**Australian Journal of Basic and Applied Sciences,** 10(17) Special 2016, Pages: 172-175

AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

# Effect of extraction condition of natural dye pigment from *Bougainvillea* flowers' bract

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**ARTICLE INFO**

***Article history:***
*Received 19 August 2016*
*Accepted 10 December 2016*
*Published 31 December 2016*

***Keywords:***
*Natural dye; Bougainvillea's* bract*; solid-liquid extraction*

**ABSTRACT**

Bougainvillea is known as a garden flower which is red in color that contains betacyanin, a betalain pigment. Recently, betacyanin is becoming an increasingly popular active ingredient as a dye especially in textile and food industries. This pigment has acquired greater significance because of its excellent color value. However, the use of bougainvillea as a natural textile colorant is still uncommon. This is due to the lack of information on its stability and compatibility in textile dyeing. In this study, solvent extraction was conducted to investigate the factors contributing for pigment extraction from the flowers' bracts. Solid-liquid ratio (SLR) and extraction time were investigated. The color intensity of the dye was evaluated using UV-Vis spectrophotometer. The findings show that both parameters displayed significant effects on the extraction process. The process was better in acidic condition than in alkaline, with a solid-liquid ratio of 0.1. The equilibrium time was reached after 60 minutes of the extraction process. These findings reveal that pigment from Bougainvillea flowers' bracts can be extracted with convenient condition of SLR and equilibrium time.

## INTRODUCTION

Colorants are known as highly colored substances that give color to an infinite variety of materials. Dyes are part of colorants and the common application of dyeing is for coloring substances that is also known as staining. Natural dyes can be derived from plants, minerals, and even some insects. Most natural dye colors are found in bark, roots, leaves, flowers, skins, and shells of plants. Unlike the synthetic dyes, which are carcinogenic, these dyes are very eco-friendly and can be used in specific applications where non-toxicity is a must. The advantage of natural dyes is that they do not create any environmental problems at the stage of production or use, and maintain ecological balance (Sivakumar *et al*., 2011). Moreover, people are increasingly preferring natural pigments over synthetic colorants, which are considered to be harmless or even healthy. These requirements compel numerous regulation changes worldwide (Azeredo, 2009).

Natural pigments that are produced from plant sources include antocyanins, betacyanins, quinones, chlorophylls, carotenoids, and flavonoids. Previous studies had stated that betacyanin was extracted from fruit of cactus (*Opuntia ficus-indica*) (Sreekanth *et al*., 2007), dragon fruit (*Hylocereus polyrhizus*) (Naderi *et al*., 2012), and red beet (*Beta vulgaris L. ssp. Vulgaris*) (Sivakumar *et al*., 2011). *Bougainvillea* is a popular ornamental plant and very common in Malaysia because it grows extremely well in this climate. The pigment betacyanins of *Bougainvillea* flowers' bract exhibit not only a positive health benefits, but also act as a good coloring agent. However, no experimental work has been performed to recover this pigment using the extraction process. Hence, the objective of this study was to extract the pigment betacyanins from *Bougainvillea* bracts using



**To Cite This Article:** Nur Athirah Sabarudin, Mimi Sakinah Abdul Munaim, Zularisam Ab. Wahid., Effect of extraction condition of natural dye pigment from Bougainvillea flowers' bract. ***Aust. J. Basic & Appl. Sci.,*** *10(17): 172-175, 2016*

extraction technique. Betacyanins are soluble in water and often used as a potential source of natural dye. The color is maintained in acidic pH condition. Betacyanins are equivalent to synthetic colorants and have high molar absorbency index.

Extraction of natural dye pigments from their raw dyestuffs is basically a solid-liquid extraction process. When a solid material is brought in contact with a solvent, the soluble components from solid material move to the solvent. The rate of mass transfer decreases as the concentration of dye in the solvent increases, until equilibrium is reached. Thereafter, there is no longer mass transfer of dye from the plant material to the solvent. One of the steps to improve the mass transfer during extraction of dyes is to investigate the parameter conditions suitable for efficient extraction (Pradesh, 2014). In this research, the effects of two factors, namely SLR and extraction time, on the extraction process of pigments from *Bougainvillea* bracts were investigated.

## MATERIALS AND METHODS

### *Material:*

*Bougainvillea* flowers' bract were collected from Gambang (Pahang). The sample was dried under the sunlight. Then, it was ground in a blender to produce fine powder sample required for the experimental work and kept in freezer to preserve its freshness (Ghasemi *et al*., 2011). Water was chosen as the solvent for the isolation of betacyanins from the bracts of *Bougainvillea* for the preparation of natural dye, to make sure that the dye is safe from harmful chemical substance (Kaur, 2014). One molar of acetic acid was used to adjust the pH to acidic condition at pH 4.0.

### *Effect of Solid-Liquid Ratio:*

*Bougainvillea* flowers' bracts that had been segregated and dried were weighed for different SLR (1.0, 1.4, 1.8, 2.0, 2.2, 2.6, and 3.0 g). All extractions and analysis were done at least in triplicate. The temperature was kept steady at room temperature of 28±1.0 °C using a water bath (Xu *et al*., 2013). The pH of the solution was set constant at acidic condition of pH 4.0. The SLRs used were 0.05, 0.07, 0.09, 0.11, 0.13, and 0.15. The absorbance readings were recorded for every time interval of 15 minutes until 3 h of the experimental process (Zhang and Laursen, 2005).

### *Effect of ExtractionTime:*

Betalains was extracted from powdered freeze-dried *Bougainvillea* flowers' bracts using a solid-liquid ratio of 0.1 and the process temperature was kept at 28 °C. Every interval time of 30 minutes, the samples were filtered and the absorbance readings of the filtrate were taken at 535 nm against distilled water as blank. When the absorbance values were constant for three consecutive readings, the extraction process was ended and the respective time was recorded as the equilibrium time (Baishya *et al*., 2012)**.**

### *Photometric Quantification Of Betacyanin Content:*

Characteristic peaks for dye from *Bougainvillea* flower's bracts were identified using a UV-Vis spectrophotometer. The $\lambda_{max}$ and absorbance of the samples were measured using a visible light spectra of 535 nm. (Pradesh, 2014)

### *Experimental Results:*

### *Effect of SLR:*

Effectiveness in the extraction of dyes is influenced by the interface area between solid particles and solvent that makes the effect of solid-liquid ratio an important factor (Zhu *et al*., 2016). The acidic pH was considered as favorable because it has also been reported to be the optimum pH of betacyanins in several studies (Reshmi *et al*., 2012). At this condition, the colour produced from the extraction process of betacyanin from the Bougainvillea floers' bract was red pink dye. It can be seen in Figure 1 that different SLR affected the absorbance reading of the extracted dye. From the scanning of UV-Vis Spectrophotometer, the highest absorbance reading was recorded at 2.147 for an SLR value of 0.1. This result is supported by previous research from Zhu *et al*. (2016) which reported that when the contact area increased because of the increasing of solid particles quantities, it accelerated the mass transfer of the dye to the solvent.

The extract yield increased with the increase of SLR from 0.05 to 0.09, reached a peak at 0.1, and then decreased when the SLR was 0.11. The absorbance reading showed a significant increase when the SLR value was 0.1 because the content of the pigment in the solid particle was higher with the increasing ratio of bract to water. Therefore, the amount of pigment extracted was increased with the increment of the SLR. Beyond this SLR point, the absorbance reading was decreased because it reached its equilibrium phase, where the mass transfer rate of the process has become saturated. As a conclusion, the quantities of solid particles affected the extraction process.

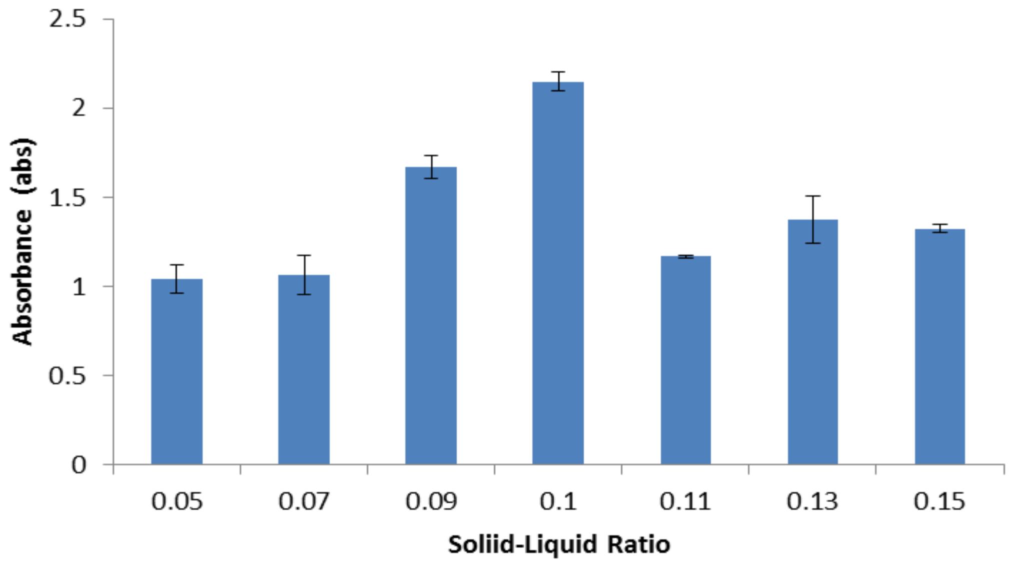


**Fig. 1:** Effect of different SLR on absorbance reading

***Effect of extraction time:***

Figure 2 shows the effect of extraction time on the amount of dye extracted. At the first 30 minutes the extract yield increased with the increase of extraction time and reached a peak at 30 minutes, and then significantly decreased. These results are complied with the study done by Xu *et al*. (2013) where sufficient extraction time yielded greater amount of extracted materials, while a prolonged treatment time might cause loss of activities. As a single factor, the time which the extraction process reached equilibrium was at 60 minutes. The decline in extraction performance may be attributed to the consequence of back-extraction that arise due to the extended period of extraction (Zhang *et al*., 2012). One hour was found as sufficient time for complete extraction corroborated with the ideas of Pradesh (2014) where the extraction of the desired component was seen through the highest absorbance value in the process. Thus the extraction time of 60 min was chosen for the extraction process.

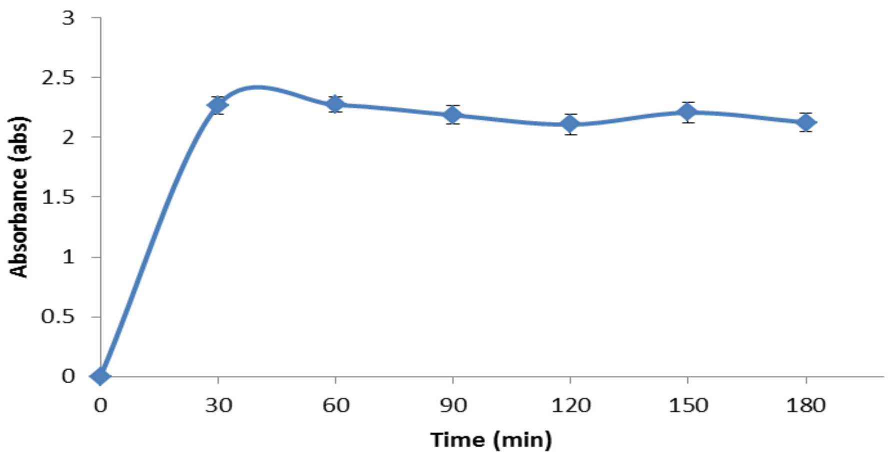


**Fig. 2:** Effect of time duration on absorbance reading with SLR 0.1

***Conclusion:***

To the best of our knowledge, this study is first of its kind to investigate betacyanin from Bougainvillea flowers' bract as an alternative to synthetic dye in textile industry. The effect of SLR and extraction time were investigated on the extraction process. This study revealed that the best SLR for the extraction process was at 0.1. While the equilibrium time reached for the extraction process was at 60 minutes. The highest absorabance reading of betacyanin dye extract was 2.3. Hence, the results suggest that betacyanin pigment dye from *Bougainvillea* flowers' bract can be used as potential dye in the future.

## ACKNOWLEDGEMENT

The authors thankfully acknowledge the financial support of this study by MyBrain 15 and Universiti Malaysia Pahang for access to lab facilities in Faculty of Technology Engineering and Faculty of Chemical Engineering and Natural Resources platform for this research.

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