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A Baseline Assessment Study of the Pigmentary Colours from Common Horticulture Plants Using UV-Visible Spectroscopy

A.O. Adetuyi
Department of Industrial Chemistry, Federal University of Technology,
Akure, Ondo State, Nigeria

Abstract: Pigmentary colours from ten ornamental horticulture flowering plants commonly found in Akure metropolis, Ondo State, Nigeria, were steeped extracted in various solvents and analyzed using UV-visible spectroscopy. All the pigments extracted exhibited strong absorptions in the visible region of the range 400-580 nm. Bougainvillea and Allamanda flowers manifested various hues in acidic and basic media, showing that they could be used as indicators in a titration where a change in pH equivalent of the environment is required such as acid-alkali titration.

Key words: Pigmentary colours, horticulture, flowers, indicator, UV-visible spectroscopy

INTRODUCTION

Principally, the colours displayed in horticulture plants are pigmentary. They are light absorbing chemical compounds embedded in plant's cells (Britton, 1983). They differ from structural colours found among the animal kingdom, in that they are of molecular origin and are not altered by crushing, grinding or compression (Britannica, 1992). They are transmitted and extractable and are sourced from both natural and petrochemical intermediates. Pigmentary could further be classified as dyes and pigments. Flowers and flowering plants provides good examples of the manifestation of colours in nature, serving the following purposes: As an enlivenments agent in the environment (Beautiful scenery) through their brilliant and attractive colours and the background green of the foliage displayed; assisting in preventing depletion of the ozone layers and global warming by releasing/renewing the consumed atmospheric oxygen; reduction of pollution and erosion and serves as wind breakers, hedges and shades; and also as sources of food, medicine, fibres, dyes and pigments, perfumes or fragrances (Bailey and Bailey, 1976).

Man had taken into ornamental horticulture-which involves floriculture and landscaping as profession, to harness and sustains the primary usefulness and the highly priced qualities of the plants in our environment. This is achieved through the cultivation of garden crops, fruits, vegetables, flowers and ornamentals of all kinds (Bailey and Bailey, 1976; Britannica, 1992).

The purpose of this study is to give a baseline assessment data of the pigments of the commonly grown ornamental horticulture flowers listed in Table 1 using UV-visible spectroscopic method.

MATERIALS AND METHODS

Sources of materials: Ten ornamentals horticulture flowering plants listed in Table 1 were sourced for, identified by a horticulturist and collected from various homes and parks and gardens (horticulture centers) in Akure metropolis, Ondo State, Nigeria.

Extraction and UV-visible spectroscopic study: Pigmented colours were extracted by steeping 2 g of each defatted fresh flowers of the plants under study in different solvents at a solute-solvent ratio of 1:20W/V for 6h.The solvent employed were: acetone, acetic acid (dil.), chloroform, diethyl ether, distilled water, lime water ($Ca(OH)_2$ and phenol. The UV-visible spectra of the best two solvent-colour extracts for each flower were run on Hexiose∝ UV-visible spectrometer V2.05.

RESULTS AND DISCUSSION

The hues of the extracted pigments from the various flowers are presented in Table 2, while Fig. 1 shows the spectra patterns of the ornamental horticulture flowers in various solvents. Table 3 gives the spectra data of these flowers. All the flowers pigments are insoluble (colourless) in water, which is the most available

Table 1: List of the common horticulture plants used

Common names	Botanical names	Family/Subfamily names	Plant's description	Methods of propagation	Colour of flowers exhibited
Golden trumpet	*Allamanda L.*	*Apocynaceae*	Climbing Plant/Shrubs	Cuttings	Yellow/Purplish
	Bauhinia poupuria L.	*Leguminosae/Fabaceae*	Trees/Shrubs	Seeds/Suckers	Purple
	Bougainvillea	*Nyctaginaceae*	Climbing/shrubs/vine with thorns	Cuttings	Crimson/orange
Broom weed	*Prairie broomweed*	*Asteraceae*	Tree	Seeds	Yellow
	Crotalaria L	*Leguminosae/Fabaceae*	Herbs/Shrubs	Seeds	Yellow
Glory flower	*Gloriosa L*	*Faboideae*	Tuberous/Climbing	Seeds/Tuber's division	Yellow/Red/Purple
Hibiscus	*H. connabinus L*	*Malraceae*	Herbs/Shrubs/trees	/Grafting	Seeds/Cuttings Various colours
Pride of barbados	*Caesalpinia pulcherrima L*	*Caesalpinaceae*	Shrubs/Trees	Seeds/Cuttings	Various colours
Sunflower	*Helianthus annuus L*	*Asteraceae*	Shrubs/Trees	Seeds	Bright yellow
Water leaf	*Talinum triangulare*	*Portulacaceae*	Herbs	Seeds	Pink

Table 2: Colour observed from the horticulture flowers after 3h and 6h steepings in various solvents

	Solvents							
Horticulture plants	Steeping time (Hr)	Acetic acid	Acetone	Chloro-form	Ethanol	Diethyl ether	Distilled water	Lime water	Phenol
Allamanda	3	G	LY	-	LY	-	-	-	-
	6	G	LY	LY	LY	R	LY	LY	-
Bauhinia	3	-	-	-	-	-	-	LPR	-
	6	-	-	-	-	-	-	LPR	LPR
Bougainvillea Plus	3/6	G	P	P	P	P	LP	-	BR
Broom weed	3/6	LO/Y	LY	LY	LY	LY	-	-	-
Crotalaira	3	LP/LY	-	LY	LY	-	-	-	LY
	6	LY	LY	LY	LY-				LY
Gloriosa	3/6	LP	-	-	-	-	-	LY	LP
Hibiscus	3/6	RD	PP	-	RD	-	-	-	RD
Pride of barbados	3	LO	LY	-	LY	-	-	-	LY
	6	DRD	DY		DY				LY
Sunflower	3/6	LY	LY	LY	LY	LY	-	-	LY
Water leaf	3/6	PR/Y	PR/Y	Y/PR	LY/PR	LY/PR	PR/Y	Y/PR	LPR

Key: DRD- Deep Red; RD- Red; PR- Purple; LPR- Light Purple; BR-Brown; DY- Deep Yellow; LY-Light Yellow; Y- Yellow; LO- Light Orange; P-Pink; LP-Light Pink; G- Green

abundant and universal solvent in nature. This insolubility status of the pigments in these flowers in water accounted for their colour stability and the flourishing of the flowers in all weathers particularly during the rainy season. Protic (ethanol, acetic acid and phenol) and dipolar aprotic (acetone) solvents extracted the flowers' pigments more than any other solvents (Table 2).

These solvents posses certain functional groups as -OH, -COOH and -CO called auxochromes. Since 'like dissolves like' their solubility in the above solvents indicated that the pigments probably contain a similar group as found in the solvents, an acidic group or election withdrawing groups such as hydroxyl, carbonyl, nitro, phenyl, ethylenic (Nohrig and Neckers, 1979) etc. The large dipole moment and the donor properties of these solvents (Neil, 1987) contribute to their extracting efficacy and the absorption of the extracted pigment at the longer wavelength of the electromagnetic spectrum (e.m.s). *Allamanda* and *Bougainvillea* exhibited different hues in acidic medium as well as in ethanol/water (Table 2), which is corroborated by increase in their wavelength of absorption to the red end of e.m.s (Fig. 1). Therefore, colour extracts from these two plants flowers may be used as indicator where a change in pH-equivalent is required such as in acid- base titration.

The spectra data of the flowers' pigments (Table 3) indicated a strong, broadband absorption patterns in the visible region (400-580 nm) of the electromagnetic spectrum. This range of absorption indicated that yellowish-green, yellow, red, purple, violet and blue are the commonly transmitted/observed colours of these flowers in their natural habitats. It further indicated that the pigments in these ornamental horticulture flowers contained conjugated double bond system as their colour imparting chromophores.

Table 3: Uv-visible absorption data for the extracted pigments from the horticulture flowers

Horticulture plants	Extracting solvents	Max. Absorption wavelength (λ_{max} nm)	Band width at Half-height (nm)	Complimentary colours associated with shape description
Allamanda	Ethanol	435	400-510	Orange
	Acetic acid	670	650-680	Bluish-green
Bauhinia	Ethanol	560	480-600	andRed-Blue
	Phenol	550	450-580	Red/Purple
Bougainvillea	Water	550	480-580	
	Phenol	540	480-580	Red/Purple
	Acetic acid	654	640-660	
Broom weed	Ethanol	460	400-480	Yellow
	Acetone	550	400-580	Orange
Crotalaira	Acetone	525	470-580	Red
	Phenol	518	425-580	
Gloriosa	Acetic acid	525	485-560	
	Lime water	435	420-480	Yellow/Red
	Phenol	670	650-680	
Hibiscus	Ethanol	520	420-580	Red-Purple
	Phenol	540	425-580	-do-
Pride of Barbados	Ethanol	440	420-480	Yellow
	Acetic acid	535	480-580	Red-purple
Sunflower	Ethanol	550	480-580	Yellow
	Acetone	420	400-480	Red-purple
Water leaf	Chloroform	440	400-485	Yellow
	Water	530	460-600	Red-Purple
	Phenol	550	480-580	-do-

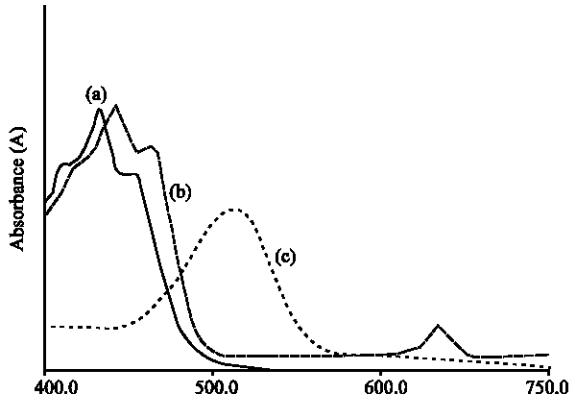

Fig. 1: Electronic obsorption spectra patterns of the ornamental horticulture flowers in various solvant, (a) Allamanda, Broom weed, Pride of Bardados (ethanol); water leaf (chloroform); Bushmorigold (diethyl ether); Gloriosa (lime water) and sunflower (acetone), (b) Allamanda, Bouhinia, Bouganvillea (acetic acid); Bushmarigold (diethy lether), Gloriosa (phenol) and pride of barbados (ethanol). (c) Bouhinia, Sunflower (ethanol); Bouganvillea (water and phenol); broom weed (acetone); crofalaria (acetone and phenol; Glorisa; pride of barbados acetic acid). Hibiscus (ethanol and phenol); Hibiscus sobdoriffa (water leaf (phenol)

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