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Short Communication
ISSN 2578-0271

Trends Textile Eng Fashion Technol

Extraction of Eco-Friendly Natural Dyes from *Tradescantia pallida Purpurea* and *Cynomorium coccineum* Growing Naturally in Tunisia

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Submission: November 03, 2017; **Published:** January 09, 2018

Abstract

Natural dyes are considered as promising choice to develop green textile dyeing process. In this framework, different parts of various plants constitute potential sources of natural dyes that are characterized by their easy availability and abundant nature. In this present work, *Tradescantia pallida purpurea* and *Cynomorium coccineum* are considered, for the first time, as sources of natural dyes for textile dyeing. Their prepared aqueous methanolic extracts were chemically characterized for Their Total Phenolic Contents (TPC), Total Flavanoid Contents (TFC) and for their ability to quench reactive species through the DPPH* radical scavenging activity. The results gleaned from the dosage experiments of TPC and TFC values are found, to be 52mg GAE/g extract and 4.05mg QE/g extract for the methanolic *Cynomorium coccineum* extract. However, in the case of *Tradescantia pallida purpurea*, the TPC and TFC values are equal to 33mg GAE/g extract and 4.88mg QE/g extract. These results demonstrate that the polyphenolic compounds are the most important functional components found in the studied plants. These aqueous extracts are, also, rich with flavonoids which are generally known for their coloring power when they are applied to textile materials. *Tradescantia pallida purpurea* gives a pH dependent color. It is red at pH3 and yellow at pH8. However, the resulted dye from *Cynomorium coccineum* is blue.

Keywords: *Tradescantia pallida purpurea; Cynomorium coccineum*; TPC; TFC; IC50

Introduction

The consumption of the natural products has improved due to the global development of maintaining good health and reducing the risk of disease [1-3]. In this setting, many plants were studied. As example, *Tradescantia pallida purpurea* has been shown to have spatial and seasonal bio monitoring characteristics for metal emissions from vehicle pollution [4]. The antho cyanins unpurified crude extracted from this plant was, also, investigated with regards to their preliminary spectroscopic and thermo-optical characterization [5]. Several species of the genus *Tradescantia* belonging to the *Commelinaceae* family are, additionally, used in ethnobotany and used as medicinal and ornamental purposes [6,7].

Another plant called *Cynomorium coccineum* L. is a non-photosynthetic plant, spread over the south of Spain to the southern Italian coast, Sardinia, Sicily, Malta and from the West African coast to North African coast (The Canary Islands to Tunisia) [8-10]. It belongs to the family of Balanophoraceae. It is a blackish red leafless root parasitic plant [11]. It is known as a traditional medicine. It is valorized as a tonic and aphrodisiac [12] and it is reported to enclose a hypo tensive effect [13]. Hence, the majority of the studies have focused on the biological properties and it has performed with aqueous and ethanol extracts [14-17]. In this framework, the works of Antonella Rosa et al. [18] dealt with the study of the composition and effect on intestinal Caco-2 cell viability and lipid profile of fixed oil obtained from dried stems of the plant and oil isolation has been performed by supercritical fractioned extraction with CO_2. However, to our knowledge, there is no data which was concentrated on the investigation of the extraction of dyes from *Tradescantia pallida purpurea* and *Cynomorium coccineum* fractions. Herein, for the first time, our study is carried out for the extraction of dyes from these plants. Their aqueous extract is characterized for their TFC, TPC values and the antioxidant activity.

Materials and Methods

Chemicals and materials

The fractions of *Tradescantia pallida purpurea* and *Cynomorium coccineum* (Figure 1) were collected from the region of Monastir Tunisia during 15 Mars-Avril. Chemicals such as Folin-Ciocalteu's reagent, gallic acid and 2, 2-diphenyl-1-picrylhydrazyl (DPPH) were purchased from Sigma-Aldrich. All other solvents and chemicals (Methanol, etc.) used in this study were of analytical grade [19].

Preparation of *Tradescantia pallida purpurea* and *Cynomorium coccineum* extracts

Fractions of *Tradescantia pallida purpurea* and *Cynomorium coccineum*, with weighted fresh mass, were extracted with absolute

methanol for a period of 72h at room temperature. After filtration, the fractions were evaporated using vacuum evaporator® apparatus (Figure 2a) and the extracted fraction were, diluted with distilled water and used for the dyeing experiments. *Tradescantia pallida purpurea* gives a pH dependent color. It is red at pH_3 and yellow at pH 8. However, the resulted dye from *Cynomorium coccineum* is blue (Figure 2).

Figure 1: Photos of *Tradescantia pallida purpurea* and *Cynomorium coccineum* grown throughout the region of Monastir, Tunisia.

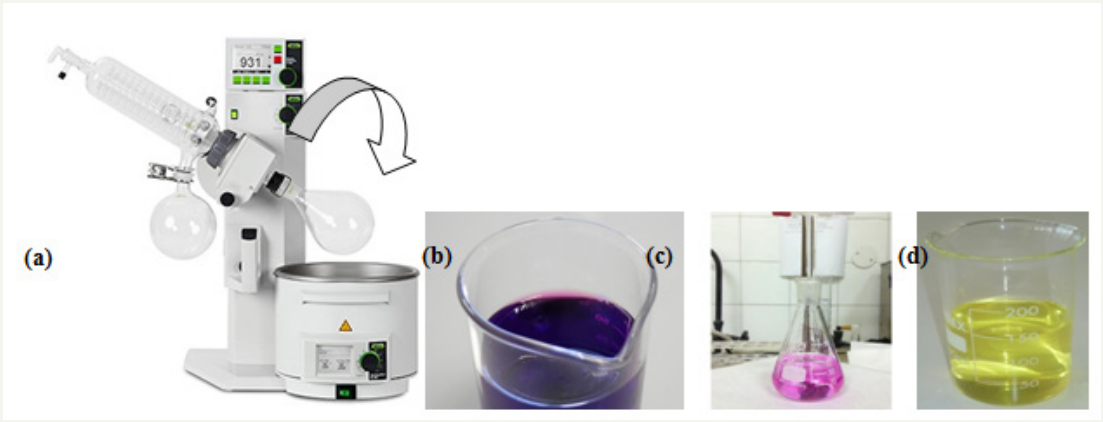

Figure 2: (a) Evaporator® apparatus, (b) dye extracted from *Cynomorium coccineum* fraction (c) dye extracted from *Tradescantia pallida purpurea* at pH=3 and (d) dye extracted from *Tradescantia pallida purpurea* at pH= 8.

The TFC value of *Tradescantia pallida purpurea* and *Cynomorium coccineum* methanolic extracts was determined based on the method of Sun et al. [20] with some modifications. Briefly, 20µL of the methanolic extract (1mg/m L) or quercetin (0.6-1mg/m L) was mixed with 30µL of $NaNO_2$ (5%). After 6min, 50µL of $AlCl_3$ (10%) was added and the resulting mixture was allowed to be kept for another 5min. To the above mixture, 100µL of NaOH (10%) was added and it has been incubated at room temperature for 15min. The absorbance was measured at 510nm and TFC value was expressed as Quercetin Equivalents (QE).

Free radical scavenging activity

The radical scavenging assay 1,1-diphenyl-2-picrylhydrazyl (DPPH) was carried out according to the method described by Yu et al. [21]. Briefly, a volume of 1mL of the as-prepared methanolic extract with different concentrations was mixed with 1mL of DPPH solution (0.1mM in ethanol). This mixture was incubated at room temperature for 30min, and the absorbance was measured at 517nm. The concentration required to scavenge 50% of DPPH* was determined based on the ascorbic acid calibration curve.

Results and Discussion

Dosage of TPC and TFC

Table 1: TPC, TFC, and IC50 determined for *Tradescantia pallida purpurea* and *Cynomorium coccineum* methanolic extracts.

Plants	TPC (Mg QE/G Extract)	TFC (Mg GAE/G Extract)	IC50
Tradescantia pallida purpurea	33	4.88	3.7
Cynomorium coccineum	52	4.05	7.5

The results of the dosage experiments of TPC and TFC values are 52mg GAE/g extract and 4.05mg QE/g extract for the *Methanolic cynomorium coccineum* extract (Table 1). However, in the case of *Tradescantia pallida purpurea*, the values are equal to 33mg GAE/g extract and 4.88mg QE/g extract. This table demonstrated that

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the poly phenolic compounds are the most important functional components found in the studied extracts. These aqueous extracts are, also, rich with flavonoids which are generally known for their coloring power when they are applied to textile materials [22].

DPPH radical scavenging assays

The ability of *Tradescantia pallida purpurea* and *Cynomorium coccineum* fractions to quench reactive species by hydrogen donation was measured through the DPPH* radical scavenging activity assay [21]. The evolution of DPPH scavenging activity (%) against the studied *Tradescantia pallida purpurea* and *Cynomorium coccineum* methanolic fractions extract concentration is depicted in Figure 3. IC50 values were deduced as 3.7mg/mL and 7.5mg/mL, respectively, for *Tradescantia pallida purpurea* and *Cynomorium coccineum*. These values are more important compared to Quercetin (0.064mg/m L). As, also, observed, the aqueous extract showed a concentration-dependent DPPH* radical scavenging activity.

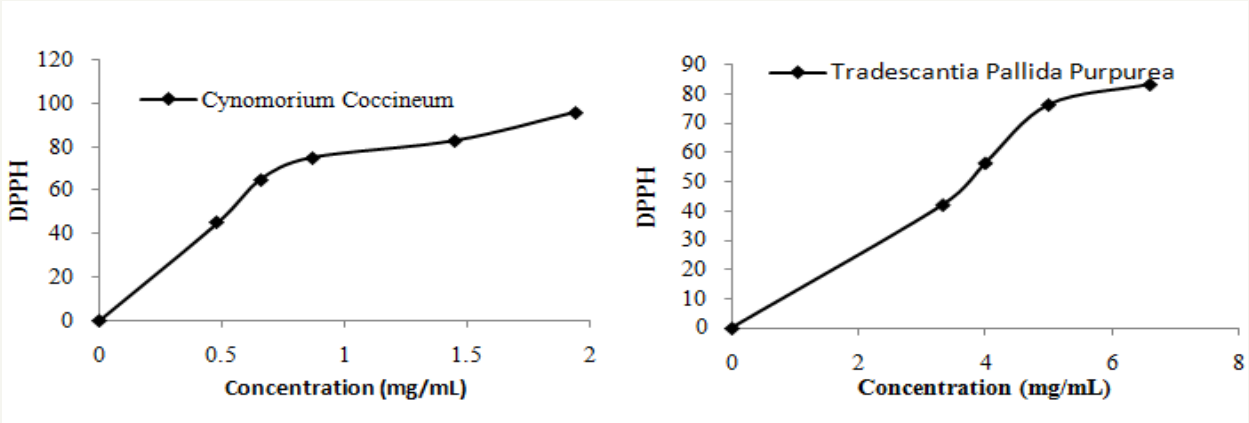

Figure 3: The ability of *Tradescantia pallida purpurea* and *Cynomorium coccineum* extracts to quench reactive species through the DPPH* radical scavenging activity assay.

Conclusion

To sum up, the methanolic extracts of *Tradescantia pallida purpurea* and *Cynomorium coccineum* were chemically characterized for their total phenolic contents, total flavanoid contents and for their ability to quench reactive species through the DPPH* radical scavenging. Data revealed that the dosage experiments of TPC values allows us to conclude that the polyphenolic compounds are the most important functional components found in the two studied plants. These aqueous extracts are, also, rich with flavonoids which are generally known for their coloring power for textile materials. Further works will be extended for the investigation of the full dyeing properties of the textile clothing using these studied methanolic extracts. The extraction process will also be optimized using various sorts of solvents.

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