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Influence of Rice Concentration on the Physical Properties of Gum Arabic/Rice Composite Material

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Abstract

In this work, Gum Arabic (GA)/ Rice composite materials were prepared using solid state reaction method. Four samples of GA with different concentrations of Rice, (0.0, 0.1, 0.2 and 0.3g) were considered. Fourier Transform Infra Red Spectroscopy (FTIR) and Ultraviolet-Visible spectroscopy (UV-visible spectroscopy) were used as analytical techniques. The optical properties of the prepared samples were determined including Energy gap and Absorption. The FTIR spectra of GA showed a broad and strong absorption band in the range 500-3500 cm–1, and these absorptions were assigned to the different stretching vibrations. The wavelengths of the samples were found to decreased when Rice concentration was increased and found in the range 221.2 and 225.4 nm, while the absorptions were found in the range 2.74-3.39 a. u. The energy band gab was calculated and was found to be in range 5.08 - 5.21 eV. The effect of doped with Rice was profound in the properties of GA as the absorption and energy band gap were found to increase with Rice concentration.

Keywords: *absorption, energy band gap, FTIR; Spectroscopy.*

1. Introduction

Gum Arabic is water soluble and slightly viscous. It is composed of, mainly polysaccharides, Arabinose, Rhamnose, and ironic acid. The molecular weight is expected to vary from about , and it varies according to the method of measurement. The shape of the molecule is believed to be of a short stiff spiral, or coil, with the length of the main molecule chain, varying between 1050 Å and 2400 Å depending on amount of charge of the molecule [1]. Gum Arabic as source of carbon and other elements [2,3] and it play a major role in preventing the occurrence of certain common disease such as colon cancer, Diabetes mellitus, coronary thrombosis, obesity, chronic renal failure [4,5].

Infrared is a common vibrational spectroscopy technique useful for determination of compounds functional groups. Compounds having covalent bond, whether organic or inorganic absorbs various frequencies of electromagnetic radiation in the infrared region of the electromagnetic spectrum. In terms of wave numbers, the vibrational infrared extends from about 4000 to 400 cm-1. In Infrared absorption process molecules are excited to a higher energy state when they absorb infrared radiation. Radiation in this energy range corresponds to the range encompassing the stretching and bending vibrational frequencies of the bonds in most covalent bonds [6-9]. The UV-visible spectrophotometer is often used in order to obtain the optical properties of material [10]. An experiment using an enrichment culture of pig bacteria showed that a Prevotella ruminicola-like bacterium was the predominant organism that was most likely to be responsible for the fermentation of gum Arabic to propionate was investigated by (Akio et al. and Badreldin et al. [4,11].

In this study, the aim was to study the effect of Rice concentration On the physical properties of Gum Arabic (GA). For this purpose, samples of Gum Arabic/Rice composite materials were prepared using solid state reaction method. The optical properties of the prepared samples were determined including Energy gap and Absorption. Fourier transformation infrared spectroscopy (FTIR) and Ultraviolet-Visible spectroscopy (UV-visible spectroscopy) were used as analytical techniques.

2. Material and Method

2.1 Sample preparation

Gum Arabic dried and Rice were obtained locally. All samples transfer to powder by a mortar one sample from Gum Arabic pure was taken and three samples from Gum Arabic (one gram constant for all samples) doped with Rice by different weight. Table 1 shows the composition of GA/Rice composite materials.

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2.2 Equipment's and measurements

FTIR measurements were performed using (Mattson, model 960m0016) spectra. In order to investigate samples on the FTIR device, the powder samples mixe in mortar with a little amount from potassium bromide (KBr).
The absorption of solution with different concentration was calculated using UV min 1240 spectrometer Shimadzy.

3. Results and Discussion

3.1 FTIR analysis

An infrared spectrum represents a fingerprint of a sample with absorption peaks which correspond to the frequencies of vibrations between the bonds of the atoms making up the material. Because each different material is a unique combination of atoms, no two compounds produce the exact same infrared spectrum. Therefore, infrared spectroscopy can result in a positive identification (qualitative analysis) of every different kind of material. In addition, the size of the peaks in the spectrum is a direct indication of the amount of material present [8-10].
The FTIR was performed in a powder sample and Figure 1 shows transmittance as a function of wave number for pure GA sample and doped samples. The results of composite materials samples are summarized in Table 1. Five peaks are observed for pure and doped samples as well and the dope with Rice is resulted in a small shift in the position of FTIR peaks. The spectra of GA composite materials showed a broad and strong absorption band in the range 662-734 cm–1 and were assigned to Bromoalkanes. The C-N stretching vibration is appeared at 1078 cm-1, while the C-C stretching vibration is appeared around 1412 cm-1 and 1412 cm-1 as well. The N-H bending vibrations are observed at 3378-3392 cm-1.

Table 1: summary of characteristic of GA/Rice composite materials

Peak No.	***Bon d***	***Type of bond***	***Absorption peak cm-1***	***Appearance***
1	C-X	Bromoalkanes	500–600 cm^{-1}	medium to strong
2	C-N	aliphatic amines	1020–1220 cm^{-1}	Often overlapped
3	C—C	aromatic C═C	1450 cm^{-1}	weak to strong
4	C—C	C═C (both sp^2)	1640–1680 cm^{-1}	medium
5	N—H	primary amines	3400–3500 cm^{-1}	Strong

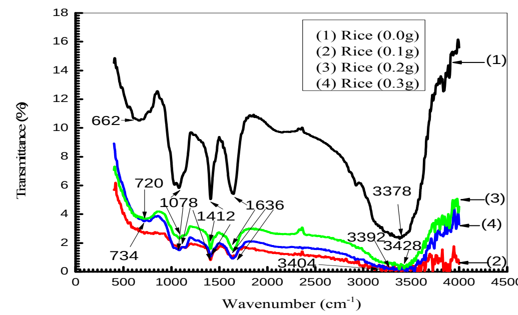

Fig. 1 the FTIR spectrum of GA Material composites doped with different concentration of Rice

3.2 UV Analysis

The absorption as a function of wavelength for GA/Rice composite materials are shown in figure 2. Figure 3 shows the absorption of the composite materials of GA/Rice and the absorptions were found to be in the range 2.74 and 3.39 a. u. it can be said that the absorption is increase as the with Rice concentration. The wave length was found to be in the range 221.2 and 225.4 nm (see Table1). Similar to absorption, the wavelength is increases with Rice concentration. The optical band gap energy of the materials is obtained using the following equation [12]

$$(\alpha h\nu) = A\left(h\nu - E_g\right)^m \quad (1)$$

In Eq. (1) Eg, the optical band gap whereas m represents the nature of the transition band gap, constant A is an energy-independent constant, (hν) is energy of photon. Assuming direct band gap transition for the samples, m was assigned a value of 1/2. To evaluate a precise value for the optical band gap, we plotted $(\alpha\ h\nu)^2$ versus energy (hν) for GA/Rice as shown in figure 4. The optical band gap was determined by extrapolating the linear portion of the plot to $(\alpha\ h\nu)^2 = 0$ and is found to be 5.08 eV, for the pure GA sample.

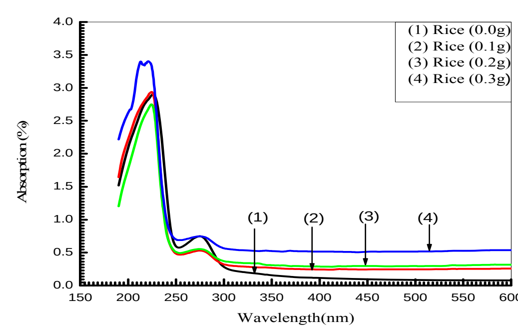

Fig. 1 Absorption as a function of wavelength for samples of GA with different concentration of Rice

4. Conclusions

Four samples of Gum Arabic (GA) doped with different concentration of Rice were successfully prepared using solid state reaction method. Fourier transforms infrared (FTIR) and Ultraviolet-visible spectrophotometer (UV-visible spectrophotometer) were used as analytical techniques. The FTIR spectra of GA showed a broad and strong absorption band in the range 500-3500 cm–1, and these absorptions were assigned to the different stretching vibrations. It was possible to deduce the effect of doped with Rice as the absorptions and energy band gab were found to increase with Rice concentration, while opposite behaviors was observed in the case of wavelengths.

Table 2: composition, Energy band gab, wavelength and absorption of Samples

Sample No.	*Gum Arabic (g)*	*Rice (g)*	*Eg (eV)*	**λ (nm)**	**Absorption (a.u)**
1	1	0	5.08	225.4	2.85
2	1	0.1	5.13	224.6	2.94
3	1	0.2	5.20	223.4	2.74
4	1	0.3	5.21	221.2	3.39

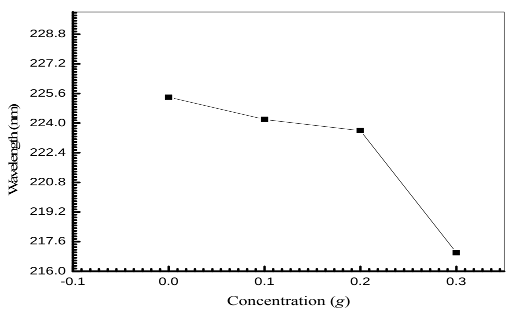

Fig. 3 Wavelength as a function of Rice concentration

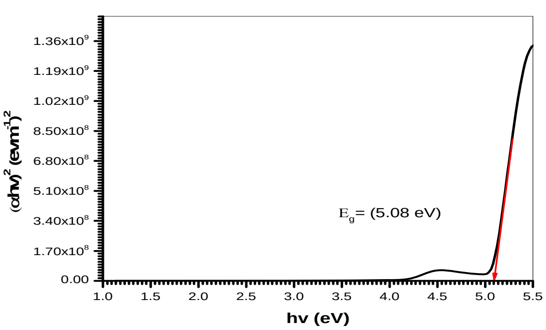

Fig. 4 Plot of $(\alpha h\nu)^2$ versus $h\nu$ for GA sample with 0.0 Rice concentration.

References

[1] Panda. H., The Complete Book on Gums and Stabilizers for Food Industry, New Delhi, Publisher: Asia Pacific Business Press Inc., 2010

[2] Henry, G. G. A Text Book of Materia Medica, Being an Account of the More Important Crude Drugs of Vegetable and Animal Origin, designed for students of pharmacy and medicine, London, Churchill 2009.

[3] Whistler, R. L., and Miller, J. N. Alkaline degradation of Polysaccharides, Adv. Carbhydr. Chem, Vol. 13, 1958, pp 289-329

[4] Akio Kishimoto, K. U, Phillips, G.O., Ogasawara, T, and Sasaki, Y. Identification of Intestinal Bacteria Responsible for Fermentation of Gum Arabic in Pig Model, Current Microbiology. Current Microbiology, Vol. 53, 2006, pp 173-177

[5] D.B. Yahaya and T.G. Ibrahim development of rice husk briquettes for use as fuel Research Journal in Engineering and Applied Sciences, Vol.1, No. 2, 2012, pp 130-133.

[6] Kavitha, V. T., Jose, R., Ramakrishna S., Wariar, P. R. S., Koshy, Combustion synthesis and characterization of Ba2NdSbO6 nanocrystals, J. Bullater Sci. Vol. 34, No. 4, 2011, pp 661-665.

[7] George Socrates, Infrared and Raman Characteristic Group Frequencies: Tables and Charts., Chichester, John Wiley & Sons. 2004

[8] Hoskins, C., Min, Y., Gueorguieva, M., McDougall, C., Volovick, A., Prentice, P., Wang, Z., Melzer, A., Cuschieri A., and Wang, L., Hybrid gold-iron oxide nanoparticles as a multifunctional platform for biomedical application, J. Nanobiotechnology., Vol. 10, 2012, pp 27-38

[9] Kazuo Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Applications in Coordination, Organometallic, and Bioinorganic Chemistry., John Wiley & Sons., New York, 2009

[10] Kim, H-S., Lee C-R., Im J-H, Lee, K-B., Moehl, T.,Marchioro, A., Moon, S.-J., Humphry-Baker, R.,Yum, J.-H., Moser,J. E., Gratzel, M., Park, N.-G, Vol. 2, Low-Temperature Solution-Processed Perovskite Solar Cells with High Efficiency and Flexibility, ACS Nano, Vol. 8, No. 2, 2014, pp 1674-80

[11] Badreldin, H. A., Ziada, A.; and Blunden, G. Biological effects of gum arabic: A review of some recent research. J. Food and Chemical Toxicology, Vol. 47, No. 1, 2009, pp 1-27.

[12] Lal Said Jan and Mohamed Ahmed Siddig, Synthesis, characterization and enhanced electrical properties of CTAB-directed polyaniline nanoparticles, Chinese Journal of Polymer Science, Vol. 29, 2011, pp 181-190.