Sudan University of Science and Technology
College of Graduate Studies

كلية الدراسات العليا

Preparation of an Emulsifier by Gum Arabic Solution and Black Cumin Seed Oil and Studying Its Optical Properties

تحضير مستحلب محلول الصمغ العربي وزيت الحبة السوداء ودراسة خصائصة الضوئية

Thesis submitted in partial for requirement of the

degree of master in physics

BY

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الايـــــة

بسم الله الرحمن الرحيم

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صدق الله العظيم

سورة الرحمن

Dedication

To my Father, who always support me in my life
My Mother, who always give me the trust in my self

My Brothers and Sisters, Who have provided me through moral and emotional support in my life

My friends

My teachers, who dedicate this work with love

Acknowledgement

Praise is to Allah, The Almighty, Who gave me healthy, strength, and patience to carry out this work and Faculty of Graduate Studies and Scientific Research

I express my deepest thanks to my supervisor

Dr: Rawia AbdElgani Elobaid Mohammed and deepest thanks and also to A. Abdelsakhy who helps me to experiment practical and provided the device I needed. Finally I thank all the members of staff in University

Abstract

The importance of this research comes from made a new material (Emulsion Definition) by used Gum Arabic and Black seed oil. The aim of this Research is Determine The optical properties of (Emulsion Definition) that made by used Gum Arabic Solution and black seed oil Such as (absorbance, transmission, reflection, absorption coefficient, extinction coefficient, refractive index and optical energy band gap) and to compare the result with pure gum Arabic solution result. In this research Four samples of (emulsifier) made by gum Arabic solution and black seed oil with different concentration (0.02, 0.03 ,0.04 and 0.05) mL was prepared and gum Arabic solution sample was reference .USB 2000 spectrometer was used to study optical properties (absorbance, transmission, reflection, absorption coefficient, excision coefficient and energy band gap).The absorption of all samples at wavelengths ranged (500- 800) nm, transmittance edge of all samples occurs at wavelength (675 nm) corresponding to photon energy (1.6 eV). The value of Energy band gap (Eg) was decreased from (1.775) eV to (1.668) eV, the decreasing of (Eg) Resulting from black seed oil molar increased on the samples. Which means that the addition of black seed oil improved the optical properties of the pure gum Arabic solution and thus expanded the fields of its use.

المستخلص

اهمية هذا البحث تاتي من صناعة مادة جديدة باستخدام الصمغ العربي و زيت الحبة السواء. هدف هذا البحث هو تحديد الخصائص الضوئيه للمستحلب المصنوع بواسطة محلول الصمغ العربي و زيت الحبة السوداء مثل الامتصاص والنفاذيه والانكسار ومعامل الامتصاص ومعامل التوهين ومعامل الانكسار و فجوة الطاقه و مقارنة هذه النتائج مع نتائج محلول الصمغ العربي النقي.

فى هذا البحث تم تحضير اربعه عينات من المستحلب المصنوع من محلول الصمغ العربي مع زيت الحبه السوداء بتراكيز مختلفة (0.05, 0.04,0.0,0.02) مل وتم استخدم محلول الصمغ العربي النقي كمرجع. تم استخدام مطياف USB2000 لدراسة الخصائص الضوئيه (الامتصاص والانتقال و الانعكاس و معامل الامتصاص ومعامل التوهين و فجوة الطاقه) وجد أن الامتصاص لكل العينات في المدى (500-800) نانوميتر كما وجد ان اكبر قيمه للانتقال يحدث عند طول موجى (675) نانوميتر ما يقابل طاقة فوتون(1.67) الكترون فولت وان فجوة الطاقة تتناقص (1.775)الي(1.668) الكترون فولت وهذا التناقص في فجوة الطاقة ناتج عن زيادة تركيز زيت الحبه السوداء في العينات.

مما يعني ان اضافة زيت الحبه السوداء ادي الي تحسين الخصائص الضوئيه لمحلول الصمغ العربي النقي و بالتالي توسيع مجالات استخدامه.

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CHAPTER ONE

INTRODUCTION

1.1 Preface

Gum Arabic, also known as gum sudani, acacia gum, Arabic gum, gum acacia, acacia, Senegal gum and Indian gum, and by other names,[1] is a natural gum consisting of the hardened sap of various species of the acacia tree. Gum Arabic is collected from acacia species, predominantly Acacia Senegal [2] and Vachellia (Acacia) seyal. The term "gum Arabic" does not indicate a particular botanical source. In a few cases so called "gum Arabic" may not even have been collected from Acacia species, but may originate from Combretum, Albizia or some other genus [1]. The gum is harvested commercially from wild trees, mostly in Sudan (80%) and throughout the Sahel, from Senegal to Somalia though it is historically cultivated in Arabia and West Asia. Gum Arabic is a complex mixture of glycoproteins and polysaccharides predominantly consisting of arabinose and galactose. It is soluble in water, edible, and used primarily in the food industry as a stabilizer. 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 and in textile industries, though less expensive materials compete with it for many of these roles. While gum Arabic is now produced throughout the African Sahel, it is still harvested and used in the Middle East.[3].

Gum Arabic's mixture of polysaccharides and glycoproteins gives it the properties of a glue and binder that is edible by humans. Other substances have replaced it where toxicity is not an issue, and as the proportions of the various chemicals in gum Arabic vary widely and make it unpredictable. Still, it remains an important ingredient in soft drink syrup and "hard" gummy candies such as gumdrops, marshmallows, and M& M'schocolate candies. For artists, it is the traditional binder in watercolor paint, in photography for gum printing, and it is used as a binder in pyrotechnic compositions. Pharmaceutical drugs and cosmetics also use the gum as a binder, emulsifying agent, and a suspending or viscosity increasing agent [4]. Wine makers have used gum Arabic as a wine fining agent [5].

It is an important ingredient in shoe polish, and can be used in making homemade incense cones. It is also used as a lickable adhesive, for example on postage stamps, envelopes, and cigarette papers. Lithographic printers employ it to keep the non-image areas of the plate receptive to water [6]. This treatment also helps to stop oxidation of aluminum printing plates in the interval between processing of the plate and its use on a printing press.

Black seeds are also known as black caraway and black cumin .They come from Nigella sativa, a small plant with pale purple, blue, or white flowers that grows in Eastern Europe, Western Asia, and the Middle East. People have used the tiny black seeds of the fruits of *N. sativa* as a natural remedy for thousands of years. The seeds can also flavor curries, pickles, and bread in a similar way to cumin or oregano.

Black seed oil contains thymoquinone, which is an antioxidant and anti-inflammatory compound that may also have tumor-reducing properties. People can ingest black seed oil in the form of capsules or apply it topically to benefit the skin. It is also possible to add the oil to massage oils, shampoos, homemade skin-care products, and fragrances. High-quality black seed oil is also suitable for use in cooking, baking, and beverages.

However, it is important to note that many studies to date have used cells or animals as models, and there is limited research available on the effects of black seed oil in humans.

1.2 Research Importance

The importance of this research comes from mead anew material (Emulsion Definition) by used Gum Arabic and Black seed oil.

1.3 Research Problem

- Apply one of the material sciences in laboratory.
- Verify the effect of black seed oil on Gum Arabic proposes
- Investigate the optical proposes of (Emulsion Definition) that made by used Gum Arabic and black seed oil.

1.4 Objectives

- Determine optical proposes of (Emulsion Definition) that made by used Gum Arabic and black seed oil like (absorbance, transmission, reflection, absorption coefficient, extinction coefficient, refractive index and optical energy band gap).
- To compare the result with the gum Arabic solution pure.

1.5 Previous Studies

At 2015 halima,s reporte show that the effect of concentrations gum on absorption and gap energy. The perparation of gum arabic by iodine of different concentrations at room tempreature and investigated the effect of vaccination of iodine on the distance between atoms and the angles between them using easy scan device. And determination the absorption and energy gap of the samples using(uv-vis).this reporte show that increased the absorbance value when gum molar increase and decreases the energy gab value when gum molar increas[8].

Boshra Varastegani and et al, July 2018, Production of instant Nigella sativa L. beverage powder by drum drying using Arabic gum as adjunct, this study determined the feasibility of drum drying process in producing drum dried Nigella sativa L. beverage powder using the response surface methodology to determine the effect and relationship between percentage of Arabic gum and drying temperature on the quality of the Nigella sativa powder produced. About 32.7 % of Arabic gum and 119.1°C of drying temperature were the optimum parameters for the production of Nigella sativa powder. Antioxidants and calcium content of Nigella sativa powder decreased significantly, while the iron, manganese, and sodium contents increased significantly after the drum drying process [9].

Abdalsakhi .S .M.H, *(Jan. - Feb. 2016),* Using Gum Arabic in Making Solar Cells by Thin Films Instead Of Polymers, This paper studied Gum Arabic based solar cells with Rhodamine 6G were fabricated on indium tin oxide by a spin coater position. Microstructure and cell performance of the solar cells with ITO/ Rhodamine 6G/ Gum Arabic structures were investigated. Photovoltaic devices based on the Rhodamine 6G / Gum Arabic hetrojunction structures provided photovoltaic properties under illumination. Absorption and energy gap measurement of the Rhodamine 6G / Gum Arabic hetrojunction were studied by using UV-VS mini 1240 spectrophotometer and light current-voltage characteristics. The energy levels of the present solar cells were also discussed. The three ITO/Gum/Rhodamine/Au solar cells were produced and characterized, which provided efficiency (η) is (3.8 - 5.1 and 5.2) %. Fill factor (FF) is (0.964 - 0.9462 and 0.973), current density (Jsc) is (2.22 - 4.31 and 4.4) mAcm-2 and Open – circuit voltage (Voc) is (1.22 -1.25 and 1.209) V. This could be used at larger scale in promoting efficiency of solar cells [10].

1.6 Thesis Layout

The thesis consists of the five chapters. Chapter one is the Introduction and Chapter two is the theoretical background. Chapter three consists of method, materials, Chapter four Results and Analysis. Chapter five is concerned with Conclusion and Recommendations.

CHAPTER TOW

THEORETICAL BACKGROUND

2.1 Introduction

Gum Arabic (GA) or Acacia gum is an edible biopolymer obtained as exudates of mature trees of Acacia Senegal and Acacia seyal which grow principally in the African region of Sahe in Sudan. The exudates is a non-viscous liquid, rich in soluble fibers, and its emanation from the stems and branches usually occurs under stress conditions such as drought, poor soil Fertility, and injury.

The use of GA dates back to the second millennium BC when the Egyptians used it as an adhesive and ink. Throughout the time, GA found its way to Europe and it started to be called "gum arabic" because was exported from Arabian ports.

Chemically, GA is a complex mixture of macromolecules of different size and composition (mainly carbohydrates and proteins). Today, the properties and features of GA have been widely explored and developed and it is being used in a wide range of industrial sectors such as textiles, ceramics, lithography, cosmetics and pharmaceuticals, encapsulation, food, etc. Regarding food industry, it is used as a stabilizer, a thickener and/or an emulsifier agent (e.g., soft drink syrup, gummy candies and creams).

In the pharmaceutical industry, GA is used in pharmaceutical preparations and as a carrier of drugs since it is considered a physiologically harmless substance. Additionally, recent studies have highlighted GA antioxidant properties. It is role in the metabolism of lipids. It is positive results when being used in treatments for several degenerative diseases such as kidney failure, cardiovascular and gastrointestinal .

Therefore, there is substantial evidence that GA can play a positive health-related role in addition to its well-known properties as an emulsifier [11].

2.2 Gum Arabic Sources and Processing

Acacia senegal and Acacia seyal trees are the main sources of GA. These species grow naturally in the semi-arid sub-Saharan regions of Africa. . Sudan has traditionally been the main GA producer and its derivatives until the early 60s with a production of 60 kTn/year. Nevertheless, such a production decreased from 60 kTn/year to 20 kTn/year in the '70s and '80s due to extensive drought and unstable governments. These facts prompted new GA-producing countries such as Chad and Nigeria which produce mainly Acacia seyal . Europe and U.S. are the most important GA markets importing 40 kTn/year, on average, while Japan, the largest Asian consumer, imports about 2 kTn/year.

The crude exudate of GA is processed differently according to the quality finally required for it to be marketed. Air drying is the easiest method to be applied which, together with mechanical milling (kibbling), are used in order to produce a granular material that is much more soluble than the raw product. Other processing methods are spray drying and roller drying. These methods involve dissolving exudate in water under controlled heating conditions and constant stirring. Heating must be mild to avoid distortion of the gum which could have a detrimental effect on its functional properties. After removing the insoluble material by decantation or filtration, the solution is pasteurized and subjected to spray or roller drying. Spray drying involves spraying the solution into a stream of hot air. The water Completely evaporates and the dry powder is separated from air by a cyclone, resulting in 50 to 100 particles. During the roller-drying, the solution is passed to the hot rollers and the water is evaporated by the air flow. The thickness of the resulting GA film is controlled by adjusting the distance between the rollers. The film is separated from the roll by scraping blades giving way to particle scales of several hundred m^3 in size. GA samples produced by spray drying and drying rollers have an advantage over raw gum as they are virtually free of microbial contamination and dissolve much faster [11].

2.3 Chemical composition and structure

In recent years, several investigations have been conducted in order to reveal the molecular structure of GA and relate it to its exceptional emulsifying and rheological properties. The chemical composition of GA is complex and consists of a group of macromolecules characterized by a high proportion of carbohydrates (97%), which are predominantly composed of D-galactose and L-arabinose units and a low proportion of proteins (<3%). The chemical composition of GA may vary slightly depending on its origin, climate, harvest season, tree age and processing conditions, such as spray dying . Therefore,
there are some differences between the chemical composition of the GA taken from Acacia senegal and Acacia seyal. In fact, both gums have the same sugar residues but Acacia seyal gum has a lower content of rhamnose and glucuronic acid and a higher content of arabinose than Acacia senegal gum. Instead, Acacia seyal gum contains a lower proportion of nitrogen, and specific rotations are also completely different [11].

2.4 Physicochemical properties

The GA is a heterogeneous material having both hydrophilic and hydrophobi affinities. GA physicochemical responses can be handled depending on the balance of hydrophilic and hydrophobic interactions. GA functional properties are closely related to its structure, which determines, for example, solubility, viscosity, degree of interaction with water and oil in an emulsion, microencapsulation ability, among others [11].

2.5 Solubility and viscosity

GA has high water solubility and a relatively low viscosity compared with other gums. Most gums cannot dissolve in water in concentrations above 5% due to their high viscosity. Instead, GA can get dissolved in water in a concentration of 50% w/v. The highly branched structure of the GA molecules leads to compact relatively small hydrodynamic volume and, consequently GA will only become a viscous solution at high concentrations. Solutions containing less than 10% of GA have a low viscosity and respond to Newtonian behavior.

However, steric interactions of the hydrated molecules increase viscosity in those solutions containing more than 30% of GA resulting in an increasingly pseudoplastic behavior. Its high stability in acidic solutions is exploited to emulsify citrus oils. The viscosity of GA solutions can be modified by the addition of acids or bases as these ones change the electrostatic charge on the macromolecule. In very acidic solutions, acid groups neutralize so inducing a more compact conformation of the polymer which leads to a decreased viscosity; In very basic solutions, the ionic strength increment reduces the electrostatic repulsion between GA molecules producing a more compact conformation of the biopolymer and thus reducing the viscosity of the solution [11].

2.6 Definition Azadirachta Indica Gum

Azadirachta indica gum, which belongs to the Family of galactan gums, it is a very complex condensate of hetero polysaccharides and proteins. The Proteins are tightly linked to the polysaccharides, which constitute the major component. Drastic degradation of a smaller gum complex component shows that it contains D-glucose, D-glucuronic acid, L-arabinose, L-fucose, mannose and xylose. Investigation of the amino acid composition of the gum shows a aspartic acid as the most abundant . Neem gum has unusual structural features in that it contains appreciable amount of D-glucosamine and proteins unlike other plant gums .Azadirachta indica (Neem) gum occupies a special position among plant gums in that, it contains about one-third of its weight as proteins [12].

2.6.1 Description

Gum is a byproduct obtained as a result of certain metabolic mechanism of plants and trees. Neem Gum is a natural exudate from Neem Tree by induced or natural injury. TheNeembark, due to some internal activity discharges clear, bright and brown-coloured gum material nonbitter in taste and is soluble in cold water. The gum is a multipurpose by product. Natural gums obtained from plants are either water soluble or absorb water to form viscous solutions. Neem has been commercially tapped for using its gum which is of use in large number of industries. It is being grown on a large scale basis for using all its parts, no wonder it is called aUniversal Tree' having a cure for almost everything. It has been used, traditionally, as an adhesive for paintings. It is used as a bulking agent and for the preparation of special purpose food (those for diabetics) [12].

2.6.2Applications of Neem Gum

Cosmetic Industry:Used in facial masks, lotions, face powder, protective creams. Paper Industry: Used as an adhesive and strengthening the paper. Pharmaceutical Industry: Used in antiseptic creams, tablet binder, and coater. Textile Industry: Used in dyeing and printing of fabrics.Personal Hygiene Industry: Used in soaps, tooth paste, tooth powders. Food Industry: Used as a stabilizing agent, gels and thickening agent.Bakery: Azadirachta indica gum used in the baking industry for its low water absorption properties, its cold water soluble and has adhesive properties.Physiochemical Properties f Gums Azadirachta indica gums are important in specification, characterization The physiochemical properties of and quality indication of the gum, and also assist to differentiate between different Neem gums. These properties vary with gums of different botanical sources, and even substantial differences in gum from the same species when collected from the plant at different season of the year, different places and different ages of the same plant [12].

2.6.3 Ash Content

In analytical chemistry, ashing is the process of mineralization for pre concentration of trace substances prior to chemical analysis. The residues after a sample is completely burnt - in contrast to the ashes remaining after incomplete combustion - consist mostly of metal oxides. Ash is one of the components in the proximate analysis of biological materials, consisting mainly of salty, inorganic constituents. Ash content is the measure of inorganic residue remaining after removal of organic matter; it is generally affected by the type of soil[12].

2.7 Black Seed Oil

Black is the new green. Enerex Black Seed Oil is quickly becoming the herbal oil to watch as it is discovered by health enthusiasts, and joins top therapeutic oils like Oregano for its powerful immune-boosting properties. Used by ancient Egyptians yet also well-researched by modern medical science, Black Seed Oil is an antioxidant, antibacterial and antiviral. It has six patents registered for everything from diabetes and asthma to cancer treatment Black Seed Oil has also been used to: Help relieve bronchitis , Remedy colic in babies , Reduce diarrhea, indigestion and heartburn , Relieve headaches and migraines , Calm insomnia , Help decrease cholesterol and increase the elasticity of blood vessel walls to increase cardiovascular health , Reduce depression or lethargy , Reduce signs of eczema , Ease joint pain and sore muscles (acting as an analgesic) , Substitute for anti-inflammatory medication , Help remedy gallstones and kidney stones and Help prevent poliosis (early graying) . Enerex's Black Seed Oil is actually quite pleasing in taste and has a light nutty flavour. The oil rather than the whole seeds is the most effective form to consume Black Seed because it is more concentrated, and it is more easily absorbed by the body therefore the therapeutic effects are increased . Take it on an empty stomach/before meals and bedtime once per day for a health maintenance dose. Black Seeds can have sedative effects for some, so if this is the case, it may be best taken in the evening. You can also add a few drops to your face and body cream for soft skin and therapy for skin disorders [13].

2.8 Emulsion Definition

An emulsion is a colloid of two or more immiscible liquids where one liquid contains a dispersion of the other liquid In other words an emulsion is a special type of mixture made by combining . Two liquids that normally don’t mix the word emulsion comes from the latin word meaning "to milk"(milk is one example of an emulsion of fat and water). The process of turning a liquid mixture into an emulsion is called emulsification.Example of Emulsion . Oil and water mixtures are emulsion when shaken together the oil will Form drops and disperse throughout the water. Egg yolk is an emulsion containing the emulsifying agent lecithin. Butter is an emulsion of water in fat. Properties of Emulsions Emulsion usually appear cloudy or white because light is scattered off the phase interphase between the components in the mixture if all of the light is scattered equally, the emulsion will appear white Dilute emulsion may appear slightly blue because low wavelength light is scattered more this is called the Tyndall effect its commonly seen in skim milk if the particle size of the droplets is less than 100 nm (a microemulsion or nanoemulsion) , its possible for the mixture to be translucent. Because emulsions are liquids,they don’t have a static internal structure.Droplets are distributed more or less evenly throughout a liquid matrix called the dispersion medium tow liquids can form different types of emulsions for example, oil and water can form an oil in water emulsion where the oil droplets are dispersed in water, or they can form a water in oil emulsion, with water dispersed in oil Further, they can form multiple emulsions, such as water in oil in water. Most emulsions are unstable, with components that won't mix on their own or remain suspended indefinitely [14].

2.9 Optical Properties

2.9. 1 Absorption

The intensity of the net absorbed radiation is dependent on the character of the medium as well as the path length within. The intensity of transmitted or non-absorbed radiation continuously decreases with distance x that the light traverses:

$$I_T = I_o e^{-\beta x} \tag{2.1}$$

Where, I_T is the intensity of the non-reflected incident radiation, I_0 is incident beam and ß the absorption Coefficient (in mm-1), is characteristic of the particular material; furthermore, varies with wavelength of the incident radiation. The distance parameter x is measured from the incident surface into the material. Materials that have large values are considered highly absorptive.

2.9.2 Transmission

The phenomena of absorption, reflection, and transmission may be applied to the passage of light through a transparent solid. For an incident beam of intensity I0 that impinges on the front surface of a specimen of thickness l and absorption coefficient, the transmitted intensity at the back face IT is

$$I_T = I_o(\,1 - R)^2 e^{-\beta l} \tag{2.2}$$

Where R is the reflectance; for this expression, it is assumed that the same medium exists outside both front and back faces. Thus, the fraction of incident light that is transmitted through a transparent material depends on the losses that are incurred by absorption and reflection. Again, the sum of the reflectivity R, absorptivity A, and transmissivity T, is unity according to Equation (2). Also, each of the variables R, A, and T depends on light wavelength. This is demonstrated the transmission [15].

2.9.3 Absorption coefficients

Much of the information about the properties of materials is obtained when they interact with electromagnetic radiation. When a beam of light (photons) is incident on a material, the intensity is expressed by the Lambert-Beer-Bouguer law:

$$I = I_o \exp(-\alpha d) \qquad (2.3)$$

If this condition for absorption is met, it appears that the optical intensity of the light wave, (I), is exponentially reduced while traveling through the film. If the power that is coupled into the film is denoted by I0, gives the transmitted intensity that leaves the film of thickness d. (α) is called "absorption coefficient". From (2.1) it follows that

$$\alpha = -\frac{1}{d}\ \mathrm{Lin}(\frac{I}{I_o}) \qquad (2.4)$$

In the region of weak absorption α is small and the transmission begins to decrease. In the medium absorption region α is large and the transmission decreases mainly due to the effect of α. In the region of strong absorption the transmission decreases drastically due almost exclusively to the influence of α. If the thickness d is uniform, interference effects give rise to the spectrum.

2.9.4 Reflection

When light radiation passes from one medium into another having a different index of refraction, some of the light is scattered at the interface between the two media even if both are transparent. The reflectivity R represents the fraction of the incident light that is reflected at the interface, or

$$R = \frac{I_R}{I_o} \qquad (2.5)$$

Where I_0 and IR are the intensities of the incident and reflected beams, respectively, if the light is normal (or perpendicular) to the interface, then

$$R = \left(\frac{n_2 - n_1}{n_{2+}n_1}\right)^2 \tag{2.6}$$

[15]

Where n1 and n2 are the indices of refraction of the two media, if the incident light is not normal to the interface, R will depend on the angle of incidence. When light is transmitted from a vacuum or air into a solid s, then

$$R = \left(\frac{n_s - 1}{n_s + 1}\right)^2 \tag{2.7}$$

Because the index of refraction of air is very nearly unity, Thus, the higher the index of refraction of the solid, the greater the reflectivity.

2.9.5 Refractive index

Light that is transmitted into the interior of transparent materials experiences a decrease in velocity, and, as a result, is bent at the interface; this phenomenon is termed refraction. The index of refraction n of a material is defined as the ratio of the velocity in a vacuum c to the velocity in the medium or

$$n = \frac{c}{\upsilon} \tag{2.8}$$

Where c represent velocity of light in vacuum and v represent velocity in the medium.

The magnitude of n (or the degree of bending) will depend on the wavelength of the light.

2.9.6 Determination of Band Gaps

The fundamental absorption is related to band-to-band or to exaction transition, which are subjected to certain selection rules [15]. The transitions are classified into several types, according to the band structure of a material. The relation between absorption coefficient and optic band gap for direct transition (k=0) is given by Tauc equation.

$$\sqrt{\alpha h\nu} = B(h\nu - E_g^{opt}) \quad (2.9)$$

And for indirect transition ($k \neq 0$) the relation becomes

$$\alpha(h\omega) \propto \frac{(\hbar\omega - E_{gap})^2}{\hbar\omega} \quad (2.10)$$

From the αhν versus hν one obtains E_g and B parameters. B is also a useful diagnostic of the material since it is inversely proportional to the extent of the tail state (Δ E) at conduction and valance band edges [16].

CHAPTER THREE

MATERIAL AND METHOD

3.1 Introduction

In this section, the materials used in the research were studied in addition to the devices and method

3.2 Martials

3.2.1Gum Arabic

The physical properties of GA may vary depending on the origin and age of trees the exudation time and climate treatment of gums after collection such as washing drying and bleaching in the sun and storage conditions affected the physical properties of gum.

3.2.2Distilled water

Can be 99, 9% pure and if needed can be distilled a second time distillation is very efficient in removing heavy metals, radionuclides, and solid particles and it kills bacteria and viruses.

3.2.3 Black seed oil

High-quality black seed oil is also suitable for use in cooking, baking, and beverages.

3.2.4 Magnetic stirrer or magnetic mixer

Is laboratory device that employs rotating magnetic field to cause a stir bar immersed in a liquid to spin very quickly and thus stirring the liquid the rotating field created by rotating magnet placed beneath the vessel with the liquid speed

Stirrer surface, the volume and viscosity of the solution and size of stirring bar.

3.2.5 USB2000 Spectrometer

The USB2000 Spectrometer is a Versatile, general-purpose UV-Vis-NIR spectrometer for absorption, transmission, reflectance, emission, color and other applications. This popular spectrometer can be custom-configured for maximum flexibility. USB2000 spectrometers have small footprint and take the measurement to the sample.

3.3 Method

In this study made four sample of (emulsifier) to used Gum Arabic and black seed oil by different concentration (0.02 ,0.03 ,0.04 an0.05) mL oil , and used USB 2000 spectrometer to give optical properties of four (emulsifier) samples and compeer by stander sample (Gum Arabic pour). The presidia that mead the samples was weight (10)g of gum Arabic dissolve in (100)ml water and pout mixture the on magnetic stirrer , then took (20) ml from this solution with (0.4)ml black seed oil to Made sample one and put this mixture on magnetic stirrer for 60 min under heating ($60^{O}C$) , reaped this work to made other sample by concentration (0.02 ,0.03 ,0.04 an0.05) mL oil . Then used USB2000 Spectrometer to give the absorbance curve and calculated the optical properties (transmission, reflection, absorption coefficient, extinction coefficient, refractive index and energy band gab

Figure (3.1) Emulsifier by Gum Arabic and Black Seed Oil samples

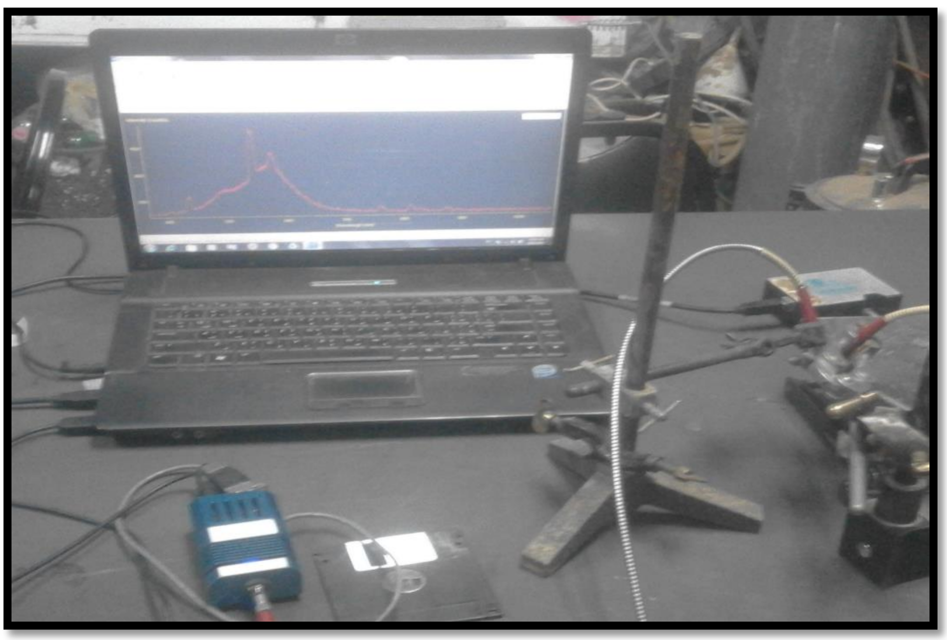


Figure (3.2) USB2000 spectrometer Used in experimental

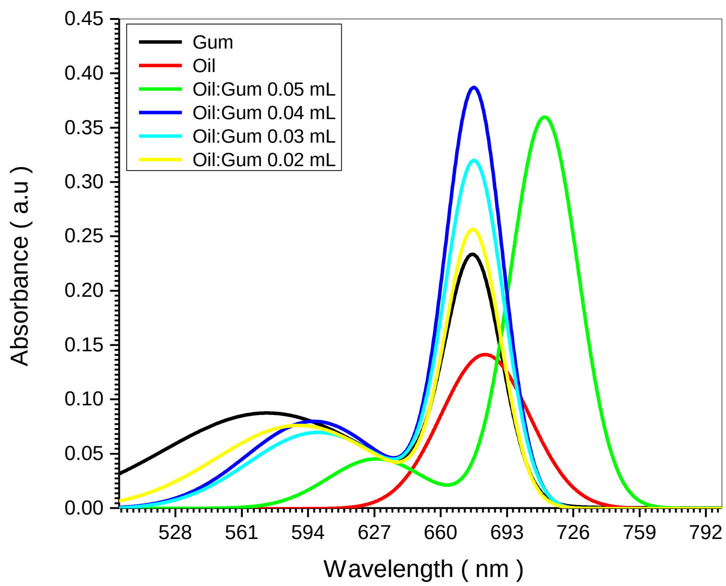
CHAPTER FOUR

RESULTS AND DISSOCIATION

4.1 Introduction

In this section the results are listed in a sequence and calculated by the systematic scientific methods

4.2 Results



Figure(4.1) relation between absorbance and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples

4.2.1Absorbances

The absorbance we found the behavior of curves is the same for four samples of Gum and (Gum + Black seed Oil) exeapt oile sample that studied using USB-2000 spectrophotometer .Show all resolute of absorbance in fig (4.1). In fig. (4.1) shows the relation between absorbance and wavelengths for siex samples of Gum, (Gum + Black seed Oil) and Black seed Oil the a absorption at wavelengths reanged (500- 800) nm . The effects of Black seed Oil molar in the absorbance value, are increased the absorbance value when Black seed Oil molar increase.

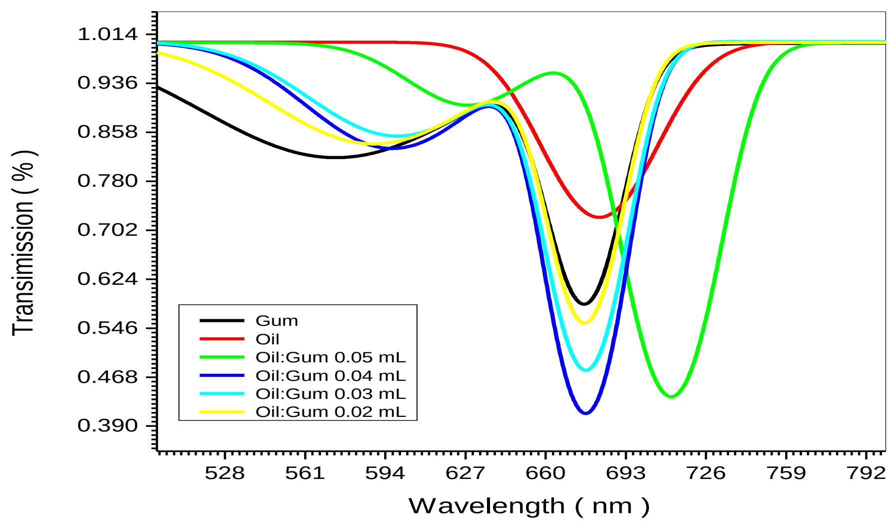


Figure (4.2) relation between Transimission and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oile samples

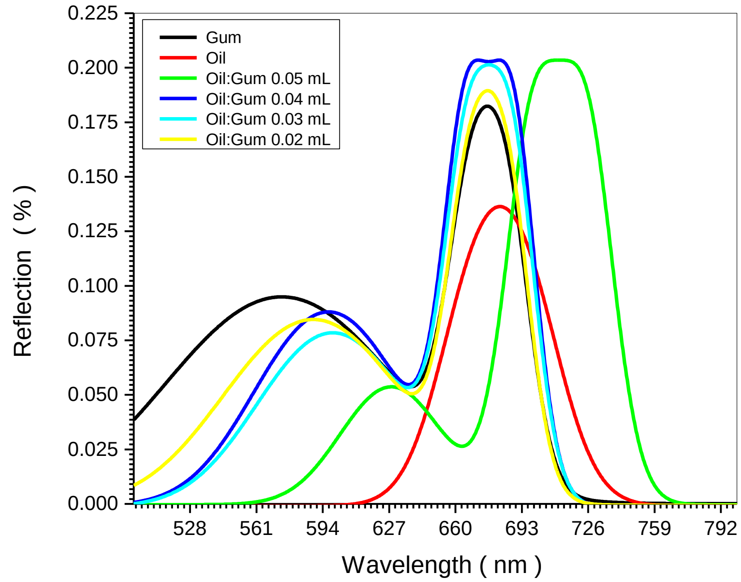


Figure (4.3) relation between Refelection and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples

4.2.2Transmittance (T) and Reflectance(R)

The optical transmittance (T) and reflectance(R) spectra in the (500 - 800) nm wavelength range for the Gum, (Gum + Black seed Oile) and Black seed Oil are depicted in Fig. (4.2) and (4.3). The minmall transmittance observed at wavelength (675 nm), and transmittance are decreases when Black seed Oile molar increase. The transimttance edge of Gum, (Gum + Black seed Oile) and Black seed Oile samples occurs at wavelength (675 nm) corresponding to photon energy (1.6 eV).

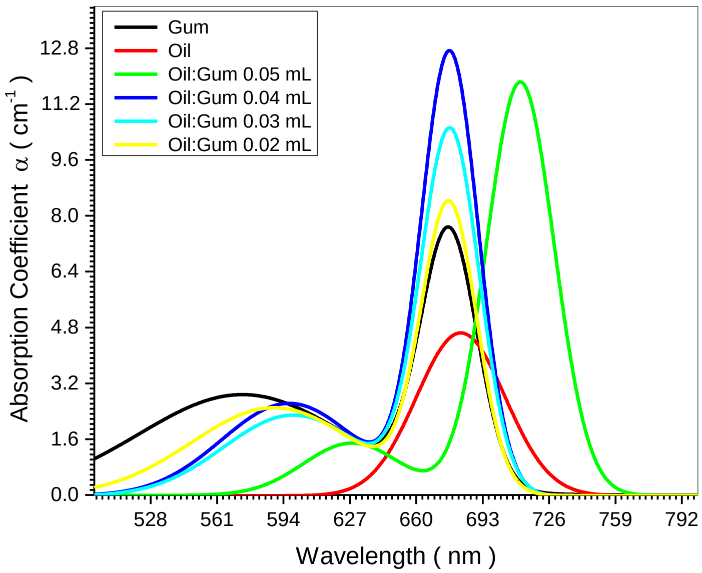


Figure (4.4) relation between Absorption Coefficient and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples)

4.2.3 Absorption coefficient (α)

The absorption coefficient (α) of seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil were found from the following relation $\alpha = \frac{2.303xA}{t}$ where (A) is the absorbance and (t) is the optical legth on the samples . In fig (4.4) shows the plot of (α) with wavelength (λ) of seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil , which obtained that the value of α = 7.74 cm^{-1} for Gum samples in 675 nm wavelength, and 12.73 for Gum + Black seed Oile 0.04 mL sample . Also, fig.(4.4) shows that the value of (α) for the seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil increase with the Black Seed Oil molar increased.

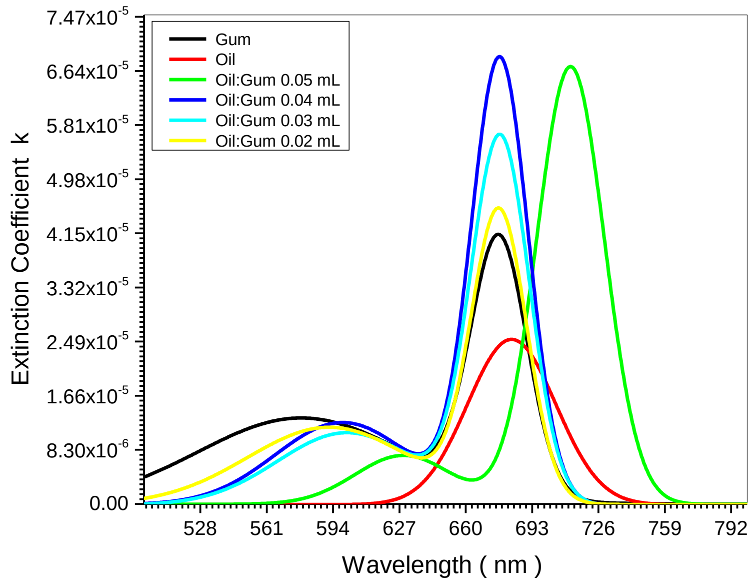


Figure (4.5) relation between Extinction Cefficient and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples

4.2.4Extinction coefficient (K)

Extinction coefficient (K) was calculated using the related $k = \frac{\alpha\lambda}{4\pi}$ The variation at the (K) values as a function of (λ) are shown in fig. (4.5) for seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil and it is observed that the spectrum shape of (K) as the same shape of (α). The Extinction coefficient (K) for seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil are show in fig.(4.5) obtained the value of (K) at the (675 nm) wavelength was depend on the samples treatment method , where the value of (K) at 675 nm for Gum sample equal 4.159×10^{-5} while for other sample (Gum + Black seed Oil) 0.04 mL at the some wavelength equal 6.86×10^{-5}. The effects of Black seed Oil molar on Extinction coefficient (k) was increased value when Black seed Oil molar increase.

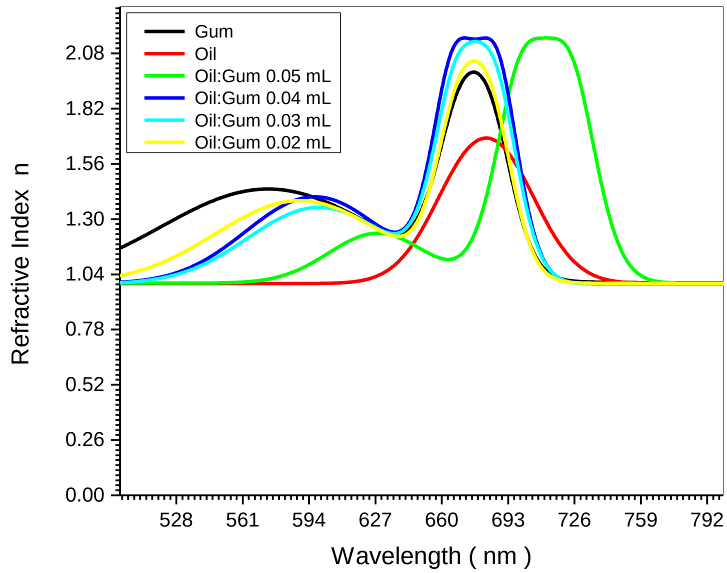


Figure (4.6) relation between Refractive Index and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples

4.2.5 The refractive index (n)

The refractive index (n) is the relative between speed of light in vacuum and speed in material which does not absorb this light. The value of n was calculated from the equation $n = [\left(\frac{(1+R)}{(1-R)}\right)^2 - (1 + k^2)]^{\frac{1}{2}} + \frac{(1+R)}{(1-R)}$ Where (R) is the reflectivity. The variation of (n) vs (λ) for seix samples was treetetment by Gum, (Gum + Black seed Oil) and Black seed Oil are shown in fig.(4.6). Fig (4.6) Show that relationsheep of seix refractive index (n) spectra,which shows that the maximum value of (n) is (2.157) for Gum + Black seed Oil 0.04 mL sample at 675 nm and Gum + Black seed Oil 0.05 mL at 710 nm which is agreement with (red sheft when the black seed oile molar increased for tow samples of (Gum + Black seed Oil) . Also we can show that the value of (n) begin to decrease when Black seed Oil molar decrease at wavelength 675 nm.

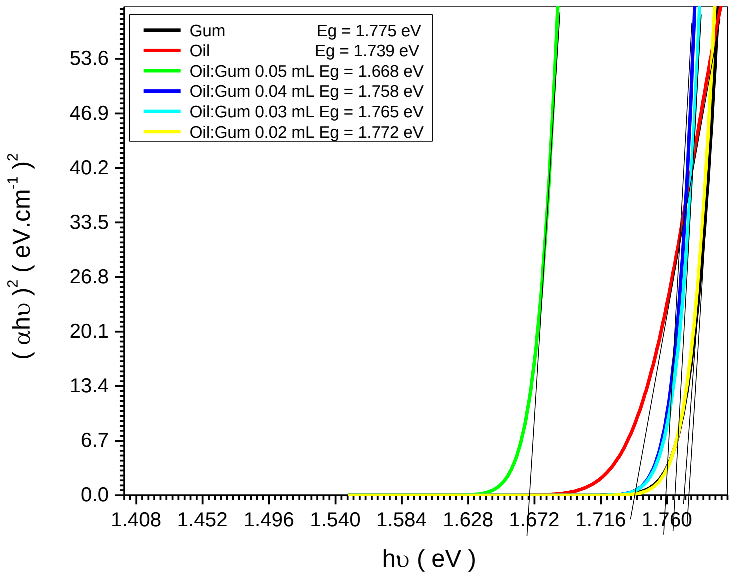


Figure (4.7) Optical Energy Band Gap of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples)

4.2.6 The optical energy gap (Eg)

The optical energy gap (Eg) has been calculated by the relation $(\alpha h\upsilon)^2 = C(h\upsilon - Eg)$ where (C) is constant. By plotting $(\alpha h\upsilon)^2$ vs photon energy (hυ) as shown in fig.(4.7) for the seix prepared sample by Gum, (Gum + Black seed Oil) and Black seed Oil. And by extrapolating the straight thin portion of the curve to intercept the energy axis , the value of the energy gap has been calculated .In fig (4.7) the value of (Eg) Gum + Black seed Oil 0.05 mL sample obtained was (1.668) eV while for Gum sample was (1.775) eV.The value of(Eg) was decreased from (1.775) eV to (1.668) eV. The decreasing of (Eg) related to black seed oil molar increased on the samples. It was observed that the different black seed oil molar for gum sample confirmed the reason for the band gap shifts .

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Four samples of (emulsifier) by gum Arabic solution and black seed oil with different concentration (0.02, 0.03 ,0.04 and 0.05) mL were prepared .and gum Arabic solution sample and other black seed oil were reference .

Studied optical properties of all samples used USB2000 spectrometer and to know the effected of black seed oil concentration on this properties (absorbance , Transmission , reflection , absorption coefficient ,excision coefficient and energy band gap) .

The absorption of all samples at wavelengths ranged (500- 800) nm. The effects of Black seed Oil molar in the absorbance value, are increased the absorbance value when Black seed Oil molar increase.

The minimal transmittance at (675 nm) wavelength and transmittance are decreases when Black seed Oil molar increase. The transmittance edge of Gum, (Gum + Black seed Oil) and Black seed Oil samples occurs at wavelength (675 nm) corresponding to photon energy (1.6 eV).

The value of $\alpha = 7.74\ cm^{-1}$ for Gum samples in 675 nm wavelength, and 12.73 for Gum + Black seed Oil 0.04 mL sample . Also shows that the value of (α) increase with the Black Seed Oil molar increased.

The maximum value of (n) is (2.157) for Gum + Black seed Oil 0.04 mL sample at 675 nm and Gum + Black seed Oil 0.05 mL at 710 nm which is agreement with (red shift when the black seed oil molar increased for tow samples of (Gum + Black seed Oil) . Also the value of (n) begins to decrease when Black seed Oil molar decrease at wavelength 675 nm.

The value of (Eg) was decreased from (1.775) eV to (1.668) eV. The decreasing of (Eg) resulting from black seed oil molar increased on the samples, It was observed that the different black seed oil molar for gum sample confirmed the reason for the band gap shifts.

5.3 Recommendation

To more study of this material (emulsifier) for other prepares (electrical, Morphology and constriction) by other dives like FTIR spectrometer, SEM (scanning electronic microscope), TEM (transmission electronic microscope) and LCR meter.

To use this material on medicine application or bio application or any application in industrial

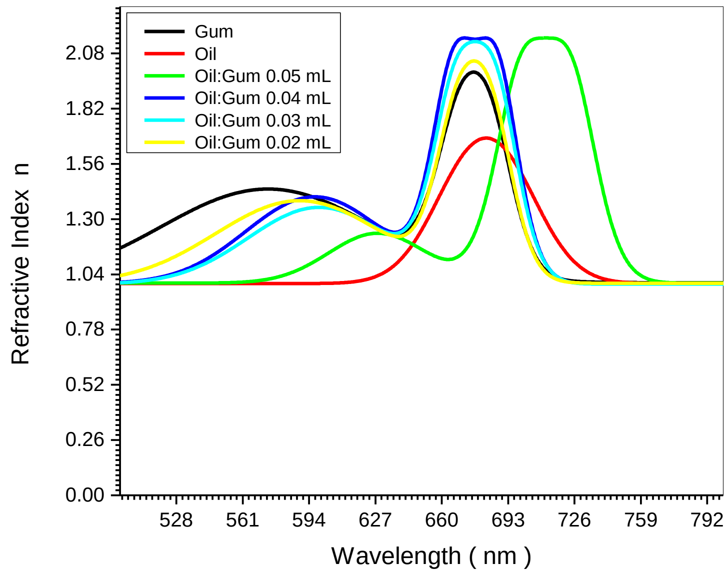


Figure (4.6) relation between Refractive Index and wavelengths of Gum , (Gum + Black Seed Oil at diefferant molar) and Black Seed Oil samples

4.2.5 The refractive index (n)

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