

Studying the applications of *Clitoria ternetea* in various domains of human welfare: A review approach

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Abstract: A great revolution is happening in the industries regarding toxicity of chemicals which led the industries to produce natural bio-made products. Due to which large companies are putting their focus over natural based products. For this purpose various plants are studied one among them is *Clitoria ternetea* which has the potential to be used in various different domains. The butterfly pea is a versatile forage legume. It is a medicinal plant that also serves as a decorative plant and a cover crop. It can withstand a broad variety of temperature, rainfall, and altitude. One of the most intriguing sources of natural color utilized in food and cosmetics is the butterfly pea. The primary pigments in its petals, anthocyanins, are readily removed with water. The stability of the aqueous extract from the butterfly pea petals was discovered to be influenced by the pH of the medium, temperature (Thermal stability), and light (Photo-sensitive). The climber known as butterfly pea *Clitoria ternetea* typically thrives in tropical climates. Its bluish petals are reported to store tannin. Tannin's are a class of delphinidin glycoside anthocyanin pigments that dissolve readily in water. Traditional uses for butterfly pea flower aqueous extracts include food coloring and hair coloring. Due to widespread worries about the safety of various harmful synthetic dyes, the use of natural dyes is now preferred in many sectors in place of synthetic dyes. The objective of this paper is to study about the application of Butterfly pea in modern days and the traditional ways of usage of flower by native people of South Eastern Asian countries.

Index Terms: Anthocyanins, Tannin, *Clitoria ternetea*, Butterfly pea, Pigment, natural dyes.

INTRODUCTION

India is one of the world's biggest mega-biodiversity hotspot which is located in Northern Hemisphere 20.5 37° N, 78.96 29° E comprising of The great Himalayas, Western Ghats, Indo-Burma region and

Deccan Plateau. The prime location of India, contributes to a wide range of geography, in terms of different flora and fauna, which are adapted to various conditions like different Climate, Rainfall patterns, Landscapes and types of soil and other impacting factors [1]. Due to this wide range of Diversity indigenous people of India are very much aware about the uses of plants for various human welfare. People in this modern era are so much concerned about their health due to which various industries are changing their products to nature based [2,3]. Some examples of changes are going in the dyeing industry where synthesis, processes and use of synthetic dyes are replaced by herbal dyes due to the health issues and hazards associated with inorganic synthetic man made dyes during the last decade[4,5]. Similarly in other fields also there is a revolution happening so concerning this problem this paper is written. India is very much familiar to science as in many texts like *Sushruta Samhita* and *Charaka Samhita* two Ayurvedic reference's are found which talk about scientific applications of natural resource for human welfare [6,7]. India is home to the most extensive plant-based medicinal traditions around the world. It is believed that there are over 25,000 potent plant-based formulas used in folk medicine and acknowledged by rural communities in India. Over 1.5 million people practice traditional medicine, which use medicinal herbs in preventative, promotional, and curative purposes. It is expected that around 7800 medical medication production firms in India utilize over 2000 tons of herbs each year [8]. For this purpose Butterfly pea flower scientifically named as *Clitoria ternetea* is used to study its applications over modern day health problems.

Place of origin:

Being one of the members of the Fabaceae family and subfamily Papilionaceae the *Clitoria ternatea*, popularly known as butterfly pea or blue pea due to its vibrant blue shade [9]. It is typically found in all of these habitats naturally: grassland, bush, open woodland, riverine vegetation, and some other disturbed areas. Within the 20°N and 24°S latitudes, *Clitoria ternatea* grows from sea level approximately to a height of 1600–1800 meters. This plant has been imported to Africa, Australia, and the Americas but is native to equatorial Asia, including parts of South Asia and Southeast Asia. It is grown as a vigorous perennial. In certain regions, the blooms are utilized to color rice cakes and cooked rice blue. Similar to eating string beans additionally, leaves are used as a pot herb or used to color dishes or run down agricultural paddocks where butterfly peas were grown [10].

Floricultural traits:

The climbing legume known as the butterfly pea (*C. ternatea*) has five leaflets, a dark and deep blue flowers, and deep roots. It can survive in a wide range of soil types with pH values between 5.5 and 9.0. The flower is grown in both heavy rainfall as well drought prone areas, it adapts to the situations present in environment. The plant is a creeper so it needs a support like Bamboo, wooden sticks on which it can climb to great height [11]. New Plant of butterfly pea propagates only from seeds. As a huge number of seeds are generated from the plant when the pods became dry new plant germinates on its own. The plant grows extensively when grazed moderately during monsoon season [10]. The plant requires usage of weeds in its initial growing stage later on it grows and resists so many infections on its own. So cultivation of butterfly pea is not labor consuming and there is no need for frequent maintenance, care and growth [12].

Plant Phenotypic Description:

There are 58 species of *C. ternatea* found in different nations all over the world, including those in the Indian Ocean, Malaysia, Indonesia, Sri Lanka, the Bahamas, South Africa, Thailand, Vietnam and Australia, Cambodia [13] The corolla of the butterfly pea flower, which has two wings, two keels, and one streamer with light yellow colour lines in the middle, has five petals that are attached to its sepals, sepals, and corolla. A pentamerous zygomorphic pea-shaped bloom, the blue

pea blossom is almost 4 cm long and 3 cm wide. The very thin leaves of the blue pea plant, a climbing legume, are around 2.5–5 cm long and 1.5–3.5 cm wide. It is an evergreen with a fibrous root system, and its huge nodules may fix nitrogen into a form that plants can use thanks to rhizobium bacteria [14,15]. In Indonesia, the roots and leaves are used to manufacture herbal drink compositions and for medicinal purposes, while the flower's extracted dye is employed as a natural colourant in the food sector [16].

Chemical composition of *Clitoria ternatea*:

Butterfly pea has both medically nutritional and bio-active component (phytochemical) in it. The wide blue color of flower is due to the presence of Anthocyanins called *delphinidins*, anthocyanins are one of the most instable organic compounds founds in the nature. The stability of anthocyanins depends upon temperature and pH range of the system. Anthocyanins change its structure (color) in ph change, it tooks *Flavilium cation* form which is red in color in acidic medium $3 < \text{pH}$. And at basic medium more $10 < \text{pH}$ the anthocyanin tends to break down and structure disintegrates into dark brown oxidized compounds and between ph 8-9 it exists in *chalcone* (yellow) form. Vitamins A, C, E and B are abundant in the blue pea plant, which is also a good source of phenolic acids such flavonoids, polyphenols, coumarins, terpenoids, alkaloids, lignans, and tannins. Since it is effective at scavenging free radicals, it can offer antioxidant capabilities, primarily in the form of leaves and flowers, as well as anti-cancer effects. *Clitoria ternatea* also contains metals like Calcium, Zinc, Magnesium, Manganese, Potassium, Sodium, Iron and copper other metals like Selenium in micro quantity is also found in the extract. Blue pea seeds and petals also include a variety of fatty acids, including linoleic acid, stearic acid, palmitic acid, and arachidic acid, which assist improved brain function. The flower also contains fibrous content's which can be used as a forage legume used to feed ruminant livestock [15,17],[18].



Figure 1 Butterfly pea drawn using Chemcraft

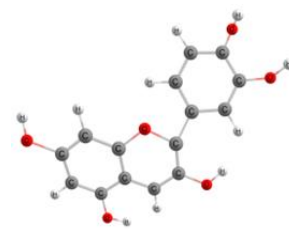


Figure 2. Anthocyanin

Traditional Uses:

The native people of south eastern Asian countries are very much aware about the phytochemical properties of butterfly pea, and familiar with the techniques of usage of the flower extract. People had used it in food, medicine, agriculture and as an ornamental plant. There are several common names for *Clitoria ternatea*. In Konkani, it is referred to as "shankha pushpa" and "gokarna" and is known as "bunga telang" in Malaysia. Blue-pea, cunha (Brazil), pokindong (Philippines), kordofan pea (Sudan), Kokkattan (Tamil), Aparajita (Bengali), Sangua pushpam (Malayalam), and Aparajit in Hindi are some of its other names [12,19,20].

An anti-diabetic, nootropic, anaesthetic, antimicrobial, antipyretic, analgesic, anti-inflammatory, antidepressant, and anti-stress compound, *Clitoria ternatea* is used in Ayurveda, memory enhancer, treats infertility, diuretic, anticonvulsant, anxiolytic, insecticidal properties like snake bites and animal stings. The flower is rich in antioxidant Phyto-chemicals [15]. In Australia's Queens land from a long time *clitoria ternatea* is used as a forage crop which yields hay for cattle and many more [21].

Efficient extraction of Anthocyanins :

A common extraction technique for anthocyanin chemicals is hydro-alcoholic extraction. The sample in this procedure is a dry powder form. Hydro-alcoholic extraction uses distilled water, methanol, or ethanol as solvents. Distilled water is a class one solvent and the optimum solvent for extracting anthocyanin chemicals, according to the FDA. When using water as the solvent and extracting the anthocyanins from blue pea flowers for 60 to 75 minutes at 40-80 degree Celsius approximately around 60 degree celsius, the yield is 56.1%(when 10g sample was taken) it's calculated after centrifuging the solution around 400rpm [3,15,56].

Efficient extraction of Flavonoids :

One type of phenolic component derived from vascular plants is flavonoid compounds. Because of the presence of anthocyanins, these compounds are well-known as blue, red, and purple pigments of blooming plants. Flavonoids a type of phenol is found in the extraction of butterfly pea flower [18]. The total flavonoid content was calculated using an aluminium chloride colorimetric method according to the journal[18]. When extracting flavonoids under aqueous ethanol, maceration is more efficient than

ultrasonic extraction. The flavonoid content of aqueous ethanol was high after 7 days in addition to applying ultrasonic extraction. Therefore, it will take longer to finish this process. There is evidence that flavonoids have anti-oxidant properties, scavenge free radicals, anti-inflammatory, hepatoprotective, anti-cancer, anti-viral, and anti-coronary heart disease properties. Flavonoids have biological properties that include defense against bacteria, viruses, cancers, platelet aggregation, inflammation, and ulcers therefore flavonids are considered as most important class of organic compounds[12].



Figure 3. Anthocyanin colour dependence on Ph change [Ref. 31]

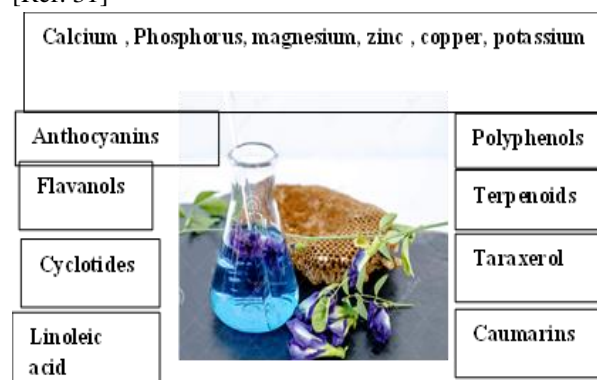


Figure 4. Constituents of Butterfly pea extract

Modern usage:

Butterfly pea leaf extract to cure Diabetes

The extraction of Butterfly Pea Leaf has been studied in the past to determine the ideal temperature, duration, and pH level. These factors do in fact have an impact on the extraction's outcome. It was extracted to liberate the active ingredient (flavonoids and phenols), which is thought to be able to cure mellitus diabetes. Mellitus diabetes is a metabolic disorder brought on by the insulin hormone's dysfunction, which causes the body's blood sugar levels to rise, which leads to complications in the

body [22]. Flavonoids may prevent the absorption of glucose or increase glucose tolerance, which exerts positive benefits against the development of illness. Flavonoids also mimics function of insulin it increases the uptake of carbohydrate into peripheral cells. Flavonoids also takes care of beta cells in our pancreas.

Aqueous crude extract to be used as Blood Smear stain: Numerous histology procedures that produce nuclear stains are known to contain naturally occurring phenolic compounds that are structurally close to anthocyanins. Already anthocyanins from red cabbage and dahlia are

been used as natural strains. Anthocyanins due to the presence of positive charge in its molecule it easily interacts with poly-nucleotides present in the nucleus this poly-nucleotides are nothing but RNA and DNA only. For the purpose of helping in identifying the blood cells within different animal peripheral blood smears, the aqueous crude extract from butterfly pea blossoms can be used as a dye. The crude extract's pH must also be carefully regulated to prevent the disintegration of the anthocyanins during the straining process, which must be done in light-protected conditions [23].

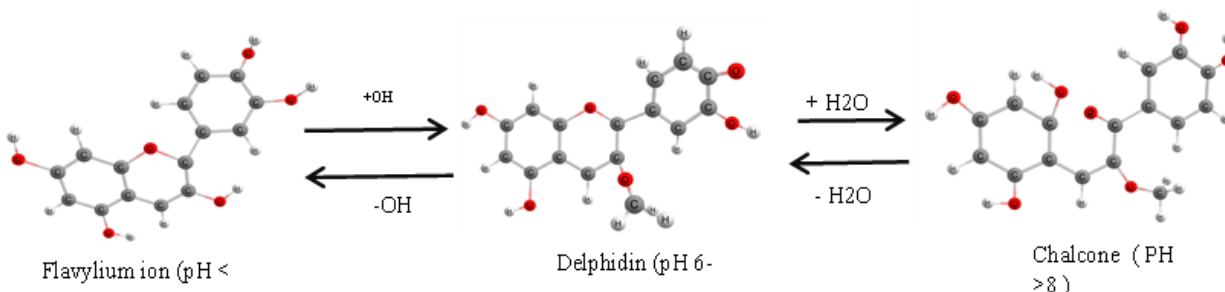


Figure 5. Inter-conversion of Anthocyanins on varying the pH level of solutions drawn using Chemcraft

Butterfly pea powder drink preparation by Co-crystallization method:

The beverage prepared from the concentrated butterfly pea flower extract was produced by co-crystallizing it with a supersaturated sugar solution (> 90 Brix), aggregating it, and baking it at 60°C for 12 hours. The beverage had 16.98 1.22 mg of anthocyanin per liter. At a temperature of 27 deg. C, the powder drink had a half-life of 27.99 days, and this time decreased as the storage temperature rose to 40 deg. C and 50 deg. C. The antioxidant activity, however, remained constant. This result demonstrated the butterfly pea's potential as a nutritious beverage source [24,25].

Improves the quality of soil:

Butterfly pea roots forms round nodules which helps the nitrogen fixing bacteria to live in symbiotic relationship with the roots and they help the plant to fix nitrogen in there roots , because nitrogen is the main constituents for the formation of proteins. When the soil is supplemented with sulfur contents the nodule formation fastens with a proper level of humidity 25-45% and sun light 11-14 hrs exposure. Studies provide light on which legume species, when planted alongside Clitoria ternatea, are most likely to develop nodules and so produce the greatest advantages for the soil. Butterfly pea not only

increases the content of Nitrogen but also there is a significant increase in potassium and phosphorus percentage in the soil[21,26,27].

Natural Colorant in food:

The vibrant, deep-blue flowers of Clitoria ternatea are made possible by the presence of delphinidin anthocyanin. The globe over, C.Ternatea flower is utilised as a natural blue colorant in foods and beverages because to its high anthocyanin pigment level. This coloring agent is frequently used in varying amounts to mocktails, cakes, ice cream, candies, and other classic foods and sweets. It is particularly well known for its flowers' blue-purple anthocyanin hue, which may be utilized as a natural food coloring. Food colorants frequently include C.Ternatea extract. Because the C.Ternatea color parameter may be used to predict and correlate the pH of the extract. Anthocyanins are in great demand due to its anti-inflammatory , anti-carcinogenic property[15,28,29].

Effect of Butterfly pea in our Nervous system:

The majority of medications used today to treat depression have a negative impact on the patient's quality of life. This causes people to not take their medicine as prescribed, which makes the situation

worse. The Indian traditional medical system of Ayurveda describes many single and compound medicinal compositions of plant origin that are used to treat mental illnesses and are praised for having less adverse effects than standard medications. Previous studies on the chemical makeup of different plants and their pharmacology indicate that plants with flavanoids and tannins have action against a variety of Central nervous system diseases [30,31].

Alternate dye for staining Mast tumor cells:

The tumor cell granules' dye extract was used to stain the samples. In comparison to the high grade MCT (Mast Cell tumors) samples, more stained granules were seen in the low grade MCT samples, which is consistent with the presence of more granules in low grade tumor cells. With the dye extract, the tumor cells' granules were brightly colored pink. The cationic ternatins in the dye extract and the anionic heparins abundant in the granules may interact chemically to produce the granular staining. The chemical makeup of the dye and its concentration, the type of solvent used, the pH, and the mordant are only a few of the many variables that affect staining. [32]. Similarly a anticancer activity of flower extract is seen in mice when. Cancer inducing (Dalton's lymphoma Ascites) DLA cells were injected intraperitoneally into mice to cause tumors. Following a 24-hour tumour inoculation, methanol extract of *Clitoria ternatea* (MECT) was administered for 14 days in a row at doses of 100 and 200 mg/kg body weight. In vitro cyto-toxicity, survival time, peritoneal cell count, haematological investigations, and antioxidant parameters were used to evaluate the impact of MECT. MECT therapy reduced viable count, packed cell volume, and tumor volume [13].

Determining freshness of food calorimetric identification:

An intelligent pH indicator might be utilized to check the freshness of packaged food if anthocyanin-incorporated starch changes color in response to pH. Developments of starch based sensitive films by incorporating Anthocyanins and Titanium dioxide, by change in the pH of food we can easily predict the freshness of food by looking in its color. According to a freshness monitor, the color changes from bright pink (fresh stage) to strong green (beginning of rotting/spoilage). With our naked eyes, we could see

what color it was. This color shift is linked to the food sample's pH rising due to the development of basic chemicals during deterioration. The butterfly pea's anthocyanin has a lot of potential for uses and advancements, particularly in the culinary and healthcare sectors. The ability of anthocyanin to adapt its colour to different pH levels, in addition to its other advantages that lean more towards the health sector, might substantially assist the food industry. This property enables the use of butterfly pea extract as a typically safe and non-hazardous universal pH indicator. Due to its pH detecting properties, it can be employed in intelligent food packaging as a colorimetric indicator for spoilage and freshness. The four reversible anthocyanin structures that alter in response to the surrounding pH are the basis for its ability to sense pH. [33–35].

Using Butterfly pea extract for acid base titration:

At pH 7, butterfly pea extract was found to be blue. These demonstrated that anthocyanin was present in butterfly pea extract and that it could be used as an acid-base indicator. Organic compounds with properties of discoloration in a range of solution pH can be used as indicators in titration. Through the equilibrium process of the molecule and ion, discoloration occurred. At pH 4, blue turned into green, from pH 9, green turned into yellow, and at pH 10 to pH 14, the butterfly pea extract began to turn from violet to blue. extract from butterfly peas changes color. The acidity of the medium affects the color of anthocyanins. The flavilium cation in the anthocyanins present in butterfly pea extract was unstable in a pH-changing solution. The structure of the anthocyanins may have changed due to the pH shift, causing the coloring. In an acidic environment, anthocyanin became crimson. pH 4 would cause the formation of colorless carbinol base [36–38].

Medicinal properties:

A. Anti-inflammatory and Anti-analgesic activity- The anti-inflammatory activities of the methanolic extract from the roots of *Clitoria ternatea* are investigated in animal models. The analgesic effect of the Ethanolic extract in mice was also examined in the same research investigation which helped to reduce the pain.[9,13]

B. Anti-microbial activity- The seeds of the plant *Clitoris ternatea* contain a protein with a low molecular

weight and a high cysteine concentration that has been known to have antifungal effects. The test fungi *A. niger* and *A. ochraceus*, as well as a variety of other microscopic species, were destroyed by the crude extract made from *C. ternatea* seeds. We can apply this extract to fabrics and food products to make them last longer and combat the growth of bacteria. Methanolic extracts of *Clitoria ternatea* were tested for their ability to inhibit the growth of a variety of pathogenic, drug-resistant Gram-positive and Gram-negative clinical isolates. The leaf was discovered to have high antibacterial properties against *E. coli* and *Vibrio cholera*, both of which cause dysentery, as well as *Staphylococcus aureus*, which causes fever. The leaf extract outperformed the root extract in terms of antibacterial activity.[9]

C. Wound healing properties- Phytochemical components that serve as free radical scavengers and antioxidants. Angiogenesis, collagen production, DNA replication, and mitogenic activity (which promotes quicker cell division) are all essential [39]. Studies on the wound-healing abilities of *Clitoria ternatea* seed and root extract were conducted using excision, incision, and dead space models in rats. When the butterfly pea root extract was administered orally to the rats, it was shown that the extract had an impact on the inflammatory, proliferative, and remodelling phases of wound healing [9,13,17].

D. Anti-Helminthic activity- *Clitoria ternatea* portions of crude alcoholic extract, ethyl acetate, and methanol were said to considerably produce paralysis and result in worm mortality. Another study examined the anti-helminthic potential of *Clitoria ternatea*'s flowers, leaves, stems, and roots in adult *Pheretima posthuma* Indian earthworms. In compared to other extracts, the methanol extract of roots is the most effective and takes very little time to paralyse and kill the worms. From flowers to leaves to stems, anthelmintic action becomes more potent[40]. This proves that the extract of this flower can be used to kill intestinal worms. Which lives as a parasite in our system.

Pharmaceutical sector now is more concentrated on the preparation of medicines from natural products to reduce the side effect of inorganic chemicals and by studying the properties of Butterfly pea we can conclude that it has the potential to cure and rectify

many human problems. Safely and economically we can use it.

Applications of butterfly pea in cosmetic industry: Many people have begun to focus on the safety of skincare products as environmental consciousness has increased. We have all heard about the serious environmental harm and pollution caused by skincare products made from chemical ingredients like environmental hormones. These skincare products can cause varying degrees of harm to the human body. As a result, consumers now prefer natural and environmentally friendly products. It is suitable for usage as a raw ingredient in skin care products such lotions, sunscreen, beauty products, bath soaps, and others. Consequently, a test mask was created using hot spring water, sodium bicarbonate, and a fermentation solution for butterfly peas. The experimental findings revealed that in addition to having no adverse effects on the skin in terms of redness, irritation, allergies, or inflammation, it also encouraged moisture retention and provided benefits for whitening. As the concentration/amount of the extract or fermentation solution grew, these effects became greater. As a natural raw material for cosmetic formulations, the fermented solution of butterfly pea petals can be used to make skin care products [41–44].

Butterfly pea extracts anti-urolithiasis property: Urinary lithiasis is often caused by an imbalance of inhibitors and promoters in the kidneys. *Clitoria ternatea* aqueous extract demonstrated improved stone formation avoidance as well as preformed stone dissolving[15]. The prevention of calcium oxalate crystal formation in vitro—a frequent major component of most urinary stones—by various *Clitoria ternatea* extracts was investigated using the titrimetric method. Alcoholic extract from *Clitoria ternatea* was discovered to have an inhibitory efficacy comparable to that of Cystone, a patented medication used to dissolve kidney stones. In terms of calcium oxalate precipitation formation, an alcohol extract of *Clitoria ternatea* leaves inhibited calcium oxalate crystallisation more effectively (72.991.2%) in vitro than cystone (90.551.27%) [13,45]. Also butterfly pea extract can resist the growth of pathogenic microbes in urinary tract *Clitoria ternatea* Linn. extract shown superior antibacterial activity against isolated *Proteus mirabilis* from urinary tract infection patients. As a

result, *Clitoria ternatea* Product has the potential to operate as a non-antibiotic option for UTI prevention. As a result, the total number of antibiotics given for UTI therapy is reduced, and medication resistance is avoided.[46]

Doped sol-gel coatings made from *Clitoria* extracts for the prevention of corrosion in mild steel:

The goal of the study is to develop a sol-gel coating for mild steel that contains *Clitoria ternatea* extracts that have been separated using water and ethanol as solvents. In this investigation, the *Clitoria ternatea* floral ethanol extract demonstrated a greater extraction yield than the flower water extract. Also, the antioxidant assay revealed that the ethanol extract had stronger antioxidant qualities and more reducing power potential than the water extract. Potentiodynamic polarisation and electrochemical impedance spectroscopy measurements were used to successfully create and analyse sol-gel coatings that contained extracts from *Clitoria ternatea* in various quantities. By obtaining an inhibition efficacy of more than 85%, both *Clitoria ternatea* extracts demonstrated significant corrosion inhibition capabilities, with the ethanol extract showing the greatest inhibition to fasten the process in some case it is evident by adding dilute sulphuric acid the rate fastens. [47–49].

Butterfly pea pills as a potential fish food ingredient: Because of a weakened immune system, humans are more susceptible to illness. Hence, it is necessary to increase food production. One method of providing wholesome food for the human population, including in Indonesia, is aquaculture. Products from the fishing industry are rich in nutrients that are good for human health, including protein, fibre, omega-3 fatty acids, and others. Aquaculture is developing quickly these days. The aquaculture industry produces almost half of the aquatic foods and goods consumed worldwide in developing nations. One cheaper alternative that can be used as organic feed ingredient is Butterfly Pea due to presence of number of nutrients in this plant, including protein, lipids, fibre, vitamin, mineral and other medicinal products. The carbohydrates, proteins, lipids and fibres are contained in leaf meal, seed meal and flower meal. There is a high protein content in seed flour. The growth of African Catfish, Tilapia and Swordtail Fish Head has not been influenced by the availability of leaf flours, seed meal or flower feed.

Alternative protein sources may include leaf, seed or flower meal as feed ingredients.

In some fish like a Swordtail fish (*Xiphophorus helleri*) which is used as an ornamental fish. The colour of the fish is enhanced by using butterfly pea as a feed due to presence of carotenoids. Fish have colour because of pigment cells, also known as chromatophores, which are present in the dermis layer on, outside of, and beneath the scales. Combining nutritional intake with colour pigments in feed is one technique to enhance the color quality of ornamental fish. The development of fish body colours is influenced by the feeds that include carotenoids. The development of colours in ornamental fish is caused by the deposition of carotenoids in tissues and the existence of chromatophores that carry pigments. [50–53]

RESULTS AND DISCUSSION

The Butterfly Pea Flower Extract cannot be utilised until the natural colourant has been eliminated from the plant material. The solvent or liquid medium used, the extraction temperature, the extraction time, and the extractable solids (flowers) to liquid solvent volume fraction are the most significant influences on the total extractable yield, or the percentage of preferred compounds derived from original plant material.[3,54]. Widely Organic Solvent extraction method is used depending upon the solubility factor of target compound from the plant, for application of extract on food industry Toxic chemicals like Methanol, Ethanol, Hexane, Acetone are not used. However methanol is categorized as class 3 and ethanol as class 2 solvent categorized by FDA[55]. So to avoid toxicity of solvent distilled water is used in food industry for extraction. But for other industries solvents of any type are used and later they are evaporated to get crystals of desired organic compound. The extracted ingredient determines how effective the approaches in different applications. The yield of this extraction technique is influenced by a number of variables, including temperature, pH, the kind of solvent employed, and the extraction period. The traditional extraction methods include maceration extraction, Soxhlet device, and cold/hot water extraction [15,56,57]. Microwave extraction and ultrasound-assisted extraction are two examples of unusual extraction methods. For completely effective

extraction in a short amount of time, the ultrasonic assisted extraction (UAE) approach is used. UAE is really helpful to extract from heat sensitive materials like organic matter found in clitoria Ternetea example's like anthocyanins. UAE is thus promising for extraction of heat sensitive material. In UAE waves in the form of pressure is applied which results in a phenomena called as cavitation which aids to the mass transfer of target compounds[58,59].

A typical household microwave oven can be used for microwave-assisted extraction of medicinal plants. It is a novel and environmentally friendly technique for drawing out the dye from blue pea flowers. With a

frequency range of 300MHz to 300GHz and a wavelength range of 1cm to 1m, the solvent is distilled water. 1:20g/ml is the sample-to-solvent ratio. The process simply needs a few minutes to be finished. The extracted dye may discolour filter paper. Microwave-assisted extraction had an extraction yield of 48.61% [15,60]. High bioactivity bioactive chemicals can be extracted using ultrasonic and MAE techniques from butterfly pea blossoms. However, there are numerous advantages to employing the UAE technique over other techniques dye to the more efficient and safely handling of the systems[60][61].

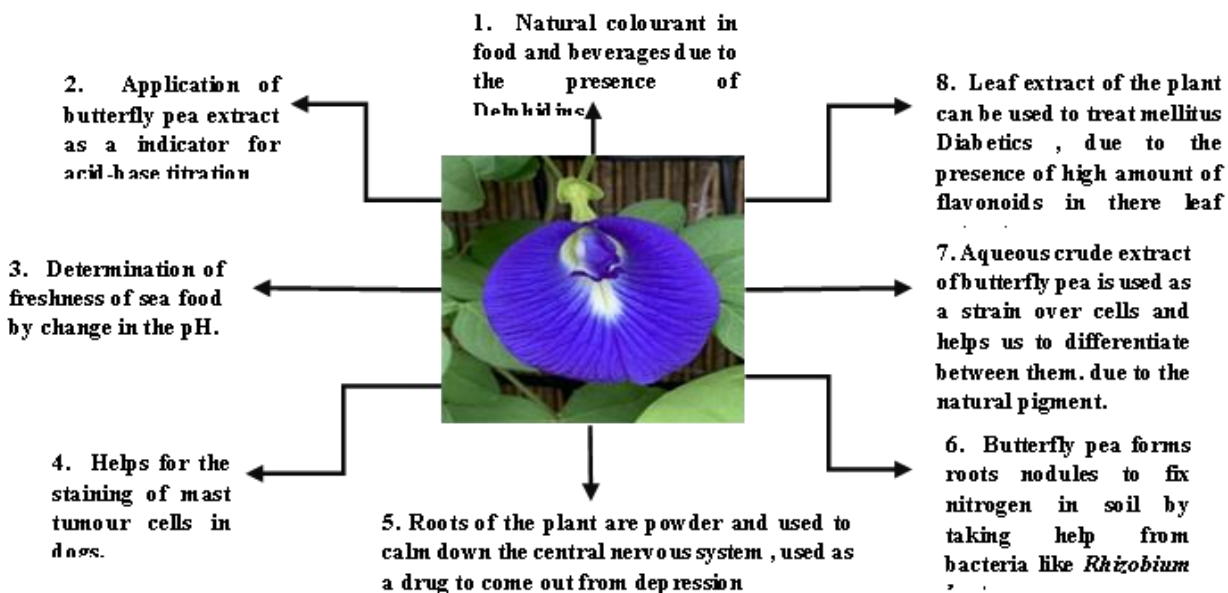


Figure 6. Applications of Butterfly Pea (Clitoria Terneta) in different domains

CONCLUSION

Clitoria ternetea is not only a wild undomesticated flower but also a therapeutic medicinal herb. There are several countries where Clitoria ternatea is grown and it has a lengthy history. It is a good medical plant with many advantages in addition to being a lovely bloom which is used as an ornamental palnt. Several scientists have worked with it in the past and have discovered a variety of pharmacological applications for it. Different groups of plant species and their primary chemicals have been investigated thanks to the development of technology, Ayurvedic traditional medicine, and scientific investigation. Ayurvedic research have tested extracts made from the roots,

seeds, petals, and leaves of C.Ternatea using various methods. Historically, C. ternatea has been used to cure a variety of conditions, including asthma, skin conditions, constipation, fever, inflammation, indigestion, snakebites, and scorpion stings. The plant contains a number of significant compounds. In C. ternatea, flavonoids, saponins, alkaloids, taraxerol, anthocyanins, tannins, ternatins, and taraxerone are the major phytochemicals that have been enhanced. It has a blue-purple hue because anthocyanins are present, making it suitable for use as a natural food dye. Both traditional and unconventional procedures are used to process and extract Clitoria ternatea. It can be used as a springboard for the creation of brand-new phytoceuticals that cure Central nervous system

disorders and enhance memory. For many disorders, appropriate therapies and drugs are yet unavailable. One of the main issues that still exist today is depression, along with stress and worry. As a result, this plant may one day be utilized to produce medications for use in medicine. Because of its capacity to scavenge free radicals, *C. ternatea* has a wide range of activities, including traditional usage, antioxidants, and applications in food, pharmaceutical, cosmetics and Bio-sensors. *Clitoria ternatea* is completely safe and effective for use as phytochemicals, according to all available information and scientific investigations.

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Conflict of Interest:

The author declares no conflict of interest.

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