WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

"A REVIEW OF FORMULATION AND EVALUATION OF HERBAL BLUE TEA FROM BUTTERFLY PEA FLOWER: A NATURAL ANTIDIABETIC AGENT"

Utkarsha Hanumant Aagaskande[1], Shraddha Sanjay Ajabe[2], Priyanka Rajendra Andhare[3], Mayuri Gokul Autade[4]

Genba Sopanrao Moze College of Pharmacy,Wagholi,Pune,411207
Savitribai Phule Pune University
priyankaandhare2002@gmail.com
Correspondance Author Prof. Rahul Chormale

ABSTRACT :

The present study explores the formulation and evaluation of a herbal tea blend utilizing Clitoria ternatea (butterfly pea flower) combined with cinnamon, turmeric, ginger, fenugreek seeds, and lemon peel for its potential antidiabetic properties. Each ingredient was selected based on its traditional medicinal use and scientifically established bioactive compounds known to aid in blood glucose regulation. Preliminary phytochemical screening and literature review suggest that the blend may enhance insulin sensitivity, reduce blood sugar, and offer protective effects against diabetes-related oxidative stress.

Keywords: Butterfly pea flower, herbal tea, antidiabetic agent

INTRODUCTION

Tea (Camellia sinensis) is a extensively consumed libation with a long history, believed to offer health benefits similar as anti-inflammation, analgesic goods, and vulnerable modulation. It's grown in about 30 countries but consumed encyclopedically at varying situations. lately, herbal teas have gained fashionability due to their perceived natural and remedial parcels. These tea are actually made up from colorful factory
including flowers, roots, seeds, dinghies, leaves etc. One of the shops that can be used as herbal teas is butterfly pea flower (Clitoria ternatea). Butterfly pea and other constituents have benefits as anti-diabetic, antioxidant, antibacterial, anti-inflammatory, anticancer, and immunomodulatory parcels. The process of making herbal tea is carried out by drying with the end of perfecting the volume and quality of the herbal tea. Given the growing burden of diabetes, especially type 2 diabetes linked to insulin resistance and rotundity, it's important to explore natural supplements that may support blood sugar control. Research has shown that composites like anthocyanins and polyphenols in Clitoria ternatea can inhibit enzymes responsible for carbohydrate digestion, helping to delay glucose immersion after refection

Types of herbal tea

Herbal teas, both fermented and non-fermented. The maturity of herbal teas consists of non-fermented teas. These are typically made by a combination of rolling, drying, dulling (short heating), withering, and picking. The factory accessories' inherent color, flavor, and active ingredients are maintained by this system. Throughout diverse societies, non-fermented herbal teas are widely used for their health-promoting properties and are incorporated into traditional medicines. For example, Combretum micranthum is referred to as a "long-life herbal tea" in West Africa for its use in treating order affections, while the delicate children of Castanopsis lamontii are used for oral health in southwest China. Other noteworthy examples include the anti-inflammatory properties of chamomile tea, which is made from dried flower heads. Its anti-inflammatory products; yacon tea, used in the Andes for diabetes and digestive problems; and Jasonia glutinosa (gemstone tea), used in the Mediterranean to support digestion. For example, butterfly pea flower tea, also called blue tea, made from Clitoria ternatea, is made by simply drying the flowers without turmoil, preserving its pictorial blue color and anthocyanin content, which offer antioxidant and cognitive benefits.

Fermented herbal teas, on the other hand, are repurposed through picking, withering, rolling, stirring, and drying; during turmoil, natural composites like catechins are oxidized to form the flavins and thearubigins, which contribute to the tea's color and aroma and provide fresh health benefits due to their antioxidant parcels. Both honeybush (Cyclopia intermedia) and Aspalathus linearis are indigenous to South Africa and prized for their high polyphenol content. It is also used to make black tea, in which the leaves are shaped, stimulated, fried, and dried to produce a flavor that is slightly sour and sweet.
Diabetes is a persistent complaint caused by a loss of glucose regulation through defective insulin production and/or action. Insulin is a hormone secreted

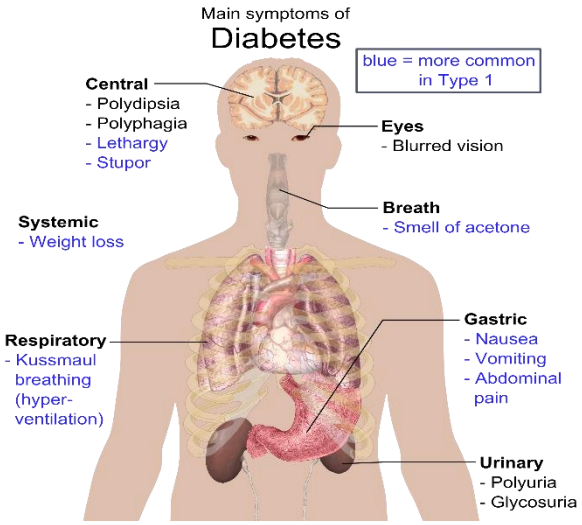
by the pancreas that regulates blood sugar levels. Insulin resistance refers to when a cell does not appropriately respond to the insulin in the bloodstream, resulting in type 2 diabetes. There are both inherited and environmental predispositions toward diabetes, with obesity being a significant factor.

Types of Diabetes

Type 1 Diabetes: An autoimmune condition in which the pancreas does not produce enough insulin. This can lead to elevated blood sugar levels. This can lead to both high blood sugar and low blood sugar resulting in confusion, unconsciousness, or even coma.

Type 2 Diabetes:Insulin resistance and pancreatic β-cell dysfunction are hallmarks of type 2 diabetes, a metabolic disorder. It's told by inheritable and environmental factors, with rotundity being a crucial threat factor. As β- cells fail to compensate for insulin resistance, glucose situations rise, leading to diabetes

Symptoms of diabetes



Both types show same symptoms, but in type 1 appear more snappily as compare to class 2 diabetes. Clinical Characteristics of Type 1 Diabetes Type 1 diabetes generally presents with conspicuous and rapid-fire symptoms similar as unintentional weight loss, frequent urination (polyuria), inordinate thirst (polydipsia), increased hunger (polyphagia), fatigue, constipation, muscle cramps, blurred vision, and incentive infections (candidiasis). Long- term cases are at threat of developing complications affecting small blood vessels (microvascular), as well as larger vessel conditions like coronary roadway complaint and supplemental vascular diseases. Clinical Characteristics of Type 2 Diabetes Type 2 diabetes is frequently linked during routine checks or when complications arise. It poses a high threat of atherosclerosis in major blood vessels and is constantly linked with conditions similar as high blood Page 2 of 3 pressure, elevated cholesterol situations, and rotundity. The leading causes of death in type 2 diabetic cases are cardiovascular conditions and order failure. Differences in geographical regions can also impact how wide and severe these issues come, affecting overall complaint burden and mortality rates

1.4) Mechanism of Diabetes:

In diabetes, glucose regulation is impaired due to insufficient insulin production (Type 1) or ineffective insulin use (Type 2) Glucose is produced by the liver and released into bloodstream. In a normal person, insulin allows glucose to enter cells for energy. In diabetics, glucose remains in the bloodstream, depriving cells of energy while damaging organs and tissues exposed to high glucose levels.

Plant bioactive compounds like anthocyanins and polyphenols exert antidiabetic activity by inhibiting pancreatic α-amylase and α glucosidase activity. It is suggested that the phenolic compounds present in C.ternatea might work in the same way and hence result in the delay of postprandial glucose.

COMPOSITION OF HERBAL BLUE TEA

The blue pea flower (Clitoria ternatea L.) is well known to contain stable polyacylated anthocyanins and therefore shown great promise as a natural food colorant. The color exhibited by the flowers is highly influenced by pH. It displays a dark green color between 8.2 and 10.2; a light blue color between 5.2 and 8.2; a violet to blue color between 3.2 - 5.2; and a red color below 3.2. The color changes are due to structural forms of anthocyanins. Furthermore, the polyacylated acyl groups in blue pea anthocyanins provide protection against degradation such that the color remains stable over a greater range of pH. This means they could be used in both acidic and neutral food systems.

A. Flavonoids- Clitoria ternatea contains flavonoids, which include anthocyanins (e.g. cyanidin, delphinidin, petunidin) and flavonols (e.g. quercetin, kaempferol, myricetin), that have significant antioxidant and anti-inflammatory properties. The specific anthocyanins tend to be responsible for the blue

and purple colors.

B. Alkaloids- The plant has also been shown to contain alkaloids organic compounds animal tranquillizers within their diversity of positive biological effects. One of the major alkaloids is known as "clitorine." While there are various alkaloids and their many biological effects, research is still ongoing to identify their function with blue pea.

C. Triterpenoids and Sterols- Clitoria ternatea contains a host of triterpenoids and sterols with various benefits. The compounds have antifungal and antimicrobial activities and show anti-diabetic, anti-inflammatory and anti-oxidant effects.

D. Saponins - The plant also contains saponins which are natural glycosides with foaming characteristics. The saponins possessed by Clitoria ternatea have exhibited biological activities such as antibacterial and antifungal properties.

BIOLOGICAL ACTIVITY OF HERBAL BLUE TEA IN CASE OF DIABETES MELLITUS

3.1) Antioxidant properties-

Clitorea Ternatea (butterfly pea) exhibits unparalleled antioxidative potential, proposing significant advantages in managing diabetes mellitus (DM), as DM is always associated with oxidative stress. The flower contains high percentages and mixtures of natural antioxidants (such as phenolics, flavonoids, anthocyanins, and quercetin, kaempferol, and myricetin glycosides, tannins, and steroids) that are known to scavenge and neutralize harmful free radicals. These bioactive components aid in protecting pancreatic beta cells from the cellular oxidative damage that contributes to DM and the subsequent effects of insulin resistance. Various in vitro models examined (DPPH, FRAP, ABTS, ORAC custom and non-custom) have shown the flower had high antioxidant activity that was comparable to at least one standard antioxidants (such as ascorbic acid and rutin). Methanol extract along with most ethanol extract (free radical scavenging activity with higher measuring anthocyanin properties) appeared to be more useful future medicinal preparations. Harmful free radicals can be scavenged by relevant concentrations of anthocyanins (for example, delphinidin-3-glucoside) that may also have anti-inflammatory effects that could also impact the improvement of insulin-dependent glucose metabolism by improving insulin's efficacy. Furthermore, human studies indicate that the ingestion of C. ternatea extract can acutely increase plasma antioxidant capacity, resulting in possible significant advantages as a natural supplement intended to reduce oxidative stresses and risk factors in diabetic states. Ternatea has shown itself to consist of many antioxidants, which indicates a possible intra-therapy in preventative aspect in diabetic management.

3.2) Antidiabetic properties-

Clitoria ternatea shows great antidiabetic potential because of its high concentration of phytochemicals (e.g., phenolics, flavonoids, anthocyanins, quercetin glycosides, kaempferol glycosides and tannins) that have potent antioxidant activity. Phytochemicals help counter oxidative stress, an important factor in diabetes mellitus onset and progression. Antidiabetic effects stem from: 1. inhibition of digestive enzymes (alpha-amylase and alpha-glucosidase) which slow the carbohydrate digestion process, reducing blood glucose spikes following meals and improving overall glycemic control, and 2. improving and/or restoring insulin sensitivity by enhancing glucose uptake, and 3. enhancing insulin secretion from pancreatic beta cells to improve glycemic management. However, additional studies are needed on isolation, characterization of the various active compounds, the mechanisms of action, and effective doses in order to fully realize its health benefits and clinical potential.

MATERIALS AND METHODS

Butterfly pea flower

The butterfly pea flower is commonly known as Aparajita in Indian ayurveda which is characterizes by its brilliant blue color. Native to Southeast Asia. It show anti-oxidant, anti-inflammatory properties and other health benefites

- Synonyms: Blue pea, Asian pigeonwings.

- Family: Fabaceae (Leguminosae).
- Biological Source: Clitoria ternatea flowers.
- Chemical Constituents: flavonoids, anthocyanins
- Uses: Blue pea extracts exhibit potential antidiabetic properties, including lowering blood glucose levels, providing antioxidant and anti-inflammatory benefits, inhibiting alpha-glucosidase to slow carbohydrate breakdown, and enhancing insulin sensitivity.

Cinnamon

Cinnamon is a spice from the inner bark of trees in the genus cinnamomun. It's traditionally used in cooking and baking, and has also been noted for its medicinal qualities. It has a unique sweet and spicy flavor and is both wholesome and delicious.

- Synonym: cassia
- Family: Lauraceae
- Source: inner bark of several Cinnamomum species
- Chemical components: essential oils, cinnamaldehyde, eugenol, phenolic compound, coumarin, tannins
- Uses: warm, sweet smell, help insulin sensitivity

Ginger

Ginger is a spicy aromatic root (Rhizome) derived from the plant Zingiber officinale. It is commonly used in food and herbal medicine, as well as natural remedies. Ginger contains bioactive constituents called gingerols, which have health benefits.

- Synonym: Adrak
- Family: Zingiberaceae
- Biological source: dried rhizomes of Zingiber officinale Roscoe
- Chemical constituents: phenolic compounds, carbohydrates, terpenes, lipids, and volatile oils
- Uses: Flavour, metabolism booster, reduces insulin resistance.

Turmeric

Turmeric is a wonderfully warm yellow spice originating from the rhizome of the plant curcuma longa, which is common in culinary practices, medicinal practices, and skincare! Turmeric, best known for the active component curcumin (the color and many health benefits), is extraordinary.

- Synonyms: Curcuma, Indian saffron.
- Family: Zingiberaceae (ginger family).
- Biological Source: Rhizomes of Curcuma longa.
- Chemical constituents: Curcuminoids (curcumin), essential oils (turmerone).
- Uses: Contributes woodsy flavor, anti-inflamitory, assist B cell function.

Fenugreek Seeds

Tiny yellowish-brown seeds from a plant called Fenugreek, which is an edible herb in the fabaceae family, are known as fenugreek seeds, methi. Fenugreek seeds, which originate from Western Asia, southern Europe, and the Mediterranean region, have a somewhat bitter taste and strong aroma that is reminiscent of maple syrup.

- Synonyms: Fenugreek, Methi
- Family: Fabaceae (Leguminosae)
- Biological Source: the seeds of trigonella foenum-graecum
- Chemical Constituents: alkaloid, flavonoid compounds, fiber, vitamins, minerals, and volatile oils
- Uses: Mild bitterness helps delay sugar absorption in the gut

Lemon peel

The lemon peel is the colourful and aromatic yellow rind of the lemon fruit and is full of nutrients and beneficial nutrients presenting a range of potential health benefits and a variety of uses. Its rich in nutrients and bioactive compounds.

- Synonyms: Lemon rind, lemon zest
- Family: Rutaceae
- Biological Source: Citrus limon fruit peel
- Chemical Constituents: Limonene (essential oil), flavonoids (hesperidin), vitamin C
- Uses: Adds citrus freshness, improves antioxidant benefits.

METHODOLOGY

1) Ingredient sourced—From original plant: high-quality dried butterfly pea flower; and from the local market cinnamon, ginger, turmeric, fenugreek seeds, and lemon peel.
2) Grinding—Ground whole ingredients into a coarse powder (to facilitate extraction during brew).
3) Mixing and blending—Mixed and blended all ingredients to have even combination of all ingredients.
4) Filling tea bags—Used biodegradable tea bags having 1 gram of the blended mixture.
5) Sealing—Sealed tea bags to keep all moisture and maintain freshness.
6) Labelling—Labels containing ingredients and health claims.

5.1) FORMULATION TABLE

Sr no	Ingredients name	Quantity given (1gm)	Role
1	Butterfly pea flower	o.45 gm	Antidiabetic qualities, such as reducing blood sugar levels and offering anti-inflammatory and antioxidant advantages.
2	Cinnamon	0.15 gm	Enhances insulin sensitivity and adds a warm, pleasant scent.
3	Ginger	0.20 gm	Boost metabolism
4	Turmeric	0.05 gm	Contributes earty taste, anti-inflammatory
5	Fenugreek seeds	0.10 gm	Mild bitterness helps slow sugar absorption in the gut
6	Lemon peel	0.05 gm	As flavoring agent.

RESULT

Phytochemical Testing

Phytochemical screening showed positive results for key bioactive compounds like anthocyanins, flavonoids, phenols, alkaloids, tannins essential oils, and coumarins.

Organoleptic Properties

Organoleptic evaluation (which includes color, odor, and taste) showed that Formulation 3 (F3) was the most pleasant — it had a fresh,slightly spicy-sweet taste with mild bitterness, making it highly acceptable for consumers.

Physical parameters

A pH around 5.5 to 6.0,
Loss on drying between 9% to 12%,
Ash values within acceptable limits,
Good bulk and tapped density for easy packaging.

CONCLUSION

Butterfly pea flower (Clitoria ternatea) exhibits considerable antidiabetic potential, attributed to its rich phytoconstituents, including anthocyanins and flavonoids. This tea has emerged as a promising complementary option for diabetes management, primarily due to its antioxidant and insulin-sensitizing effects. Butterfly pea flower tea is more than just a vibrant drink—it may also have many health benefits. Still more studies on people are needed to know for sure how well it works. Until then, it might serve as a helpful addition to a healthy lifestyle, especially for those looking for natural ways to support their blood sugar.

REFERENCES

1. Sowmya, R., V. Supriya, and M. Rajkumar. "Clitoria ternatea (Butterfly Pea)–A plant with antioxidant and antidiabetic properties." *Indian J Sci Technol* 16.31 (2023): 2431-40.
2. Lucianus, Johan, et al. "Anti-diabetes mellitus potential of butterfly pea flower (Clitoria ternatea L.) extract based on antioxidant and inhibition of α-amylase and α-glucosidase activities." (2024): 267-273.
3. Singh, Sakshi, and Babita Agrawal. "Biological activities and phytochemicals of clitoriaternatea (Butterfly pea)."
4. Sofiah, Sofiah, et al. "Making herbal tea from a mixture of butterfly pea flower (Clitoria ternatea) and ginger powder (Zingiber officinale) by using drying method according to Indonesian National Standards (SNI)." *5th FIRST T1 T2 2021 International Conference (FIRST-T1-T2 2021)*. Atlantis Press, 2022.
5. Liu, Yuchao, et al. "Review on herbal tea as a functional food: classification, active compounds, biological activity, and industrial status." *Journal of Future Foods* 3.3 (2023): 206-219.
6. Yusuf, A. B., A. A. Turaki, and A. A. Adetunji. "Formulation and evaluation of mango leaf tea supplemented with moringa and ginger powder." *Haya Saudi J Life Sci* 7.5 (2022): 151-157.
7. Sofiah, Sofiah, et al. "Making herbal tea from a mixture of butterfly pea flower (Clitoria ternatea) and ginger powder (Zingiber officinale) by using drying method according to Indonesian National Standards (SNI)." 5th FIRST T1 T2 2021 International Conference (FIRST-T1-T2 2021). Atlantis Press, 2022.
8. Anees A Siddiqui*, Shadab A Siddiqui, Suhail Ahmad, Seemi Siddiqui, Iftikhar Ahsan, Kapendra Sahu “Diabetes: Mechanism, Pathophysiology and Management-A Review” Int. J. Drug Dev. & Res., April-June 2013, 5(2): 1-23.
9. Gayan Chandrajith Vidana Gamage, Yau Yan Lim and Wee Sim Choo* School of Science, Monash University Malaysia, Subang Jaya, Malaysia.
10. Oguis, Georgianna K., et al. "Butterfly pea (Clitoria ternatea), a cyclotide-bearing plant with applications in agriculture and medicine." *Frontiers in plant science* 10 (2019): 645.
11. Allen, Robert W., et al. "Cinnamon use in type 2 diabetes: an updated systematic review and meta-analysis." *The Annals of Family Medicine* 11.5 (2013): 452-459.
12. Chattopadhyay, Ishita, et al. "Turmeric and curcumin: Biological actions and medicinal applications." *Current science* (2004): 44-53.
13. Singh, Nitika, et al. "Features, pharmacological chemistry, molecular mechanism and health benefits of lemon." *Medicinal Chemistry* 17.3 (2021): 187-202.
14. Banerji, Sangeeta, and Shanta Banerjee. "A formulation of grape seed, Indian gooseberry, turmeric and fenugreek helps controlling type 2 diabetes mellitus in advanced-stage patients." *European Journal of Integrative Medicine* 8.5 (2016): 645-653.
15. Baynes, H. W. "Classification, pathophysiology, diagnosis and management of diabetes mellitus." *J diabetes metab* 6.5 (2015): 1-9.