STUDY ON THE UV-VIS SPECTROSCOPIC PROPERTIES OF SUDAN III AND SUDAN IV DYES IN DIFFERENT ORGANIC SOLVENTS

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ABSTRACT

Uv/vis spectroscopy is a simple, low cost technique that can be used to identify and quantify adultrants such as azo dyes in foods. In this study, the ultraviolet-visible absorption spectral properties of Sudan III and Sudan IV dyes in non-polar solvent hexane, moderately polar solvent acetonitrile, and highly polar solvent ethanol were investigated using UV-VIS spectrophotometry. The results showed that the absorption peaks of Sudan III dye in hexane, acetonitrile and ethanol were within wavelenth ranges of 254-362 nm, 264-364 nm and 258-348 nm respectively, while the absorption peaks of Sudan IV dye in hexane, acetonitrile and ethanol were within the wavelenth ranges of 256-345nm, 262-367nm and 275-369nm respectively, with the dyes absorbing maximally within the ultra violent region of the electromagnetic spectrum. This study will be very useful to the food scientists as it will assist in determining the appropriate wavelength for measuring/quantifying sudan lll and sudan IV dyes in food as the trend of azo dye adulteration of food such as palm oil is now rampant and has become one of the major challenges of food safety.

Keywords: Ultra violet-visible; spectroscopy; sudan dyes; palm oil; solvents; adulteration

INTRODUCTION

Synthetic organic dyes such as Sudan III and Sudan IV dyes are known to be one of the main compounds of study in much research [1]. This is because the dyes are used illegally as food coloring agents and has been reported to have high toxicity and adverse effects, including teratogenic, carcinogenic and mutagenic effects in animals. However, in industries, they are used for dyeing other synthetic products such as textiles, plastics, shoe leather, paper printing, non-linear optics, liquid crystal displays, floor polishes [2] and cosmetics. Sudan dyes are inexpensive and available, highly lipophilic, and has an attractive, intense red-orange color, and are used illegally as a food additive to improve the color of foods [3] [4]. Such foods include palm oil, spices, chili powders, tomato sauces, and some meat products. [5] [1] [6]. Most dyes are conjugated substances with alternating double and single bonds and typically absorb light in the visible spectrum. [7]. Spectrophotometry is widely used in the estimation and possible identification of food colourants in foods [8] [4]. In recent years, the high demand for palm oil for both domestic and industrial use has been backed up by an increase in adulteration in which Sudan

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III and Sudan IV stands out as the major adulterants [9] [10]. Much research has been devoted to the study of the photophysical properties of azo dyes in solvent environments, showing that the photophysical behavior of dissolved dyes depends on the molecular structure of the dye, the nature of the environment, and solvent-solute interactions [11]. Analytical applications have received much attention in studying the relationship between the structure, solubility, and spectroscopic properties of these dyes [12]. Spectroscopic characterization and quantification of azo dyes are important for practical, industrial and analytical applications. The polarity of the solvent used in the analysis has a significant impact on the spectrophotometric properties of these Sudan dyes [11]. Also the polarity index unit of hexane and ethanol was reported to be 0.1 and 5.2 respectively [13]. In this work, the uv-vis absorption spectral properties of Sudan III and Sudan IV dyes were studied in three different solvent media with different polarity. Since the polarity of solvents used affects spectrophotometric characterization of Sudan dyes, this will help guide scientists to know the wavelength these dyes exhibit maximum absorption when conducting spectrophotometric analysis.

MATERIALS AND METHODS

Sudan III and Sudan IV dyes were obtained from Pyrex-IG scientific company, Nigeria, and used without further purification as solutes. All of the solvents used in the study were of analytical grade.

UV-VIS Absorption spectroscopy

A double-beam VWR UV-630PC Double Beam Spectrophotometer was used to record the absorption spectra over a wavelength range between 190 and 1000 nm. Quartz rectangular cuvettes with a 1 cm path length were used for measurements in solution.

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RESULTS AND DISCUSSION

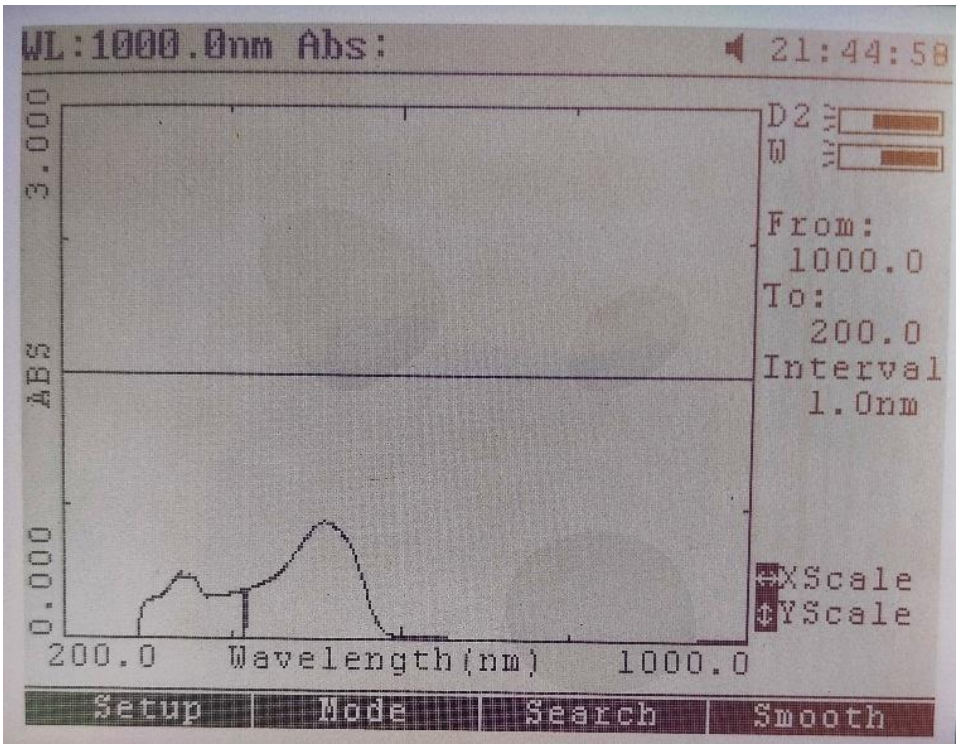

Figure 1: UV-VIS Scanning of Sudan-III Dye in Ethanol Showing the maximum absorption at 309 nm.

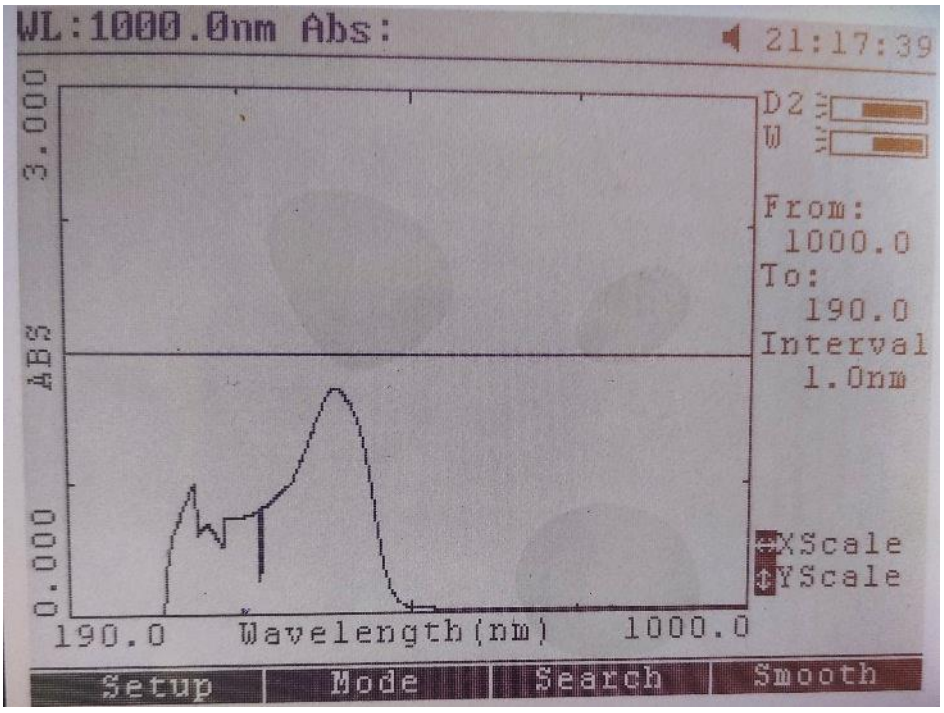

Figure 2: UV-VIS Scanning of Sudan-III Dye in Acetonitrile Showing the maximum absorption at 313 nm.

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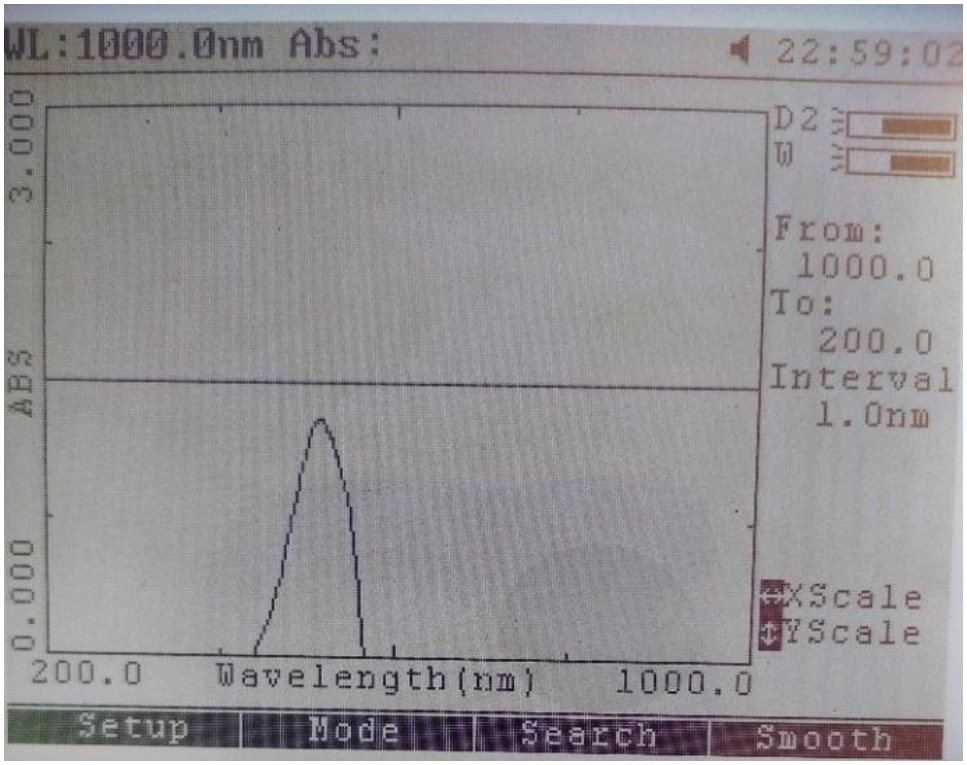

Figure 3: UV-VIS Scanning of Sudan-III Dye in hexane Showing the maximum absorption at 343 nm.

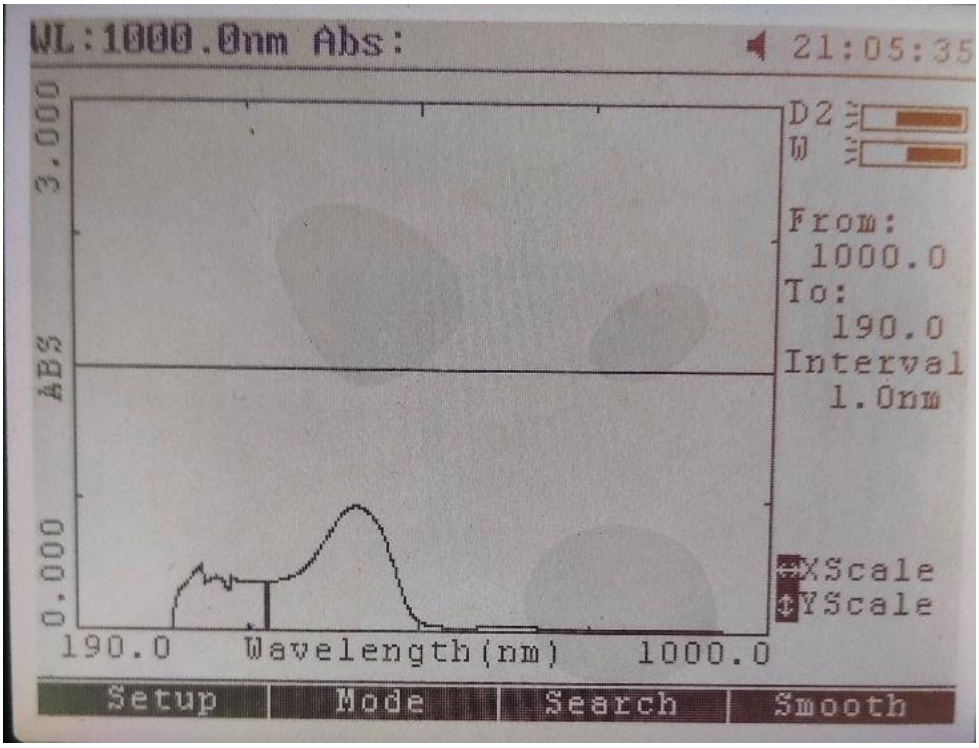

Figure 4: UV-VIS Scanning of Sudan-IV Dye in Ethanol Showing the maximum absorption at 324 nm.

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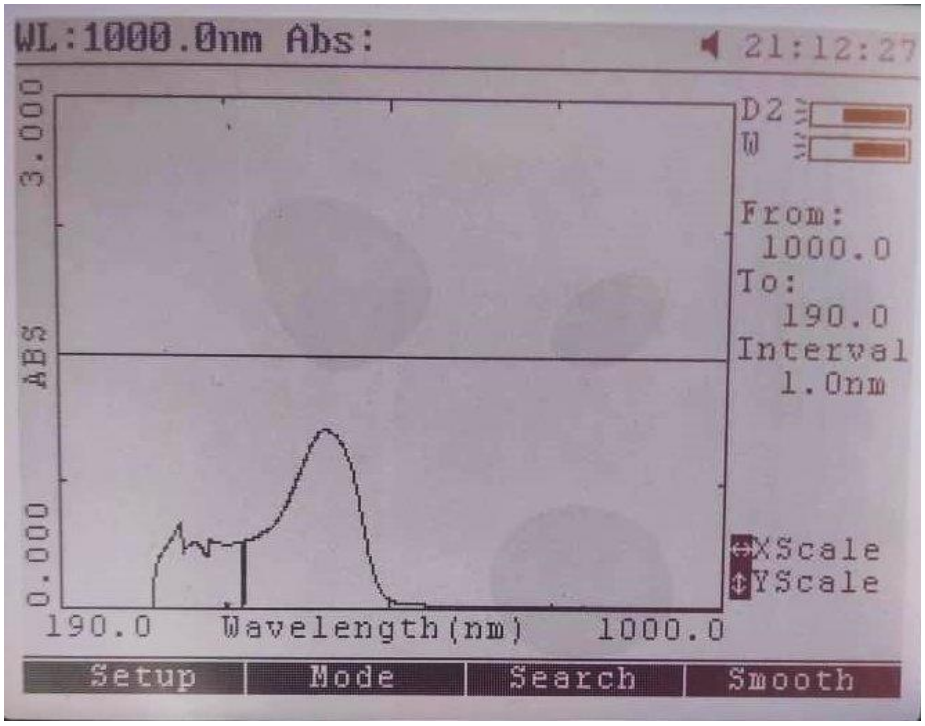

Figure 6. UV-VIS Scanning of Sudan-IV Dye in Acetonitrile Showing the maximum absorption at 322 nm.

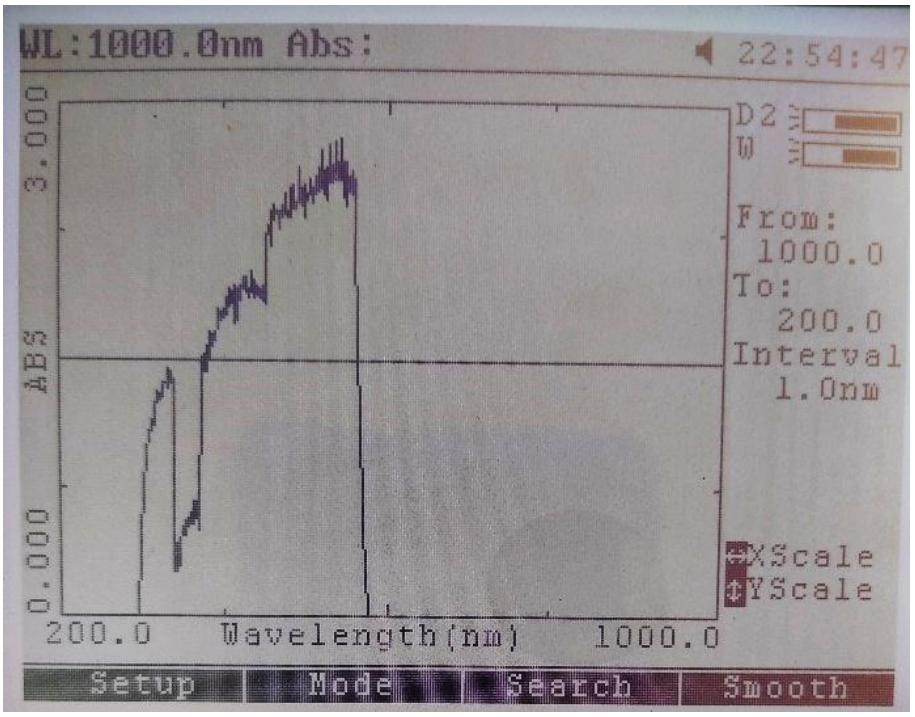

Figure 7. UV-VIS Scanning of Sudan-IV Dye in Hexane Showing the maximum absorption at 314 nm.

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Table 1: Spectral data showing wavelength of Maximum absorption of Sudan III and Sudan IV in different solvents

	Sudan III	**Sudan IV**
Solvents	λmax	Λmax
Ethanol	309	324
Acetonitrile	313	322
Hexane	343	314

The contribution of solvents to the spectral properties of Sudan III and Sudan IV dyes was studied. The data obtained indicates that the influence of the solvent on the absorption spectra of the studied Sudan dyes largely depends on the groups included in the dye structure and the nature of the solvent. The spectroscopic behavior of Sudan dyes in polar and non-polar solvents shows some variations. In polar solvents, Sudan III and IV dyes show lower absorption peak values than in non-polar solvents [11]. In table 1 above, the wavelengths of maximum absorption (λmax) for each of the Sudan dyes in the respective solvents are given, and were all within the ultra-violent region of the electromagnetic spectrum. These results corroborate earlier studies in which similar absorption pattern of Sudan lll dye in different solvents was reported [1]. This will assist food chemists and other researchers to select the appropriate wavelength when using a spectrometer for quantifying and identification of Sudan III and IV dyes in foodstuffs and beverages as the trend of azo dye adulterants in food is now rampant and has become a major concern of food safety. Although uv-vis spectroscopy can be employed as a simpler and less expensive technique for identification and quantification of Sudan dyes in palm oil which can be adopted in developing countries which do not have the necessary tools for this kind of study [4]. It is important to state that the drawback of this technique is that it is less sensitive when compared to sophisticated tools such as HPLC plus UV diode array detection (HPLC-DAD), two dimensional high-pressure liquid chromatography in conjunction with solid phase extraction (2D HPLC-SPE) and surface-enhanced Raman spectroscopy (SERS) usually used for identification and quantification [5] [12] [14]. These techniques offer higher level of precision as they can detect and quantify

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very minute levels of dye in food samples but are quite expensive and are not readily available here in Nigeria.

CONCLUSION

This study determined the wavelength of maximum absorption of Sudan III and IV dyes in different solvents. The result will assist food scientists and other researchers to sellect the appropriate wavelength when using a spectrometer for quantifying and identification of Sudan III and IV dyes in foods

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