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Effect of Flower Maturity on the Physicochemical and Colorimetric Properties of Butterfly Pea (Clitoria Ternatea L.) Flower Extract

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Abstract: *Butterfly pea (Clitoria ternatea L.) is a blue-flowered plant containing natural pigments, mainly anthocyanins, which give the flowers their characteristic colour. The amount and properties of these pigments may change with flower maturity. The present study investigates the effect of flower maturity on the physicochemical and colorimetric properties of butterfly pea flower extract. Flowers at two maturity stages, fully mature and older flowers, were collected and extracted using distilled water under controlled conditions. The extracts were analysed for extraction yield, pH, and electrical conductivity. Colour intensity was evaluated by measuring absorbance using a UV–Visible spectrophotometer or colorimeter. The wavelength of maximum absorption (λmax) was determined before comparing the samples. The results showed differences in the measured properties between the two maturity stages. Fully mature flowers showed higher colour intensity and extraction yield than older flowers. The study indicates that flower maturity influences the quality of butterfly pea extract and that selecting a suitable maturity stage can provide a better natural colour source using a simple and environmentally friendly extraction method.*

Key Words: Clitoria ternatea L. (Butterfly pea), Flower maturity, Aqueous extraction, Extraction yield; pH, Electrical conductivity, Absorbance.

1. INTRODUCTION

Natural plant pigments have gained considerable attention because of the increasing demand for safe and environmentally friendly alternatives to synthetic colourants. Flowers are an important source of naturally occurring pigments and other bioactive compounds that can be used in food, cosmetics, pharmaceuticals, textiles, and other applications. The amount and quality of these compounds can vary depending on plant variety, environmental conditions, harvesting time, and the maturity of the plant material.

Butterfly pea (Clitoria ternatea L.) is a flowering plant belonging to the family Fabaceae. It is commonly recognized by its attractive blue flowers, which contain natural pigments responsible for their characteristic colour. The flowers are particularly known for their anthocyanin-rich composition. These pigments are of interest because they can provide intense natural colour and may also possess antioxidant properties. Extracts obtained from butterfly pea flowers have therefore attracted interest as potential sources of natural colourants.

Flower maturity is an important factor that may influence the concentration and characteristics of pigments present in flowers. As a flower develops from an early stage to full maturity, biochemical changes occur within its tissues. These changes may affect pigment accumulation, colour intensity, pH, extractability, and other physicochemical properties. However, the relationship between flower maturity and the properties of butterfly pea flower extracts requires systematic evaluation under controlled extraction conditions.

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The present study focuses on evaluating the effect of different flower maturity stages on the physicochemical and colorimetric properties of Clitoria ternatea L. flower extracts. Parameters such as extraction yield, pH, and colour characteristics will be compared among different maturity stages. The study may help identify the maturity stage that provides desirable extract properties and better colour intensity.

The findings of this research could contribute to the better utilization and standardization of butterfly pea flowers as a natural source of colour. It may also provide useful information for future applications of butterfly pea extracts in food, cosmetic, textile, and other natural colourant-based products.

II. MATERIAL & METHODOLOGY

MATERIAL:

- Fresh butterfly pea (CLITORIA TERNATEA L.) Flowers
  - Fully mature
  - Older flowers.
- Distilled water
- Standard buffer solutions
- Digital balance
- Beakers,
- Water bath,
- Whatman filter paper,
- Evaporating dish,
- pH meter,
- Conductivity meter
- Colorimeter with cuvettes.

METHODOLOGY

COLLECTION OF BUTTERFLY PEA FLOWERS

Fresh flowers of butterfly pea (Clitoria ternatea L.) were collected from healthy plants growing under similar conditions. The flowers were divided into two maturity groups:

- **Stage I** – Fully mature flowers: completely opened flowers with a fresh and intense blue colour.
- **Stage II** – Older flowers: completely opened flowers showing visible fading or a change in their original blue colour.

The collected flowers were gently washed with distilled water to remove dust and other impurities.



FULLY MATURE FLOWERS



OLDER FLOWERS

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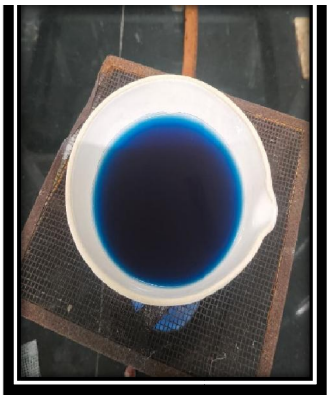
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2. PREPARATION OF FLOWER EXTRACT

The flowers were separated from their stalks and gently dried using clean tissue paper. 5 g of fresh flowers from each maturity stage were accurately weighed and cut into small pieces.

Each sample was transferred separately into a clean beaker, and 100 mL of distilled water was added. The mixtures were heated at 60–70°C for 20–30 minutes with occasional stirring. After extraction, the mixtures were allowed to cool to room temperature.

The extracts were filtered using Whatman filter paper. The clear filtrates were collected in clean, labelled containers. The same flower-to-water ratio, extraction temperature, and extraction time were maintained for both maturity stages.



FULLY MATURE FLOWERS EXTRACT



OLDER FLOWERS EXTRACT

3. DETERMINATION OF pH

The pH of each flower extract was measured using a calibrated digital pH meter. The instrument was calibrated with suitable standard buffer solutions before measurement. The electrode was rinsed with distilled water between measurements. The pH values were recorded at room temperature.

4. DETERMINATION OF ELECTRICAL CONDUCTIVITY

The electrical conductivity of each extract was measured using a calibrated conductivity meter. The conductivity cell was rinsed with distilled water before measuring each sample. The conductivity values were recorded in µS/cm or mS/cm.

5. COLORIMETRIC ANALYSIS BASED ON ABSORBANCE

The colour intensity of the butterfly pea flower extracts was determined by measuring their absorbance using suitable colorimeter. Before measurement, the extracts were brought to room temperature. Distilled water was used as the blank, and the instrument was adjusted to zero absorbance using the blank solution. Determination of Maximum Absorption Wavelength (λmax).A representative butterfly pea flower extract was first scanned over a suitable wavelength range in the visible region. The wavelength showing the maximum absorbance (λmax) was identified.The experimentally determined λmax was then used for measuring all the extracts so that the colour intensity of the two maturity stages could be compared under the same conditions.

Measurement of Absorbance

A clean cuvette was rinsed with a small amount of the sample extract and then filled with the extract. The cuvette was placed in the spectrophotometer, and the absorbance was recorded at the selected λmax. The same procedure was followed for extracts prepared from fully mature and older flowers. The same dilution, cuvette type, and instrumental conditions were maintained for samples.

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Each extract was measured and the absorbance was calculated.

A higher absorbance value was considered to indicate greater colour intensity at the selected wavelength, whereas a lower value indicated lower colour intensity.

6. DETERMINATION OF EXTRACTION YIELD

The extraction yield was determined to compare the amount of extractable material obtained from flowers at different maturity stages.

After filtration, a known volume of each extract was transferred into a previously weighed clean evaporating dish. The extract was evaporated carefully on a water bath at a low temperature until most of the water was removed. The remaining material was then dried to constant weight.

The evaporating dish containing the dried extract was cooled in a desiccator and weighed. The weight of the dried extract was calculated by subtracting the weight of the empty dish from the weight of the dish containing the dried extract.

The extraction yield was calculated using the following formula:

Extraction Yield (%) = (Weight of dried extract / Weight of fresh flower sample) × 100

The extraction yield was determined separately for fully mature and older flowers. Each determination was performed in triplicate, and the mean extraction yield was calculated.

III. DATA ANANLYSIS

1. pH and Conductivity

PARAMETER	FULLY MATURE FLOWERS	OLDER FLOWERS:
pH	5.20	4.84
Conductivity	0.38	0.44 mS

2. ABSORBANCE DATA

Wavelength (nm)	F Absorbance	O Absorbance
400	0.09	0.14
420	0.22	0.28
470	0.27	0.33
500	0.28	0.35
530	0.51	0.62
620	0.64	0.65
660	0.44	0.46
700	0.04	0.04

For both samples, the maximum absorbance is observed at 620 nm, so λmax = 620 nm.

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3. EXTRACTION YIELD

- **FULLY MATURE FLOWER**

$$\% \text{ extraction yield} = \frac{0.037}{5.035} \times 100$$
$$= 0.735\%$$

- **OLD AGE FLOWER**

$$\% \text{ extraction yield} = \frac{0.03}{4.780} \times 100$$
$$= 0.627\%$$

IV. RESULTS

The present study compared the extraction yield, pH, conductivity, and absorbance of extracts prepared from fully mature and older butterfly pea (Clitoria ternatea L.) flowers. The fully mature flowers produced 0.037 g extract from 5.035 g sample, giving an extraction yield of 0.735%. In comparison, the older flowers produced 0.030 g extract from 4.780 g sample, with an extraction yield of 0.628%. Thus, the mature flowers showed a higher extraction yield than the older flowers. The pH of the fully mature flower extract was 5.20, whereas the older flower extract had a pH of 4.84. Conductivity values were 0.38 mS and 0.44 mS for fully mature and older flowers, respectively. Absorbance was measured at different wavelengths from 400 to 700 nm. Both extracts showed their highest absorbance at 620 nm. The absorbance at 620 nm was 0.64 for fully mature flowers and 0.65 for older flowers. Therefore, the maximum absorption wavelength (λmax) for both samples was 620 nm. These results indicate measurable differences in extraction yield and physicochemical properties between the two maturity stages.

V. DISCUSSION

The results indicate that flower maturity affects the properties of butterfly pea flower extract. Fully mature flowers showed a higher extraction yield (0.735%) than older flowers (0.628%). This difference may be due to changes in the amount and composition of soluble compounds during flower ageing. The pH decreased from 5.20 in fully mature flowers to 4.84 in older flowers, showing that the older flower extract was slightly more acidic. The conductivity increased from 0.38 mS to 0.44 mS in older flowers, which may be related to changes in soluble ionic substances present in the extract. Both samples showed the same λmax at 620 nm, indicating that their main light-absorbing colour compounds had similar absorption behaviour. The older flower extract showed a slightly higher absorbance (0.65) than the fully mature extract (0.64). However, this difference is very small and should not be considered significant without repeated measurements and statistical analysis. Overall, the findings suggest that flower maturity can influence extraction efficiency, pH, conductivity, and colour-related properties of Clitoria ternatea flower extract.

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