Original article

Quantitative Optical Properties of *Acacia tortilis* var. *raddiana* Gum using Ultra Violet Visible "UV- VI" Spectrophotometer

Rawia Abd-alaziez[1], Aldesogi Omer hamed[2*], Mohammed Elmubark[3], Omaima Elrayah[2], Abdalsakhi, S .M.H[1], Abdel Karim Sabir Ali[1]

[1] Faculty of Science and Technology, AlNeelain University, Khartoum, Sudan.; [2] Faculty of Science, Kordofan University, AlObied, Sudan; [3] Faculty of Science, Sudan University of Science and Technology. Khartoum, Sudan

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Abstract

In this work, three samples of *Acacia tortilis var.raddiana* gum were collected from different locations in Sudan: (Wd-Mahala Forest) Khartoum, (SharqElneel) Khartoum and (Tayba forest) in Gezira State. UV-VS mini 1240 spectrophotometer was used to study the quantitative optical properties (absorbance, transmission, reflection and absorption coefficient). The samples were prepare in six different weight (0.3, 0.5, 0.7, 0.10, 0.15 and 0.20g) and dissolved in distil water; hence the absorption of *Acacia tortilis* var. *raddiana* gum was recorded. The result at wavelength (200 – 315) nm show that, the absorbance (2.427- 3.771) a.u, the absorption coefficient (5.568 –8.735) cm-1, the transmission (0.69 –0. 961) at wave length (318-500) nm, and reflection (0.17-0.204). These results indicate that, the (*Acacia tortilis* var. *raddiana*) gum is an excellent material can be used in different devices and manufacturing of goggles and filters as they prevent the transmission of UV and allows the passage of visible light.

* Corresponding author E- mail: dosogy2014@gmail.com

Introduction

The main gum Arabic producing regions of the Sudan, covers most of Kordofan and Darfur state and Part of other state (Khalil *et al.*, 2021). Gums are natural exudates from trunk, branches or fruit of trees due to scission, injury (whether incidental or deliberate) or fungal infection (Ahmed *et al.*, 2018). They are used in foods (Salve. *et al.* 2011 and FAO. 1996), pharmaceutical and many other industries (Elzain *et al.*, 2012).

Gum Arabic is a natural polymer, play an important role in our daily life. It is one of the major exported goods from Sudan more than 67% of world product is from Sudan (Khalil *et al.*, 2021). Gum Arabic is high molecular weight polymeric compounds, composed mainly of carbon core mixed in heterogeneous manner, including some metals in ionic forms (Ahmaed *et al.*, 2020).

Gum Arabic is a key ingredient in traditional lithography and is used in printing, paint production, glue, cosmetics and various industrial applications, including viscosity control in inks, although cheaper materials compete with it for many of these roles (Omer *et al.*, 2019).

Gum Arabic dissolves in water to form highly concentrated solutions of relatively low viscosity which is a consequence of gum's highly branched and very compact structure. Polymeric

materials have attracted the scientific and technological researchers, because of their wide applications (Khalil *et al.*, 2021). This is mainly due to the light weight, good mechanical strength and optical properties and makes them to be multifunctional materials (Hamed *et al.*, 2021). More ever; these polymers are traditionally considered as an excellent host material for composites. The study of characterization of polymer and physical properties are very important for using in different application (Abd-alaziez *et al.*, 2017 and Suwanboon *et al., 2010*). Optical properties characterize the response of material to incident electromagnetic radiation. For each material, the incident radiation is partially transmitted, reflected and absorbed. The optical properties in general depend on: Incident radiation, wavelength, the direction of incident and polarization. Material: the type of material, chemical composition, structure and temperature (Abd-alaziez *et al.*, 2017 and Chopro *et al.*, 1983).

Acacia tortilis or Spreading crown spreads in seasonally dry area of Africa and Middle East. *A. tortillis* (forssk) Hayane is one of about 135 African species. It includes four varieties: *A. tortilis* var. *spirocarpa*, *A. tortilis* var *hetracantha*, *A. tortilis* var *raddiana* , *A. tortilis* var. *tortilis* . *Acacia tortilis* var. *tortilis* often called the" umbrella thorn" for its distinctive crown. The known species of the Sudan is *Acacia raddiana* and the Arabic name of the tree is "sayyal". In Sudan it *grows* in fossil black clays and on rocky cliffs (Mohamed *et al.*, 2021)

Experimental:

Acacia tortilis var. *raddiana* gum samples were collected from three different locations from (Wd-Mahala Forest) Khartoum, (SharqElneel) Khartoum and (Tayba forest) in Gezira State with the assistance of the staff of Forests National Corporation (FNC) Sudan in 2019. Gum nodules were dried at room temperature cleaned by hand, ground using mortar and kept in labeled plastic containers for analysis. To prepare the samples for the optical study, three samples of (*A. tortilis* var. *raddiana*) gum were prepared with five different weights (0.03g, 0.07g, 0.10g, 0.15g, and 0.20g) dissolved in 5 ml of Distilled Water. The absorption of the samples with different concentration was recorded using UV min 1240 spectrometer SHIMADZU, in the range (190 – 1100) nm, then the optical properties calculated by using Origin lab 9.

Results and Discussion

Figures (1, 2 and 3), show the absorption as a function of wavelength for (*A. tortilis* var. *raddiana*) gum samples. The position of the maximum peak for Gum samples dissolved in distilled water was found to shift to a higher value with the increase of concentration at (200–315) nm wavelength, and the absorptions were found (2.835 –3.771) a.u for sample 1, (3.057 – 3.691)a.u for sample 2 and (2.427 – 3.451)a.u for sample3, by using this relation

$\alpha = \frac{2.303xA}{t}$ where (A) is the absorbance and (t) is the optical length in the samples.

It was notes that the highest value of absorption for the different (*A. tortilis* var. *raddiana*) gum samples was (3.771) a.u, while it was found in a previous study (3.899) a.u, (3.832) a.u and (3.637) a.u for *Acacia nilotica*, *Acacia Seyal* and *Acacia Senegal* respectively.

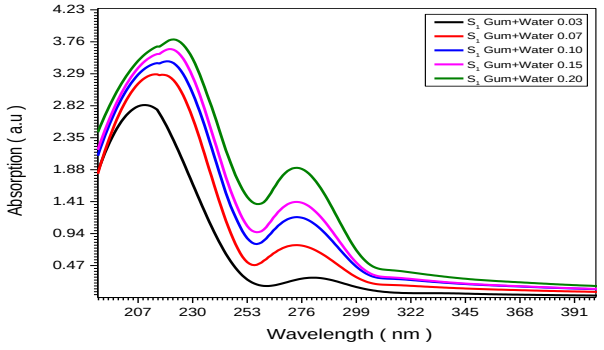

Figure (1) Relationship between the wavelength and the absorption for sample1

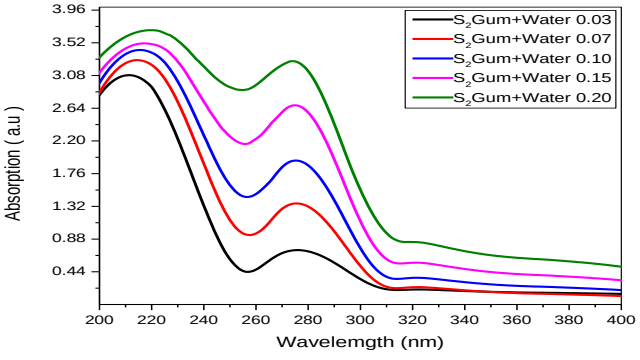

Figure (2) Relationship between the wavelength and the absorption for sample 2

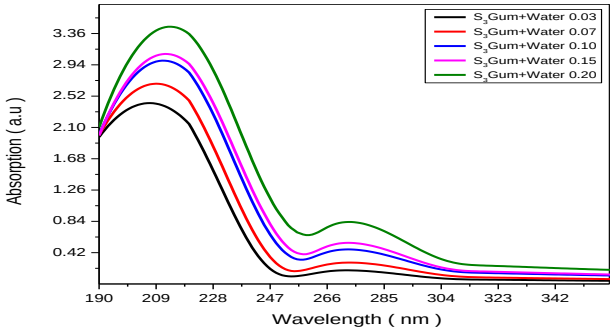

Figure (3) Relationship between the wavelength and the absorption for sample 3

Figures (4), (5) and (6) indicates the plot of the absorption coefficient with the wavelength for (*A. tortilis* var. *raddiana*) gum solutions, it was recorded that the absorption coefficient increased with increasing concentration of the samples, at (200 – 315) nm wavelength, the values are (6.526 – 8.735) cm^{-1} for sample 1, (7.091 – 8.473) cm^{-1} for sample 2 and (5.568 – 7.948) cm^{-1} for sample 3. By Referring to previous studies, it was found that the value of the absorption coefficient was (7.114) cm^{-1} for *Acacia nilotica*, (7.005) cm^{-1} for *Acacia Seyal* and (6.678) cm^{-1} for *Acacia Senegal.*

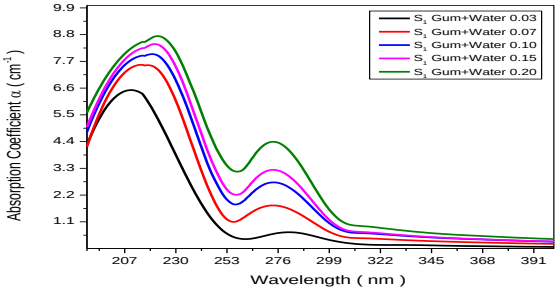

Figure (4) Relationship between the wavelength and the absorption coefficient for sample1

The relation between the wavelength and the transmission showed in figures (7), (8) and (9). The transmission was found depend on the absorption, and it's showing an opposite relationship where the higher the sample concentration, the less transmission, by using $T = 1/(10^{A})$

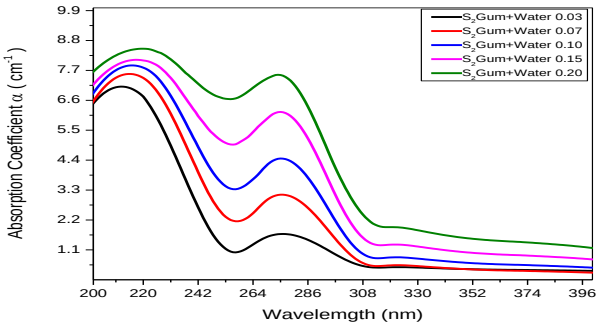

Figure (5) Relationship between the wavelength and the absorption coefficient for sample 2

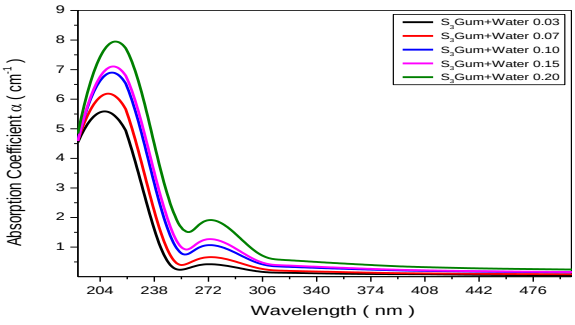

Figure (6) Relationship between the wavelength and the absorption coefficient for sample 3

The transmission has an effect on the wavelength range (318 – 500) nm and the maximum ratio ranging between (0.80 – 0.961) % for sample 1, (0.69 – 0.93) % for sample 2 and (0.79 – 0. 95) % for sample 3.

The present results are in agreement with the results obtained for two types of *A. senegal* and *A. seyal*.

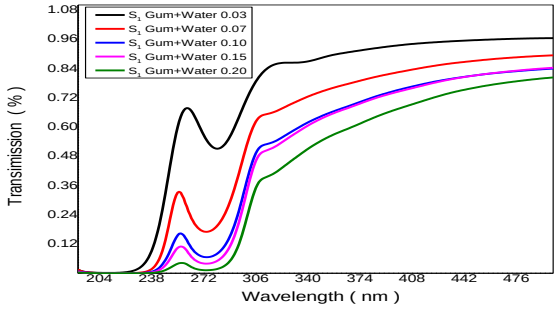

Figure (7) Relationship between the wavelength and the transmission for sample1

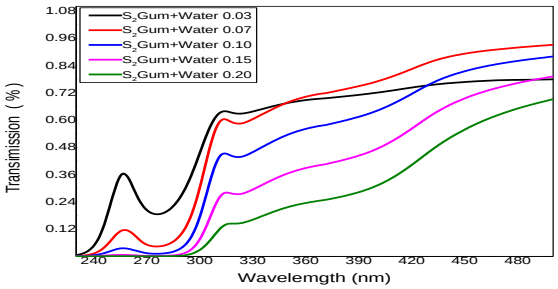

Figure (8) Relationship between the wavelength and the transmission for sample2

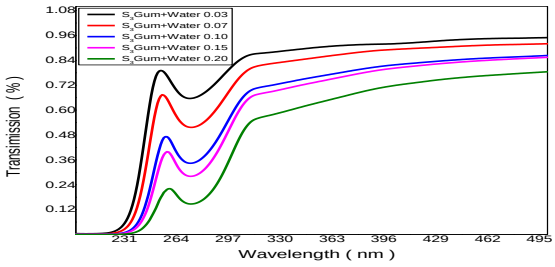

Figure (9) Relationship between the wavelength and the transmission for sample3

Figures (10), (11) and (12) show the reflection curves for (*A. tortilis* var. *raddiana*) gum solutions. It was noticed that the reflectivity increased to reach a certain peak then it decreases as a result of the increase in absorption. In the ultraviolet region, it can be noted that the samples had high reflectance in the wavelength range (240 – 400) nm, with the highest reflectance ratio of about (0.204) % at the wavelength of (325) nm, (380) nm and (303) nm for sample 1, 2 and 3, respectively.

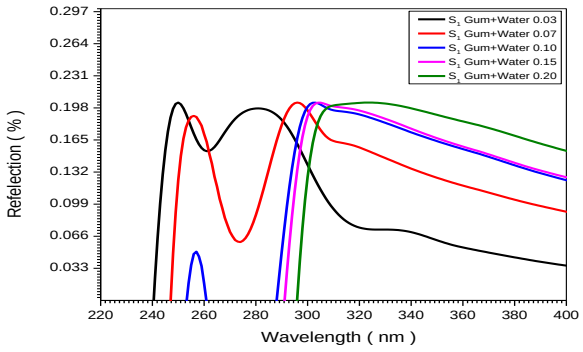

Figure (10) Relationship between the wavelength and the reflection for sample1

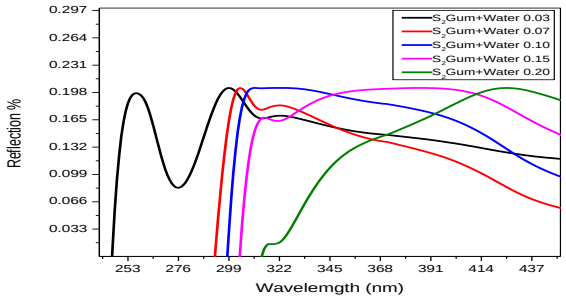

Figure (11) Relationship between the wavelength and the reflection for sample2

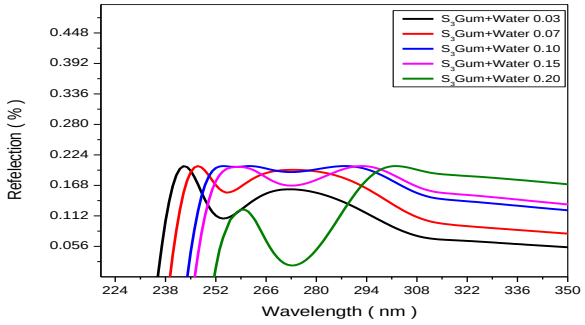

Figure (12) Relationship between the wavelength and the reflection for sample3

Conclusion

- The present results indicate that the *A. tortilis* gum has the highest absorbance in ultraviolet region, and the highest transmission in visible region of light.
- The *A. tortilis* gum has an excellent quantitative optical properties and can be used in different devices and manufacturing of goggles and filters.

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