



A Review on the Ethnobotany and Phytochemical Composition and Functions of Different Parts of *Clitoria ternatea*, Butterfly Pea Flower

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ABSTRACT

The uses of the plants differ according to the benefits that are able to obtain from the each part of the plant. The multi-purpose of the each part of the plant has been contributed in our daily life for many years. The traditional uses of the plant have enhanced since our ancestors begin to use in the daily activities. The traditional usage of any part of the plant for medication purpose is known as medicinal plant. Several part of the plant is involved in the active principles for the usage such as the roots, leaves, flowers, seeds and many other part of the plant. The plant's pharmacological aspects also have been discussed in the review paper such as antioxidant and cytotoxic activity, anti-diabetic activity, local an anaesthetic effect, gastrointestinal effect, anti-inflammatory, analgesic, antipyretic activity, antihistamine activity, effect on learning and memory, antidepressant, tranquillizing and sedative activity, anticonvulsant and antistress activity of CT, anti-asthmatic activity, hepatoprotective activity and wound healing effect. The phytochemical composition and functions of different parts of the flower's plant parts such as the flower, leaf, root and seed containing many different phytochemicals and each of part has their own benefits.

Keywords: Ethnobotany; Phytochemical; Butterfly pea flower; Antidepressant; Anti-asthmatic activity

INTRODUCCION

The uses of the plants differ according to the benefits that are able to obtain from the each part of the plant. The multi-purpose of the each part of the plant has been contributed in our daily life for many years. The traditional uses of the plant have enhanced since our ancestors begin to use in the daily activities. The frequent application of the plant in different ways also has become a traditional practice to use the plant. There are several classifications to the usage of the plant in many forms depending to the methods of using it. The common type of the classifications of the usage is medicinal

herbs, culinary herbs, aromatic herbs, ornamental herbs. Each of the classification has its own benefits and advantages [1-6].

According to Mani, each of the classification has been described with examples such as medicinal herbs have curative powers and are used in making medicines because of their healing properties. The traditional usage of any part of the plant for medication purpose is known as medicinal plant. Several part of the plant is involved in the active principles for the usage such as the roots, leaves, flowers, seeds and many other part of the plant. Each part of the plant has its own benefits and advantage which can be used in various types of application. The extraction of the active ingredients from the raw material of the medical plant which used in the synthesis

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of the drugs is a frequent usage of the medical plant. The common examples given by Mani, for medicinal herbs are marigold, lemon balm, lavender, Johnny-jump-up, and feverfew. Culinary herbs are probably the mostly used as cooking herbs because of their strong flavors like oregano, parsley, sweet basil, horseradish and thyme. Polyphenols are found in numerous plant derived foods including herbs and spices, which, especially in their dried forms, generally contain relatively high levels of polyphenols compared to other polyphenol rich foods including broccoli, dark chocolate, red, blue and purple berries, grape and onion. According to Opara and Chohan, polyphenols and polyphenol rich foods especially fruits, vegetables and green tea, are widely known for their antioxidant properties however they exert other biological effects such as anti-inflammatory, anti-cancer and neuroprotective which may also contribute to their purported benefits, possibly or not, *via* their antioxidant properties, and they are therefore linked to the maintenance of health *via* protection against the development of non-communicable diseases. Aromatic herbs have some common uses because of their pleasant smelling flowers or foliage. Oils from aromatic herbs can be used to produce perfumes, toilet water, and various scents. For example mint, rosemary and basil. Ornamental herbs are used for decoration because they have brightly coloured flowers and foliage like lavender, chives, bee balm and lemongrass. The use of aromatic plants for their extracts and essential oils, as functional ingredients in the pharmaceutical, food and feed industries as stated by Christaki, et al.

LITERATURE REVIEW

Pharmacology of the Butterfly Pea Flower Plant

The plant is a perennial herbaceous plant, with elliptic, obtuse leaves. It grows as a vine or creeper, doing well in moist, neutral soil. The most striking feature about this plant is the colour of its flowers, a vivid deep blue; solitary, with light yellow markings. They are about 4 cm (1.6 in) long by 3 cm (1.2 in) wide. Some varieties yield white flowers. The fruits are 5 cm–7 cm (2.0 in–2.8 in) long, flat pods with six to ten seeds in each pod. They are edible when tender. It is grown as an ornamental plant and as a revegetation species (e.g., in coal mines in Australia), requiring little care when cultivated. Being a leguminous plant its roots form a symbiotic association with soil bacteria known as *Rhizobium* which fixes atmospheric nitrogen into a plant usable form (a process called nitrogen fixing), therefore, this plant is also used to improve soil quality through the decomposition of nitrogen rich plant material.

Table 1: The ethnobotany of BPF.

Location	Part	Utilization	References
Tamao village, Embaloh Hulu district, West Kalimantan, Indonesia	Flowers	Medicine, traditional ceremony, and ornamental	Haryanti, et al.

The butterfly pea flower, BPF is known as the *clitoria ternatea* were or even has a name as the blue pea flower belonging to the Fabaceae family and the Papilionaceae subfamily is a perennial leguminous twiner. The uniqueness of the flower is the vivid, deep blue and white coloration of the flower and it is usually used in food preparation as a natural colourant. BPF is a tropical flower that is commonly found in gardens and in the wild as well. They are about 4 cm (1.6 in) long by 3 cm (1.2 in) wide. Some varieties yield white flowers. The fruits are 5 cm–7 cm (2.0 in–2.8 in) long, flat pods with six to ten seeds in each pod. They are edible when tender.

The plant's pharmacological aspects also have been discussed in the review paper such as antioxidant and cytotoxic activity, anti-diabetic activity, local an anaesthetic effect, gastrointestinal effect, anti-inflammatory, analgesic, antipyretic activity, antihistamine activity, effect on learning and memory, antidepressant, tranquillizing and sedative activity, anticonvulsant and antistress activity of CT, anti-asthmatic activity, hepatoprotective activity and wound healing effect [7-12].

Traditional Uses

The flower has several uses for the preparation of food and as a medicinal advantage. Butterfly pea is one of the most interesting sources of natural colour used in food and cosmetics. BPF tea is a caffeine free herbal tea, or tisane, a beverage made from a decoction or infusion of the leaves of the BPF plant and dried lemongrass. Butterfly pea flower tea retains many of the medicinal properties of the BPF as well as extracting the deep blue colour of the petals that have made the plant a popular dye for centuries. One of the aspects of the tea is the fact that the liquid changes colour based on the pH level of the substance added to it, for instance, adding lemon juice to the tea will turn it purple. Chinese have also used this plant in medical preparations for curing ailments afflicting reproductive organs. BPF is known as aparajita in Bengali which is used as a well-known Ayurvedic medicine. All the part of the herb (leaf, root, shoot) is used as medicine. In traditional Ayurvedic medicine, it has been used for centuries as a memory enhancer, nootropic, antistress, anxiolytic, antidepressant, anticonvulsant, tranquillizing and sedative agent. It is also used in neurological disorders.

RESULTS

Ethnobotany of BPF

As shown in below [Table 1](#).

Five of Pakraman villages, Bali (Pakraman Jatiluwi Tabanan, Pakraman Sukawati Gianyar, Pakraman Penglipuran Bangli, Pakraman Tenganan Karangasem, and Pakraman Banyuning Buleleng), Indonesia	Flowers	Traditional ceremony (Panca Yadnya)	Surata, et al.
Lenteng district, Guluk-Guluk district, and Bluto district in Sumenep regency, Indonesia	Flowers	Eye disease medicine	Destryana and Ismawati.
The Hindu community of Jagaraga village, West Lombok Regency, West Nusa Tenggara, Indonesia	Flowers	Eye disease medicine	Eni, et al.
Togian Tribe, Tojo Una-Una, Central Sulawesi, Indonesia	Flowers	Boils and fever medicine	Tabeo, et al.
The Adjacent Area of Lake Buyan-Tamblingan, Bali, Indonesia	Flowers	Eye disease medicine	Oktavia, et al.
Mincidan Village, Klungkung, Bali, Indonesia	Flowers	Eye disease medicine, 'nunas' tirta ceremony, and ornamental	Defiani and E
Madura Sumenep communities, Indonesia	Flowers	Clean and clear baby's eyes	Ismawati and RA
India	Roots and seeds	'Tonic of the nerves', alterative and laxative	Mukherjee, et al.
India	Leaves and roots	Used in the treatment of a number of ailments including body aches, especially infections, urinogenital disorders, and as an anthelmintic and antidote to animal stings.	Mukherjee, et al.
India	Roots	Used in the treatment of various diseases, like indigestion, constipation, fever, arthritis and eye ailments	Mukherjee, et al.
India	Seeds	Treats colic, dropsy and enlargement of abdominal viscera; they are also used in swollen joints	Mukherjee, et al.
India	Root, stem and flower	treatment of snakebite and scorpion sting	Mukherjee, et al.
Cuba, America	Root	Promote menstruation and induce uterine contractions and to aid in el flujo loquial	Mukherjee, et al.
America	Flowers and roots	Treat clorosis (a malady of adolescents involving "impoverishment of the blood," probably anemia) and against liver and intestinal problems.	Mukherjee, et al.
Kerala, India	Young shoots, leaves, flowers and tender pods	Eaten as vegetable	Gomez and A Kalamani
Philippines	Young shoots, leaves, flowers and tender pods	Eaten as vegetable	Gomez and A Kalamani
Malaysia	Leaves and flower	A blue colour to food and the flowers to impart a bright blue colour to rice cakes.	Mukherjee, et al.

BPF is used in Beverages

Blue tea from BPF begins to be known in Indonesia. It possesses antioxidant properties for healthy beverages because it reduces oxidative stress. One of the unique characteristics of butterfly pea flower is its bluish purple at a low acidic condition, while other most anthocyanins are colorless. The combination of the exotic color and health benefits promoted butterfly pea flower as a functional drink. In Thailand, the drink called doknam anchan is very popular. Recently, in Indonesia the butterfly flower drink is much easier to be found at many restaurants. Butterfly pea buds themselves have a subdued flavor similar to a slightly more herbal black tea, but the plant primarily functions as a natural dye that's subtle in flavor but bold in visual pop. The flowers are most famously used to make a traditional Thai welcome tea known as dokanchan, which hotels there frequently serve to travelers upon their arrival. Both hot and cold versions of dokanchan are widely offered, prepared in an almost identical fashion. Butterfly pea pods are soaked until their color begins to bleed out, then the drink is consumed either piping hot or on ice with a dollop of treacly honey and a wheel of lemon or lime on the side. The burst of citrus causes the drink to have a punchy aftertaste, but it also serves a more arresting purpose making the drink change colors.

Butterfly pea tea has an incredibly sensitive pH balance; meaning even the slightest shift in acidity can turn a beverage from deep blue, to a vibrant plum, to a fizzy magenta. The drink becomes a shippable chameleon: The more acid that comes in contact with the tea, the lighter in color it becomes. From pH 8 to pH 4, the tea is a regal shade of blue. It quickly shifts into deep purple terrain at pH 3, and finally bursts into carnation pink territory at pH 2. The flower has finally made its way into rocks glasses primarily by way of the first-ever commercially produced concentrate from the wild *Hibiscus* flower company, b'lure. Packaged in a dropper bottle, b'lure is essentially butterfly pea simple syrup that enables drinks to appear just a little more oceanic with a few drops of the liquid rationed out like dashes of bitters. Butterfly pea buds themselves have a subdued flavor similar to a slightly more herbal black tea, but the plant primarily functions as a natural dye that's subtle in flavor but bold in visual pop [13-15].

Advantages of using BPF as Beverages

When the colourful (blue) antioxidant flora boiled with water served as break drink, popularly known as blue tea. Floral blue tea has a sweet and earthy flavor. The benefits that can be extracted from the flower include which it is a natural antioxidant, improves blood circulation and helps prevent hair loss and greying hair. There are studies that claim that it cleanses the blood, improves night vision and revitalizes skin and hair. Extract of BPF has been demonstrated to possess anti-diabetic activity and has strong ant glycation and

antioxidant properties and might have therapeutic potentials in the prevention of advanced glycation end products or AGE-mediated diabetic complication. Consumption of CTE beverage increases plasma antioxidant capacities without hypoglycemia in healthy subjects. Furthermore, CTE reduces postprandial plasma glucose and insulin concentration concomitant with improved antioxidant status in the subjects when consumed with sucrose. More of the above it is non caffeinated drink, which may have overcome many side effects occurs due to frequent consumption of coffee such as:

Anxiety

It works by blocking the effects of adenosine, a brain chemical that makes feel tired. It triggers the release of adrenaline, hormone associated with increased energy. Caffeine-induced anxiety disorder listed in the Diagnostic and Statistical Manual of mental disorders (DSM), which is published by the American psychiatric association.

Insomnia

Caffeine can help you stay awake during the day, but it may negatively impact your sleep quality and quantity. Cut off your caffeine consumption by the early afternoon to avoid sleeping problems.

Digestive Issues

Coffee's laxative effect has been attributed to the release of gastrin, a hormone the stomach produces that speeds up activity in the colon. Caffeine itself also seems to stimulate bowel movements by increasing peristalsis.

Muscle Breakdown

People may develop rhabdomyolysis, or the breakdown of damaged muscle, after they ingest large amounts of caffeine. Limit your intake to 250 mg per day if you're uncertain of your tolerance.

Addiction

Going without caffeine for several hours may lead to psychological or physical withdrawal symptoms in those who consume large amounts on a daily basis.

High Blood Pressure

Caffeine seems to raise blood pressure when consumed at high doses or prior to exercise, as well as in people who rarely consume it. But this effect may only be temporary, so it's best to monitor your response.

Rapid Heart Rate

Large doses of caffeine may increase heart rate or rhythm in some people. These effects appear to vary greatly from person to person. If you feel them, consider reducing your intake.

Fatigue

Although caffeine provides energy, it can indirectly lead to fatigue when its effects wear off. Aim for moderate caffeine intake to help minimize rebound fatigue.

Table 2: The potency of BPF tea.

The potency of BPF tea.	
Panda	Anthelmintic activity
	Antihistaminic activity
	Antimicrobial activity
	Cytotoxic activity
	Central cholinergic activity in rats
	Hypoglycemic effect
	Neurogenic potential
	Proteolytic activities
	Wound healing activity
	Larvicidal activity
	Antipyretic activity
	Hepatoprotective activity
	Antioxidant activity

BPF is used in Cosmetics

Public concerns on the safety of synthetic colorants have given rise to demand for natural colorants used in cosmetics and food. Blue dye aqueous extract from the petal of butterfly pea is traditionally used in cosmetics as hair dyeing to cover grey. Flowers of blue variety is used in the preparation of health drinks dyes and eyeliners. Extracts of BPF (Butterfly Pea) flowers are used in Thailand as a component of cosmetics and the chemical composition of the flowers suggest that they may have antioxidant activity. The aqueous extracts of BPF were shown to have stronger antioxidant activity than ethanol extracts. The qualitative analysis of BPF shows the presence of bioactive compounds such as alkaloids, tannins, glycosides, resins, steroids, saponins, flavonoids and phenols. The quantitative estimation of total saponins, flavonoids and phenols in roots and of flavonoids in shoots, flowers and seeds is also reported which is very important for the pharmaceutical industry. The flower also attempted to be used for facial cosmetics, which can be used as scrub, but also as cleanser and ant pigment effect.

C. ternatae (blue) was used to produce natural lipstick where matching synthetic colorant were used to produce lipstick. *C. ternatea*, or commonly known as butterfly pea, is a native

Frequent Urination and Urgency

High caffeine intake has been linked to increased urinary frequency and urgency in several studies. Reducing your intake may improve these symptoms.

The BPF tea have the potency in following as shown in **Table 2**.

plant in equatorial Asia regions and is a potential source of anthocyanins, which contribute to its deep blue color of the flowers. The high amount of anthocyanins of the butterfly pea flowers are derived from the dephindin.

Advantages of using BPF as Cosmetics

BPF contained tannins, phlobatannin, carbohydrates, saponins, triterpenoids, phenols, flavanoids, flavonol glycosides, proteins, alkaloids, anthraquinone, anthocyanins, cardiac glycosides, Stigmast-4-ene-3, 6-dione, volatile oils and steroids. The plant showed many pharmacological effects including antioxidant, hypolipidemic, anticancer, anti-inflammatory, analgesic, antipyretic, antidiabetic, CNS, antimicrobial, gastro-intestinal ant parasitic, insecticidal and many other pharmacological effects.

DISCUSSION

Free Radical Scavengers

Reactive chemical species having one or more unpaired electrons are free radicals, products of the oxidation of oxidative cells. Stressful environmental conditions, such as

toxins and UV radiation, are regularly applied to the body and particularly the skin, creating a significant amount of aggressive oxidants that destroy all biological skin cell membranes (Figure 1).

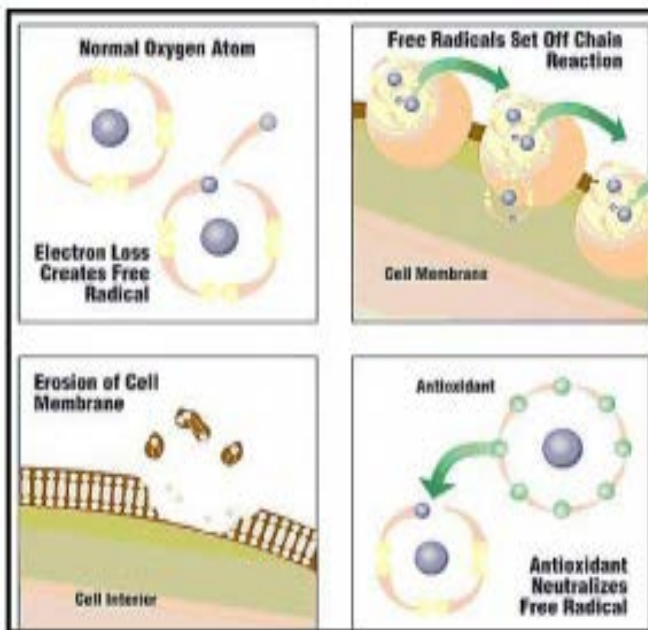


Figure 1: Free radical Scavengers mechanism.

There are few herbs that has major contribution to the anti-aging properties in a herbal drink and acting as free radical scavenger such as grapes (*Vitis vinifera*) gives astringinin from flavonoids (anthocyanins, catechins) and neoflavanoids (stilbenes) has antioxidant properties, Japanese star anise (*Illicium anisatum*) gives protocatechuic acid marks the free radical scavenging activity of anise and yerba mate (*Ilex paraguariensis*) gives the phenolics of the extract has antioxidant activity [16-19].

Prevention of Photoageing

In regions exposed to sunshine, a phenomenon known as photo-aging, ageing is accelerated. Owing to a combination of short wavelength (UVB) damage to the outer layers of the skin (epidermis) and long wave length (UVA) injury to the middle layers (dermis), it is termed photo-ageing. Dryness of the scalp, abnormal pigmentation-freckles, lentiginous, hyper pigmentation, wrinkling, and inelasticity are the clinical presentation of photoageing. Histologically, stratum corneum compaction increased, granular cell layer thickness increased, epidermal thickness decreased, epidermal rete ridge elongation increased, and the number of hypertrophic dopa-positive melanocytes increased. ROS synthesis is induced by ultraviolet radiation, which has been involved in mutagenesis and photoageing (Figure 2).

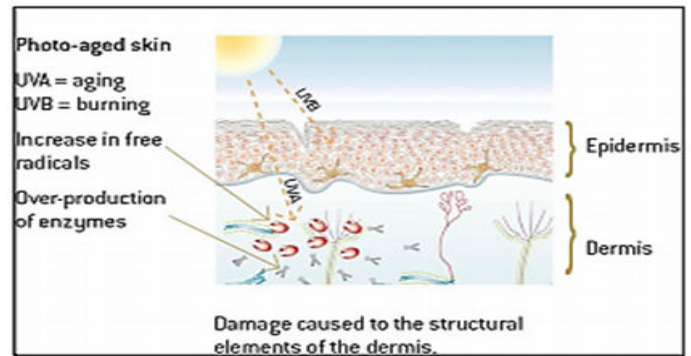


Figure 2: Photo aged skin.

There are few herbs that has major contribution to the prevention of photoageing such as cabbage palm fern (*Polypodium leucomotos*) gives phenolic components have dual protective effects on the extracellular matrix via the inhibition of the proteolytic enzymes, Nevvari (*Ixora parviflora*) gives polyphenols of Ixora are influential in reducing UVB-induced intracellular reactive oxygen species and milk thistle (*Silybum marianum*) gives favourably supplements skin protection. Silymarin possesses anti-inflammatory, anti-photo carcinogenic properties.

Protection of Skin Matrix

For example, spontaneous tissue injury, as a consequence of ultraviolet exposure or the formation of reactive oxygen species, results in the creation of a persistent vicious cycle that leads to increasing damage to the matrix over time. A variety of cytokines are caused by both low dose and high dose ultraviolet radiation, including very notably, tumour necrosis factor such as cell signaling protein involved in systemic inflammation through a post-translational mechanism (Figure 3).

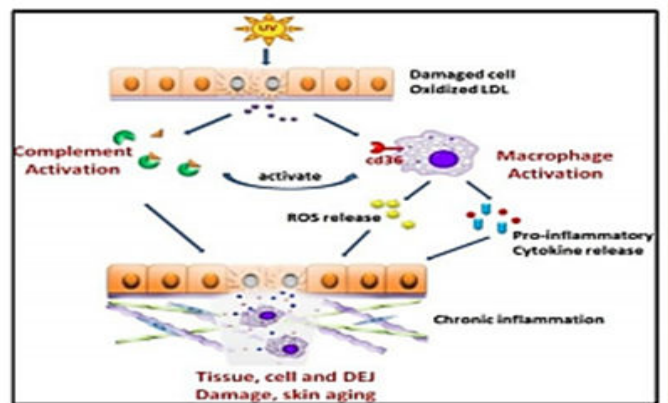


Figure 3: Skin matrix damage.

There are few herbs that has major contribution to the protection of skin matrix such as *Areca* nut palm (*Areca catechu*) gives phenolic compounds of areca provides anti-hyaluronidase and antielastase activity, Burdock (*Arcium lappa*) polyphenolic content of burdock acts as inhibitory

agent for elastase and tyrosinase responsible for causing skin ageing and *Astragalus* root (*Astragalus membranaceus*), the polysaccharides, Asragalosides have potential to prevent tissue injury via anti-oxidant mechanisms.

Elasticity and Skin Tightening Properties

The dermis layer is responsible for providing the epidermis with support and nutritional materials. This layer consists mostly of the fibres of collagen and elastin. Collagen is a type of protein constructed as dense and interwoven fibres, facing in various directions and retaining strength and stretching without breaking. Elastin fibres provide elasticity to the skin. They are relatively small and work like elastic fibres, allowing the skin to revert to its original shape. These fibres tend to shift with age and give the skin an aged, wrinkled appearance (Figure 4).

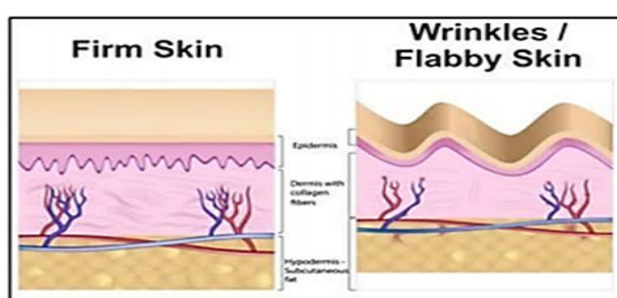


Figure 4: Firm skin vs. loose skin.

There are few herbs that has major contribution to the elasticity and skin tightening properties such as persimmon leaves and seeds (*Diospyros kaki*), tannins and flavonoids possess astringent activity which promotes skin tightening, Dill leaves (*Anethum graveolens*), the dill extract is found to increase skin elasticity, firmness and also reduces wrinkle and hops (*Humulus lupulus*), Xanthohumol, humulones and lupulones are potent antioxidants. Xanthohumol possesses highest oxygen radical absorbance.

Phytochemical Constituents

In the review paper entitled 'phytochemical and pharmacological aspects of *Clitoria ternatea*-a review' by Chakraborty, et al. Several contents are well discussed regarding the butterfly pea flower. For phytochemical composition and functions of different parts of the flower, the authors have discussed the different part of the plant such as the flower, leaf, root and seed containing the phytochemicals and their functions.

The phytochemical for each part of the plant differ according to the usage of the different parts of flower. Each phytochemical has its own benefit according to each part of the flower (Table 3).

Table 3: Phytochemical composition and functions of different parts of *Clitoria ternatea*.

Plant parts	Phytochemicals	Functions	References
Flower	Saponin, tannins, alkaloids, glycosides, phytosterols, carbohydrates.	Anti-inflammatory, analgesic, ethanol extract is used as antidiabetic.	Malik, et al.; Srivastava, et al.
Leaf	Alkaloids, reducing sugars, flavonoids, steroids, glycosides	Prevention of neurodegenerative diseases and diabetes mellitus and effectively controls excessive sweating.	Scalbert, et al.
Root	1,1-Diphenyl-2-Picrylhydrazyl (DPPH)	It is used as an antioxidant and the root bark is diuretic and laxative; a decoction is given as a demulcent in the irritation of the bladder and urethra.	Braca, et al.
Seed	The seeds contain nucleoprotein with its amino-acid sequence similar to insulin, delphinidin-3,3,5-triglucoside, essential amino-acids, pentosan, water-soluble mucilage, adenosine, an anthoxanthin glucoside, greenish yellow fixed oil a phenol glycoside, 3,5,7,4-tetrahydroxy-flavone-3-rhamoglycoside, an alkaloid, ethyl Dgalactopyranoside, p-hydroxycinnamic acid polypeptide, a highly basic proteinfinotin, a bitter acid resin, tannic acid, 6% ash and a toxic alkaloid.	Seeds are cathartic, purgative and aperients. They are used in swollen joints, dropsy and enlargement of abdominal viscera.	Chakraborty, et al.

CONCLUSION

In the review paper entitled 'a mini-review on non-caffeinated blue tea' by Panda, have discussed about the potency of blue tea such as anthelmintic activity, antihistaminic activity, antimicrobial activity, cytotoxic activity, central cholinergic activity in rats, hypoglycemic effect, neurogenic potential, proteolytic activities, wound healing activity, larvicidal activity, antipyretic activity, hepatoprotective activity and antioxidant activity.

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