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Harnessing the Potential of Butterfly Pea Flower: Formulation and Optimization of Sorbet

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Clitoria ternatea, commonly known as butterfly pea or blue pea, is a perennial herbaceous plant from the Fabaceae family. It has recently attracted a lot of interest as it has potential applications both in recent medicine and agriculture, and as a rich source of flavonoids and antioxidants. Additionally, *Clitoria ternatea*, has been widely used in traditional medicine, particularly as a supplement to enhance cognitive functions and alleviate symptoms of numerous ailments including fever, inflammation, pain, and diabetes. The edible flower is Non-toxic and innocuous with health benefits consumed in the human daily diet. It contains beneficial nutrients for human health. Butterfly pea flower Sorbet was formulated and prepared using butterfly pea flower. The acceptability responses of the 25 semi-panelists were encouraging for 90 days interval periods up to 270 days. Accordingly, it was found that the product was accepted by the semi-trained panel

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members. The sensory quality of butterfly pea flower sorbet was acceptable till the storage period of 270 days at refrigerated temperature. Formulation and Standardization of indigenous Butterfly pea Sorbet was prepared without adding any artificial colour and preservatives. The Butterfly pea can be very well for the preparation of Sorbet, and the product scored very well when compared with the commercial one.

Keywords: Butterfly pea flower; neutraceutical properties; natural preservatives and colourant; Sorbet and organoleptic evaluation.

1. INTRODUCTION

Clitoria ternatea, generally known as butterfly pea or blue pea, is a perennial herbaceous plant from the Fabaceae family. It has recently attracted a lot of interest especially because of its pleasant color and it has potential applications both in modern medicine and agriculture field, and has a rich source of antioxidants. Clitoria ternatea (Butterfly pea or Blue pea) flower is a vivid blue color that fascinates all age group. “A natural dye can be extracted from the butterfly pea flower has deep blue color is because of the Anthocyanin compounds. Butterfly pea flower extraction was obtained through different methods and they vary with their manufacturing process. This plant was widely used in traditional medicine because it is rich in bioactive compounds. In treating diabetics, blood pressure, retinal damage, edema, and indigestion, both the aerial and underground parts of this plant are being used. Researchers proved this plant's medicinal activities include nootropic, antioxidant, analgesic, anti-inflammatory and antibacterial activity. Currently, this plant's uses are also widely spread in the nanotechnology field” (Thilini Weerasinghe, et al*.,* 2022).

Objectives:

The following are the specific objectives of the study:

1. To formulate the recipe and standardize the preparation of the Indigenous Butterfly pea sorbet for commercial purposes, using lime juice as a natural preservative, for the benefit of small farmers engaged in agro-enterprises.
2. To review the functional and nutraceutical properties of Butterfly pea flower and how they are used as alternatives to medicine for many diseases and aliments.
3. Comparing the formulated and standardized Butterfly pea sorbet prepared using natural preservatives and colourants with the commercial Butterfly pea sorbet product through organoleptic evaluation.

Butterfly pea possesses many functional and nutraceutical properties and this plant may procure at large scale for providing herbal alternative to many diseases. In view of the above point the present study on Harnessing the Potential of Butterfly Pea Flower: Formulation and Optimization of Sorbet was conducted at KVK premises.

2. MATERIALS AND METHODS

It presents the methodology of unit operations including various materials required for preparation of Butterfly pea Sorbet, based on the “Harnessing the Potential of Butterfly Pea Flower: Formulation and Optimization of Sorbet” was conducted in the ICAR-Krishi Vigyan Kendra-Tirunelveli (Tamil Nadu) in the year January 2022. A brief description of methodology is presented below:

2.1 Raw Materials

Butterfly pea fresh flowers were collected from the farm of ICAR-KVK-Tirunelveli, Tamil Nadu. The fresh petals were separated from the flower and washed in 2 % of salt solution. The ingredients and its quantity were mentioned in Table 1. Raw materials i.e. Sugar, whole Ginger and acid lime were procured from the local market of Surandai, Tirunelveli, Tamilnadu.

Table 1. Requirement of raw materials for sorbet preparation

S.No.	Ingredients	Quantities
1	Butterfly pea flower	40 nos.
2	Ginger (150gms) extract water –Flavoring agent	1 L
3	Sugar	2 kg
4	Acid lime – (Natural Preservative)	30ml

1. Clean ginger and add one liter of water into it, grind it and extract the juice.
2. Boil the ginger extract water with the sugar, add washed and cleaned butterfly pea flower and boil till the sugar syrup reaches 80-90^{O} C for 15 mins (Brix 60-65 ^{O} C).
3. Remove from flame and add juice of two acid lime and mix well.
4. Allow to cool and filter it with muslin cloth.
5. Butterfly pea flower sorbet is ready to use.
6. Bottling and Storing.
7. Add 30 ml of sorbet and mix it in plain soda or water (90ml) to it and serve with ice cubes (If needed).

2.2 Cleaning and Washing

The selected Butterfly pea flowers were washed thoroughly in 2% of salt water. The Ginger and acid lime were washed thoroughly in running water to remove dust. The fresh and firm ginger and acid lime were selected. Gentle rubbing may be necessary to remove mud, dust and dirt from ginger.

2.3 Peeling

Peeling is a necessary procedure in the processing of ginger to remove unwanted or inedible materials and improve the flavour of ginger. In case of Ginger, the hand peeling method is particularly suitable with a peeler. In this method, the peeler is pressed against the surface of the rooted vegetable to remove the skin. The skin can be easily removed by soaking it for an hour, which causes little damage or loss of flesh.

2.4 Slicing or Chopping

Slicing or Chopping is an important procedure before extraction of ginger juice otherwise juice extractor could be choked. Slicing or chopping was done by whole pulp cut into many small halves with a stainless steel knife.

2.5 Extraction and Straining of Juice

The gingers were cut into many halves and the juice was extracted with a juice extractor. Care should be taken that all the skin operations of ginger should be removed entirely; or else it makes the butterfly pea sorbet bitter. Finally the juice was strained through a thick muslin cloth or a double strainer to remove the residue portion.

2.6 Preparation of Sugar Syrup and Bottling

Sugar and acid lime act as natural preservatives to enhance the shelf life of the product. In the preparation of Butterfly pea Sorbet generally the ratio of ginger extract water and sugar is 1:2. Mix the sugar and ginger extract water and then heat for proper mixing. The sugar solution is allowed to boil until it is 80-90^{O} C for 15 mins (Brix 60-65^{O} C), which is considered as the end point. Adding 30 ml of acid lime juice for clarification of undesired substance during heating time and to make cleared and transparent sugar syrup at the end. Allow them to cool the sorbet solution for 12 hours, and then the clarified juice was filtered through a muslin cloth or double -layered strainer. Bottling was done in a sterilized container.

2.7 Sensory Evaluation

The acceptability of the prepared butterfly pea Sorbet was evaluated using Organoleptic Evaluation with a five point hedonic scale by semi-trained panel members. According to Lawless and Heymann (2010), sensory science is “a scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing”.

Table 2. Sensory evaluation score

I. Scale used		**II. Sensory evaluation**
	5-point Hedonic scale	
Points	**Attributes**	**Evaluate each of these two samples**
5	Excellent	1–Colour & Appearance
4	Good	2 –Aroma
3	Average	3 –Taste
2	Poor	4-Texture
1	Very Poor	5-Overall acceptability

Table 2 depicted about the 5 points hedonic scale and its attributes and its findings

3. RESULTS AND DISCUSSION

3.1 Nutritional Composition

The Nutritional analysis of fresh Butterfly pea flowers is given below:

In Table 3, the Nutritional Composition of butterfly pea plant is high in minerals like Calcium (1.5-25.9 g/kg), Potassium contains 7.7-23.0 g/kg, Phosphorous has 0.3-3.9 g/kg, Sodium 0.3-1.1g/kg, Manganese - 28-91 mg/kg, Magnesium has 3.2- 6g/kg, Zinc - 25- 44mg/kg and Copper has 6-9 mg/kg. "Various types of fatty acids are also present in blue pea seeds & petals like Linoleic acid, Arachidic acid, Palmitic acid & Stearic acid which help to boost up brain health. (Mukherjee et al*.,* 2008). Crude protein and fiber contents are high in CT and because of its fiber content, it can be used as forage" (Heuzé et al*.,* 2016).

"The butterfly pea plant is loaded with Vitamin A, Vitamin C, and E and is also rich in polyphenols like flavonoids, phenolic acids, tannins, lignans, alkaloids, terpenoids, and coumarins. It plays an important role in free radical scavenging hence it can provide antioxidant properties mainly by leaves and flowers and anti-cancer properties. There are different types of extraction methods used to separate polyphenolic compounds of this plant and its quality depends upon the method and types of equipment used. Polyphenols found in roots are pentacyclic triterpenoids, taraxerol, and taraxerone". (Sing J et al*.,* 2012).

"In recent days many scientists and researchers are researching Butterfly pea flower for making various medicines, due to the occurrence of many functional compounds in this plant. Presently, butterfly pea tea is available in the market, and it has been a trending beverage in Asian countries. Specially, "Starbucks" Asia launched a special edition of cold beverages using butterfly pea flowers. But only a few value-added products are available in the market". (Pasukamonset et al*.,* 2017).

3.2 Functional Compound and Its Bioactivities

"Anthocyanin is the chief functional compound found in Clitoria ternatea (butterfly pea flower). They are water-soluble pigments belonging to the Flavonoids. Flavonoids are a subclass of the polyphenol Family. Because of the presence of flavonoids vegetables, fruits, and greens look in various colors like violet, blue, orange and red. For this reason, butterfly pea flowers are looking much more eye-catching. Scientists identified more than 700 types of Anthocyanins. Anthocyanins are accountable for protecting the plant cells from Ultra Violet radiation as well they are contributing to pollination" (Vidana Gamage et al*.,* 2021). "In the Butterfly pea flower, polyacrylate anthocyanins are the most ample source of Anthocyanins because their stability is greater than the Non-Acylated Anthocyanins. The big advantage of polyacrylate anthocyanins is, that they are known to be used as natural food coloring agents". (Marpaung et al*.,* 2020).

Table 3. Nutritional composition of butterfly pea flowers for 100 gms

Major components	Fresh Butterfly pea flowers (per 100g fresh weight)
Moisture (%)	92.4-0.11
Ash (%)	0.15-1.40
Protein (%)	0.02-0.32
Fat (%)	2.5-0.11
Crude fibre (%)	0.2-2.0
Minerals	
Calcium (g/kg)	1.5-25.9
Phosphorous (g/kg)	0.3-3.9
Potassium (g/kg)	7.7-23.0
Sodium (g/kg),	0.3-1.1
Magnesium (g/kg),	3.2- 6
Manganese (mg/kg),	28-91
Copper (mg/kg)	6-9
Iron (%)	0.1441-0.007
Zinc (mg/kg)	25- 44

"The chief bioactivity of Anthocyanin is the Antioxidant activity. Antioxidants are substances that prevent oxidation and protect the cells against free radicals. The antioxidant activity has the capability to donate the hydrogen atoms or electrons to free radicals and then reposition free radicals and inhibit the damage occurring from the free radicals" (Tan et al., 2015). "Anthocyanins exhibit two types of antioxidant activities that are in vivo and vitro" (Escher et al., 2020 & Vidana Gamage et al., 2021). "Due to its antioxidant properties, anthocyanins found in the butterfly pea flower could prevent types of diseases such as neurological diseases, cardiovascular diseases, cancers, and diabetes. Some of the studies have proven the toxicological safety of using the petal extract of the butterfly pea". (Cazarolli et al., 2009), (López et al., 2019). Antocyanin, Antioxidant and Metabolite Content of Butterfly pea flower radicals (Suryana, 2021).

3.3 Medicinal Properties

"The popular use of butterfly pea flowers in traditional medicine has motivated researchers to reveal the pharmacological activities of extracts acquired from various*C. ternatea*tissues. Numerous animal studies have stated that the extracts reveal diuretic, antioxidant, nootropic, anti-inflammatory, antiasthmatic, antidiabetic, analgesic, antipyretic, antilipidemic, anti-arthritic, and wound healing properties. Although these collective studies claim thatbutterfly pea flowerextracts showcase a varied range of pharmacological properties, many of these studies are preliminary study and require more detailed investigation. In many cases, the researchers have attributed the extract activities to the presence of flavonols and anthocyanins. However, attempts to separate and test individual components are limited. Certainly several components inbutterfly pea flower extracts could be acting synergistically. For instance, cyclotides which have been stated to have immunosuppressive properties may contribute" (Gründemann et al., 2012,2013;Thell et al., 2016), as could the plenty of delphinidins (Sago et al., 2015; Tani et al., 2017; Harada et al., 2018).

The product developed from butterfly pea sorbet KVK, of paired comparison is depicted in the Table 4. Tirunelveli which is compared with commercially available Butterfly pea product from the market. Organoleptic Evaluation was done using five point hedonic scales by 25 semi trained panel members. Table 4 depicted about the mean sensory evaluation results and it is compared Sample A and B. Sample A - Butterfly pea Sorbet from KVK and Sample B – Butterfly pea squash commercial product.

In the Fig. 1, the panelists responses were encouraging in the sense that, for a period of 270 days (in 0, 90, 180, and 270 days interval periods) the product scored better than the commercial one, mainly due to the colour & appearance, aroma, taste, texture and overall acceptability. Accordingly, the panelists found sample A more acceptable.

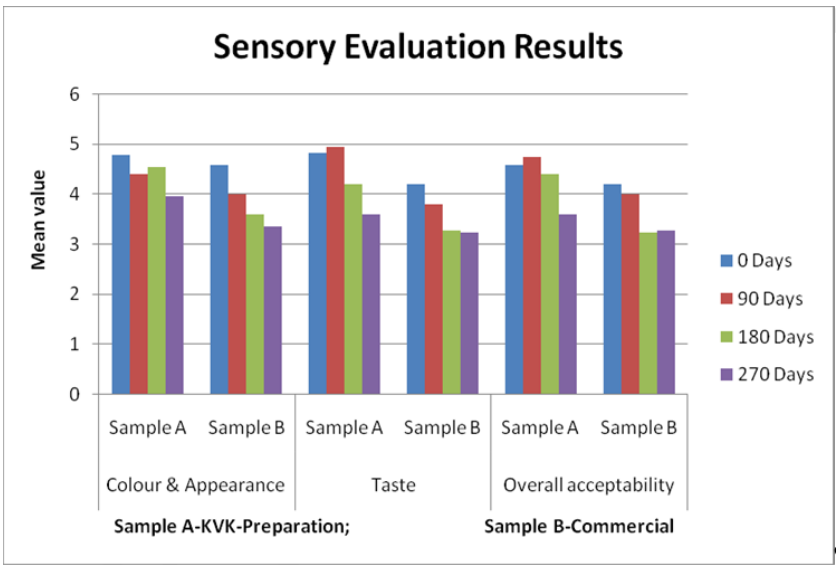

Fig. 1. Mean Sensory Evaluation results for the product developed from KVK butterfly pea sorbet, and compared with the commercially available Butterfly pea product

Table 4. Mean Sensory Evaluation results

Mean Sensory Evaluation results										
Evaluation	**Colour & Appearance**		**Aroma**		**Taste**		**Texture**		**Overall acceptability**	
Intervals	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**	**Sample A**	**Sample B**
0 Days	4.82	4.62	4.54	4.42	4.86	4.22	4.78	4.42	4.62	4.22
90 Days	4.45	4.05	4.20	3.85	4.98	3.82	4.75	4.5	4.78	4.05
180 Days	4.58	3.65	4.35	3.45	4.25	3.30	4.75	4.35	4.45	3.28
270 Days	3.98	3.38	3.85	3.29	3.65	3.28	4.68	4.29	3.65	3.28

Sample A - *Butterfly pea Sorbet from KVK; and* ***Sample B -*** *Commercial Butterfly pea product from market*

4. CONCLUSION

The presence of anthocyanins in the Butterfly pea flower gives it a blue-purplish color, making it a natural food dye in food industry. Processing and extraction of Clitoria ternatea can be done by conventional and non-conventional methods. Coldwater and hot water extraction methods are most commonly used in conventional extraction methods.

Antioxidants found in butterfly pea flowers have the capability to counteract free radicals that are reactive and unstable in cells. Consequently, the use of the blue colour of the butterfly pea flower is supposed to prevent several diseases and aliments. The value-added products from butterfly pea flowers into functional drinks can prevent atherosclerosis. Intake of butterfly pea flowers in any form can reduce symptoms of depression, control obesity, stress, and prevent cancer. Based on the phytochemical screening of butterfly pea calyx, the flower contains secondary metabolites comprising flavonoids. Flavonoids have pigments in the form of anthocyanins that are rich sources of antioxidants which can prevent congestion of blood vessels. The butterfly pea flower has various important phytochemicals. The main phyto -chemicals enriched in Clitoria ternatea (butterfly pea flower) are flavonoids, anthocyanins, alkaloids, saponins, ternatins, taraxerol, tannins, and taraxerone.

The value added product, Sorbet was prepared from Butterfly pea. Hence, it may be concluded from the above findings that the product can be utilized throughout the year. The sensory quality of Butterfly pea Sorbet was highly acceptable by semi trained panel members up to 9 months at refrigeration temperature without adding any artificial preservatives. The Butterfly pea can be very well utilized for preparation of Sorbet at minimal cost. The acceptability rating of the 25 semi trained panelists has conclusively shown that the product retains its original properties without any deterioration for a period of at least 270 days. It has the functional and Nutraceutical compounds may comforts to allievate communicable and non communicable disease.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Cazarolli LH, Folador P, Pizzolatti MG, Silva FRMB (2009). Signaling pathways of kaempferol-3-neohesperidoside in glycogen synthesis in rat soleus muscle. Biochimie. ;91(7):843-849.

Escher GB, Wen M, Zhang L, Rosso ND, Granato D. (2020). Phenolic composition by UHPLC-Q-TOF-MS/MS and stability of anthocyanins from Clitoria ternatea L. (butterfly pea) blue petals. Food Chemistry;331:127341.

Gründemann, C., Koehbach, J., Huber, R., and Gruber, C. (2012). Do plant cyclotides have potential as immunosuppressant peptides?*J. Nat. Prod.*75, 167–174. doi: 10.1021/np200722w. PubMed Abstract|CrossRef Full Text|Google Scholar

Harada, G., Onoue, S., Inoue, C., Hanada, S., and Katakura, Y. (2018). Delphinidin-3-glucoside suppresses lipid accumulation in HepG2 cells.*Cytotechnology*70, 1707–1712. doi: 10.1007/s10616-018-0246-0. PubMed Abstract|CrossRef Full Text|Google Scholar

Heuzé V, Tran G, Boval M, Bastianelli D, Lebas F. (2016). Butterfly pea (Clitoria ternatea).

Lawless HT and Heymann H. Introduction. In: Lawless HT, Heymann H, editors (2010).Sensory Evaluation of Food: Principles and Practices.2nd ed. Springer Science and Business Media; New York, NY, USA:1–2.

López Prado AS, Shen Y, Ardoin R, Osorio LF, Cardona J, Xu Z, Prinyawiwatkul W. (2019). Effects of different solvents on total phenolic and total anthocyanin contents of Clitoria ternatea L. petal and their anti-cholesterol oxidation capabilities. International Journal of Food Science & Technology;54(2):424-431.

Marpaung AM, Lee M, Kartawiria IS (2020). The development of butterfly pea (Clitoria ternatea) flower powder drink by co-crystallization. Indonesian Food Science & Technology Journal;3(2):34-37.

Mukherjee P. K., Kumar V., Kumar N. S., Heinrich M. (2008). The Ayurvedic medicineClitoria ternatea-from traditional use to scientific assessment.J. Ethnopharmacol;120 291–301. 10.1016/j.jep.2008.09.009[DOI] [PubMed] [Google Scholar][Ref list]

Pasukamonset P, Kwon O, Adisakwattana S. (2017). Oxidative stability of cooked pork patties incorporated with Clitoria ternatea extract (blue pea flower petal) during refrigerated storage. Journal of Food Processing and Preservation; 41(1):e12751.

Singh J, Tiwari KN (2012). In vitro plant regeneration from decapitated embryonic axes of Clitoria ternatea L.: An important medicinal plant. Industrial Crops and Products;35(1):224-229.

Sogo, T., Terahara, N., Hisanaga, A., Kumamoto, T., Yamashiro, T., Wu, S., et al. (2015). Anti-inflammatory activity and molecular mechanism of delphinidin 3-sambubioside, a*Hibiscus*anthocyanin.*BioFactors*41, 58–65. doi: 10.1002/biof.120. PubMed Abstract|CrossRef Full Text|Google Scholar

Suryani, M.R. (2021). Ekstraksi Antosianin Pada Bunga Telang (*Clitoria ternatea* L.): Sebuah Ulasan. Pasundan Food Technology Journal (Pftj), 8(2), 45–50. https://doi.org/10.23969/pftj.v8i2.4049

Tan JBL, Lim YY (2015). Critical analysis of current methods for assessing the in vitro antioxidant and antibacterial activity of plant extracts. Food Chemistry;172:814-822

Tani, T., Nishikawa, S., Kato, M., and Tsuda, T. (2017). Delphinidin 3-rutinoside-rich blackcurrant extract ameliorates glucose tolerance by increasing the release of glucagon-like peptide-1 secretion. *Food Sci. Nutr.*5, 929–933. DOI: 10.1002/fsn3.478. PubMed Abstract|CrossRef Full Text|Google Scholar

Thell, K., Hellinger, R., Sahin, E., Michenthaler, P., Gold-Binder, M., Haider, T., et al. (2016). Oral activity of a nature-derived cyclic peptide for the treatment of multiple sclerosis.*Proc. Natl.Acad. Sci. U.S.A.*113, 3960–3965. doi: 10.1073/pnas.1519960113. PubMed Abstract|CrossRef Full Text|Google Scholar

Thilini Weerasinghe, Dayana Perera, Nethmi De Silva, Dinithi Poogoda and Hashani Swarnathilaka, (2022). Butterfly pea: An emerging plant with applications in food and medicine. *The Pharma Innovation Journal*; SP-11(6): 625-637

Vidana Gamage GC, Lim YY, Choo WS. (2021). Sources and relative stabilities of acylated and nonacylated anthocyanins in beverage systems. Journal of Food Science and Technology;1, 1-15.

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