

NATURAL DYES AND THEIR FT-IR SPECTROSCOPY STUDIES

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Abstract

The present study focuses on the extraction of Natural dyes from *Curcuma longa*, *Allium cepa*, *Optuntia ficus-indica*, *Beta vulgaris*, *Hibiscus*, *Lawsonia inermis* with improved properties for textile applications. The plant material was made in to the paste and was subjected to dryness to recover the dye in a pure powder form. The dyes were characterized by FT-IR spectroscopy.

Keywords: Natural dyes, FT-IR spectroscopy, *Curcuma longa*, *Allium cepa*, *Optuntia ficus-indica*, *Betavulgaris*, *Hibiscus*, *Lawsoniainermis*

I. INTRODUCTION

A dye is a colored substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution, and requires a mordant to improve the fastness of the dye on the fiber. Both dyes and pigments appear to be colored because they absorb some wavelengths of light more than others. In contrast with a dye, a pigment generally is insoluble, and has no affinity for the substrate.

An attempt has been made to extract some of the natural dyes from plants and study their spectral properties by FT-IR spectroscopy. The IR Spectra was recorded for all the samples, using Fourier Transform Infrared Spectroscopy (FTIR)-model No-4100 type A Serial No.C193061016. The FTIR Spectra have been recorded at the Chemistry Research Centre of PSN college of Engineering and Technology, Melathidiyoor, Tirunelveli, Tamil Nadu.

A. Description of the Plants studied

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae. It is native to tropical South Asia as it was first discovered and used in Ancient India. It needs temperatures between 20 °C and 30 °C and a considerable amount of annual rainfall to thrive. Its active ingredient is curcumin and it has a distinctly earthy, slightly bitter, slightly hot peppery flavour and a mustardy smell.

Onion (*Allium cepa*) is the most widely cultivated species of the genus *Allium*. The genus *Allium* also contains a number of other species variously referred to as onions and cultivated for food widely in Central Asia.

Optuntia, also known as no pales or paddle cactus (see below), is a genus in the cactus family, Cactaceae. Currently, only prickly pears are included in this genus of about 200 species distributed throughout most of the Americas.

The most commonly culinary species is the Indian *Optuntia* (*O. ficus-indica*). The beetroot (*Beta vulgaris*) is a plant in the Chenopodiaceae family which is now included in Amaranthaceae family. It is best known in its numerous cultivated varieties, the best known of which is the purple root vegetable known as the beetroot or garden beet.

Hibiscus is a genus of flowering plants in the mallow family, Malvaceae. It is quite large, containing several hundred species that are native to warm-temperate, subtropical and tropical regions throughout the world. Member species are often noted for their showy flowers and are commonly known as hibiscus, sorrel, and flor de Jamaica, or less widely known as rose mallow.

Henna (*Lawsonia inermis*), also called henna tree) is a flowering plant used since antiquity to dye skin, hair, fingernails, leather and wool. The name is also used for dye preparations derived from the plant, and for the art of temporary tattooing based on those dyes. Additionally,

the name is misused for other skin and hair dyes, such as black henna or neutral henna, which are not derived from the plant.

II. MATERIALS AND METHODS

The solvent used for the extraction of the dyes from the plants is Acetone. It was purchased from Loba chemie in pure form and used as such. The materials required for the extraction of the dyes were freshly collected from root of Turmeric and beetroot leaves of *Opuntia* and henna, skin of Onion, flower of Hibiscus.

A. Method of extraction

20g of the plant material (root/ flower/skin/leaves) was weighed in a 400ml beaker. It was meshed to fine paste. 30ml acetone and 20ml water were added and stirred continuously for 30 minutes.

The contents were centrifuged and the sediments were discarded. The solution containing the dye was evaporated over a water bath. The dried powder was dissolved in acetone, filtered and evaporated again to get the dye in pure form. The dyes were characterized by FT-IR spectroscopy.

B. Spectral Characterization

The seven dyes extracted and characterized by FT-IR spectroscopy. The IR Spectra was recorded for all the samples, using Fourier Transform Infrared Spectroscopy (FTIR)-model No-4100 type A Serial No.C193061016.

III. RESULTS AND DISCUSSION

The spectral characteristics of the dyes prepared from turmeric, Onion skin, *Opuntia*, hibiscus, beetroot and mehendi have been discussed in this section and are shown in Fig.1 to Fig.6 respectively. The spectral ranges obtained from FTIR have been used in identifying the components present in the dye extract. The dye present in turmeric is curcumin (Fig.1). The yellow dye in onion skin is made a of mixture of flavonoids: quercetin, Kempferol and quercetin-3-glucoside(Fig.2). *Opuntia* dye extract indicates structures of the flavanols, Kempferol and Catechin (Fig.3). Structures of the dye extracted from Hibiscus are Delphinidin 3-sambubioside (Fig.4). The dye

extracted from Beetroot is Betanin, a betacyanin (Fig.5). The dye extracted from Henna leaves (Mehnthi), contains 2-Hydroxy-1, 4-naphthoquinone (Fig.6).

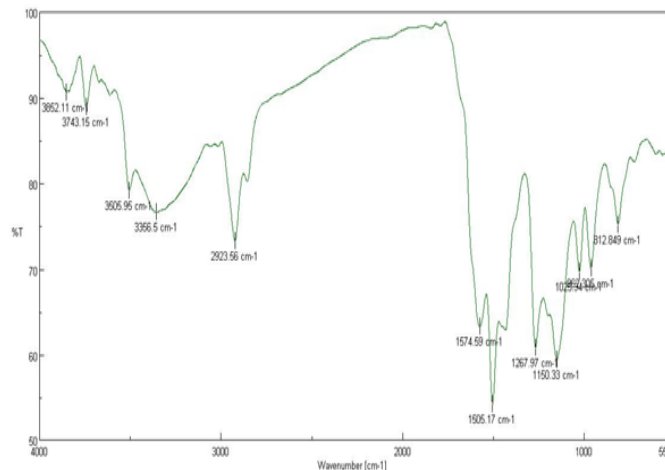


Fig.1. FTIR Spectrum of Turmeric dye

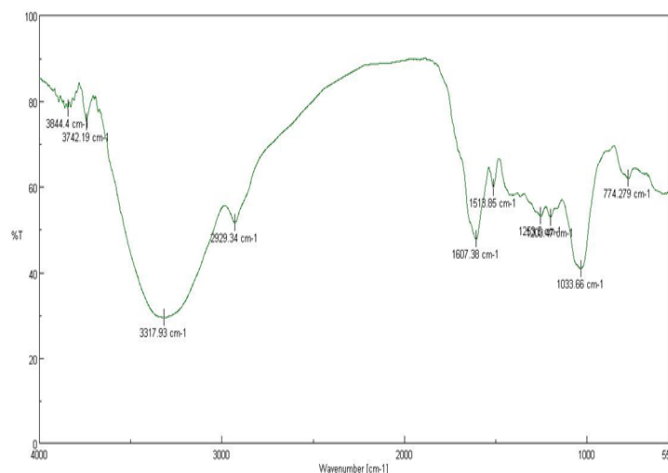


Fig. 2. FTIR Spectrum of onion skin dye

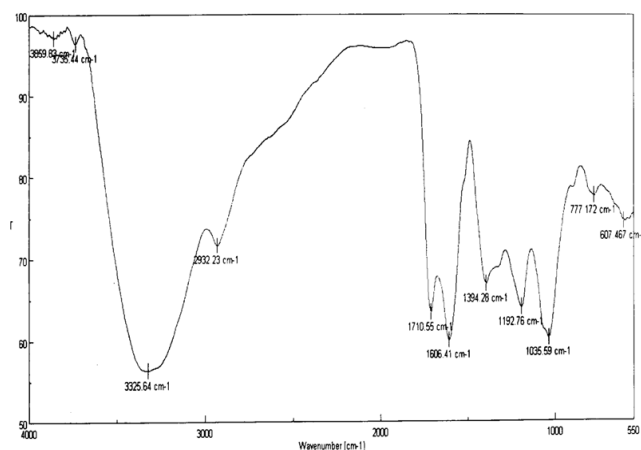


Fig. 3 . FTIR Spectrum of Optuntia dye

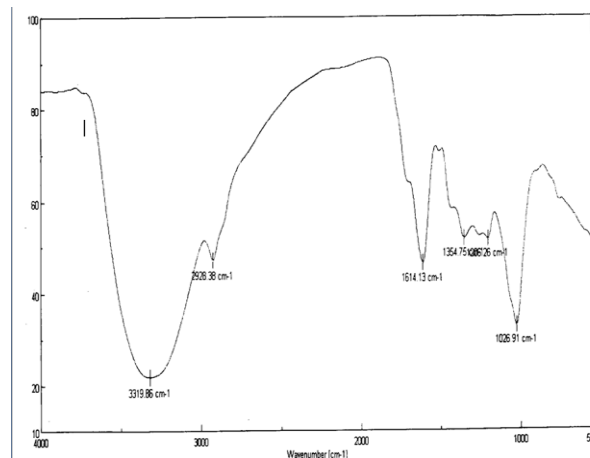


Fig .6. FTIR Spectrum of Mehanthi dye

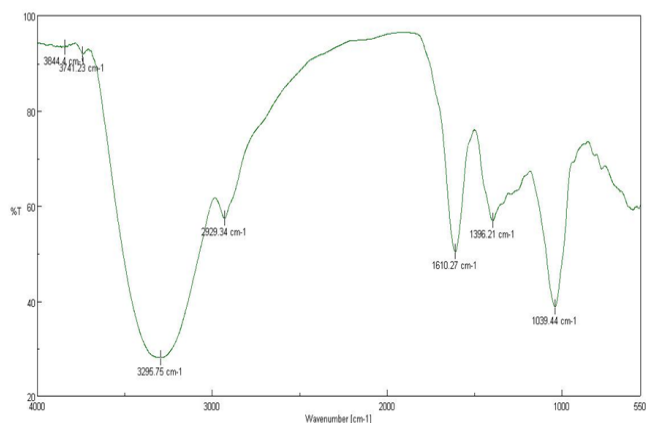


Fig. 4. FTIR Spectrum of Hibiscus dye

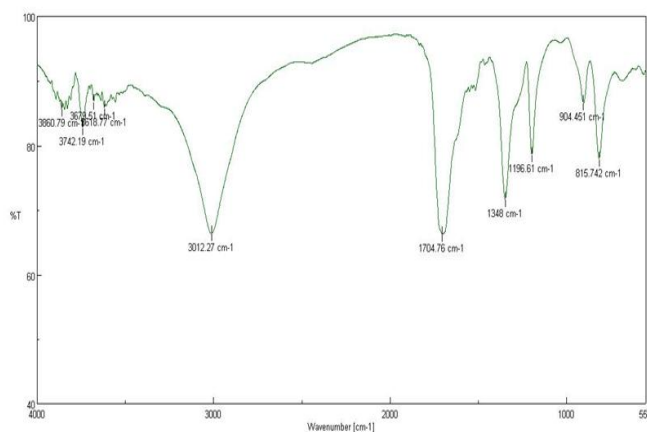


Fig. 5 FTIR Spectrum of Beetroot dye

IV. CONCLUSION

The different types of plants dyes are extracted and characterized by FT-IR Spectroscopy. The dye present in turmeric is curcumin. The yellow dye in onion skins is made of a mixture of flavonoids: quercetin, Kempferol and quercetin-3-glucoside. Optuntia structures of the flavanols, Kempferol and Catechin. Hibiscus is Delphinidin 3-sambubioside. The major component of the dye extracted from Teak bark is Bixin and Beetroot is Betanin, betacyanin. The dye extracted from Henna leaves (Mehnthi), contains 2-Hydroxy-1, 4-naphthoquinone.

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