain sure alkaloid content. There square measure alternative kinds of tea product that square measure caffeine free equivalent to Yerba mate.

Different tea products and their caffeine content.

Caffeine chemistry



Chemical Formula : C₈H₁₀N₄O₂

In its pure kind, caffeine may be a soft white solid or long smooth crystal. it's odorless, however features a distinctive bitter style. caffeine belongs to the family of heterocyclic compounds referred to as purines. It has the systematic name 3,7-dihydro-1,3,7-trimethyl-1H-purine-2,6-dione; it is also known as 1,3,7-trimethylxanthine, and 1,3,7-trimethyl-2,6-dioxopurine. Caffeine can be classified as an alkaloid, a term used for substances produced as end products of nitrogen metabolism in some plants. The chemical formula is C₈H₁₀N₄O₂. Caffeine features a molar mass of 194.19 grams (6.85 ounces). it's soluble in water and in several organic solvents, and it appears in pure kind as white crystals. caffeine will be ready by extraction from natural sources or by synthesis from acid.

Caffeine pharmacokinetics

Caffeine may be a naturally-occurring substance found in several plant species, and humans will consume it for its stimulant effects - this can be why coffee perks you up within the morning (or afternoon or whenever you wish it). although it's present, the Food and Drug Administration (FDA) still tracks its use in product and has labeled caffeine as each a food substance and as a drug.

Absorption and distribution

When alkaloid is run severally, it shows is fast absorption once taken orally in a exceedingly amount of roughly 45 minutes to an hour to an extent that reaches up to 99. However, it's absorbed to a lesser extent once administered as Tea or low.

The alkaloid molecule is of a lipotropic nature that explains its simple passage through the biological membranes throughout the canal (GI) tract. it's low binding property to proteins that will increase the number of caffeine freely circulating within the blood in addition as their passage into the blood cells. In infants in addition as in newborns, the concentration of caffeine in plasma and also the cerebrospinal fluid is comparable. once caffeine is taken heavily by pregnant girls, studies have showed that premature infants have high levels of caffeine thanks to the very fact that the placenta doesn't act as a barrier for the transfer of caffeine from the mother to the foetus.

Half-life

A single cup of tea would roughly give a dose of 0.4 to 2.5 mg/kg of alkaloid. Peak plasma concentration is reached in 15 to 120 minutes when oral intake. The half-life of caffeine lasts for four.5 hours in each young and senior once taking a dose of ten mg/kg. However, neonates have an inflated half-life because of the decreased activity of cytochrome P-450.

Clearance

Caffeine clearance is that the lowest throughout the primary amount of life at the age of one month (31 ml/kg/h) and reaches its peak in infants of 5- to 6-month-old (331 ml/kg/h), and declines in adults to a mid value (155 ml/kg/h).

In adult smokers, the half-life of caffeine drops to value from 30 to 500th below the clearance of nonsmoking males. On the opposite hand, oral contraceptives would double the alkaloid clearance once taken by the females.

Metabolism

Caffeine is metabolized in the liver to make variety of metabolites similar to dimethylxanthine, monomethylxanthine, dimethylallantoin, and acid. all these reactions are carried out within the liver microsomes.

These metabolic pathways are saturable since the elimination half-life of caffeine is dose dependent. A caffeine concentration of 1.1 mg/kg would provides a plasma level of 0.5 to 1.5 mg/l.

Pharmacology

One theory states that caffeine's therapeutic actions arise from its action on cyclic nucleotide phosphodiesterases, significantly by inhibiting it. Yet, this theory lacks solid proof that may lead to contradiction of its accuracy since caffeine concentrations that are below the brink to inhibit phosphodiesterase do cause a rise within the blood pressure.

Caffeine taken at higher levels would decrease the uptake in addition because the storage of Ca within the sarcoplasmic reticulum which might increase the extent of free Ca within the striated muscles. At the concentration of 0.2 mmol or additional, caffeine would cause relaxation within the smooth muscle with the presence of norepinephrine and angiotensin that are potent activators of contraction. At nucleoside receptors, it acts as an antagonist through the competitive inhibition mechanism once given in quantities inside the therapeutic vary. This explains the explanation behind observant constant effects of alkaloid by removing nucleoside from the body and decreasing it to an explicit extent. Other effects of caffeine area unit synergy of inhibitors of autacoid synthesis and also the risk that methylxanthines scale back the uptake and/or metabolism of catecholamines in non-neuronal tissues.

Mechanism of action

Almost all of the knowledgeable about effects of caffeine are mediate via adenosine receptors through its competitive repressing action mentioned earlier within the medical specialty. adenosine is to blame for the sleepy-eyed feeling and also the yawning that we have a tendency to experience. By competitive with nucleoside for constant receptors, alkaloid is ready to counteract the consequences of nucleoside created by our body once given in concentrations that permits it to occupy most of the on the market receptors. For this idea to be simply understood, it

may well be explained as if the receptor is adenosine's chair within the workplace and caffeine occupies it, inhibiting adenosine from acting its work.

Caffeine and health

The past decade has been passed with intensive analysis on caffeine concerning some fibrocystic disease, behavior on children, reproductive function, cardiovascular disease, behavior in kids, birth defects and cancer has no vital health hazard from traditional caffeine consumption.

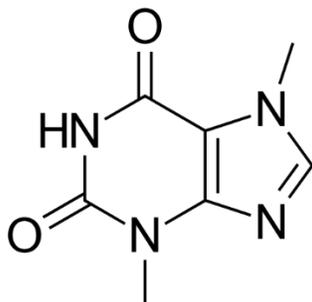
Most of the researches that was created regarding the health hazards that alkaloid will impose to human health, particularly with studies on teratology, reproduction behaviors, carcinogenicity, and upset has no traces that sure use of alkaloid on beverages would result in health injuries.

folks that continuously take tea and coffee haven't any worries regarding their intake of alkaloid since there's no serious concern regarding it as long as there's moderate diet and alcohol consumption, according to researches done over the decades.

Theobromine

Theobromine, is also known as xantheose. It is a bitter alkaloid of the cacao plant, It is found in chocolate, as well as in a number of other foods, including the leaves of the tea plant, and the kola nut. It is classified as a xanthine alkaloid, others of which include theophylline and caffeine. The compounds differ in that caffeine has an extra methyl group.

Theobromine chemistry



Chemical Formula : $C_7H_8N_4O_2$

Theobromine pharmacology

Caffeine could be a naturally-occurring substance found in several plant species, and humans will consume it

Absorption and distribution

The ratio of brain: blood theobromine concentrations diminished ceaselessly from 0.96 at birth to zero.60 in 30-day-old rats. when twenty four unit of time, no organ accumulation of theobromine or its metabolites might be seen in adult animals.

Theobromine, a organic compound by-product like caffeine and also the medicine theophylline, is employed as a CNS stimulant, gentle diuretic, and respiratory stimulant (in neonates with symptom of prematurity).

Half-life

Theobromine is fat soluble, attains peak blood concentrations 2–3 hours when consumption, associated has an calculable half-life of 7 –12 hours

Clearance

Theobromine nephritic clearance was 67 larger than that for theophylline however most of the distinction was thanks to the lower macromolecule binding of theobromine (free fraction = 0.86 compared to 0.58 for theophylline).

Metabolism

The major substance of theobromine in human excretion is 7-methylxanthine (34-48%), followed by 3-methylxanthine (20%) and 7-methyluric acid (7-12%), 6-amino-5-(N-methylformylamino)-1-methyluracil (6-9%) and three,7-dimethyluric acid (1%). Of the dose, 1-18% is recovered within the excretion as unchanged theobromine

Pharmacology

Mechanism of action

Theobromine primarily functions to boost your circulatory, metastasis, and expelling systems. It blocks phosphodiesterase enzymes and will increase the activity of a messenger known as cAMP. This traveller activates an enzyme known as PKA, that reduces inflammation and causes widening of blood vessels and will increase stimulation.

Theobromine conjointly blocks nucleoside receptors. These sometimes trigger hormones such as norepinephrine, that may increase vital sign, however theobromine acts to dam this. It will increase the speed the brain responds to signals, reminiscent of increasing vital sign.

Theobromine and health

Theobromine encompasses a similar result than alkaloid, however regarding ten times weaker. Theobromine has water pill, stimulant and restful effects. Theobromine will lower the vital sign as a result of it will to dilate blood vessels. Theobromine has stimulant properties, like alkaloid. not like alkaloid theobromine doesn't have an effect on the central systema nervosum.

Theobromine may relax bronchi muscles within the lungs. Theobromine will be used as cough drugs. Studies indicate that theobromine acts on the pneumogastric, that runs from the lungs to the brain.

Chemical Properties

Theobromine could be a slightly soluble (330 mg/L[5]), crystalline, bitter powder. Theobromine is white or colourless, however commercial samples will be xanthous.[6] it's an impression like, however lesser than, that of alkaloid within the human systema nervosum, creating it a lesser homologue. Theobromine is associate compound of theophylline, furthermore as paraxanthine. Theobromine is classified as a dimethyl organic compound.

Conclusion:

Studies on tea shows the health benefits. As the human clinical evidence is still limited, future research needs to define the actual magnitude of health benefits, establishes the safe range of tea consumption associated with these benefits, and elucidates the mechanisms of action.

Development of more specific and sensitive methods with more representative models along with the development of good predictive biomarkers will give a better understanding of how green tea interacts with endogenous systems and other exogenous factors. Definitive conclusions concerning the protective effect of green tea have to come from well-designed observational epidemiological studies and intervention trials. The development of biomarkers for green tea consumption, as well as molecular markers for its biological effects, will facilitate future research in this area.

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