Biochem. Cell. Arch. Vol. 21, No. 2, pp. 3205-3214, 2021 | www.connectjournals.com/bca | *ISSN 0972-5075*
DocID: https://connectjournals.com/03896.2021.21.3205 | *eISSN 0976-1772*

PREPARATION AND IDENTIFICATION OF FE (III) NANOOXIDE USING FIG LEAF (*FICUS LYRATA*) EXTRACT AND STUDY OF ITS EFFECT ON THE PHOTOSYNTHESIS OF POLY (VINYL ALCOHOL)

Sami Assaf Jiad* and Hameedd Khalid Ali

Department of Chemistry, College of Education for Pure Sciences, University of Anbar, Iraq.
*e-mail : sam19u4016@uoanbar.edu.iq

(Received 28 June 2021, Revised 21 August 2021, Accepted 30 August 2021)

ABSTRACT : The study involved preparing (Fe_2O_{3NPS}) green method using fig leaf (ficus lyrata) extract, diagnosing it and studying its effect on the photovoltaic properties of polyvinyl alcohol prepared by casting and 65±5µm thickness after adding concentrations of nanomaterial (0.0025, 0.005, 0.01, 0.02, and 0.04) % to the polymer solution before and after exposure to the UV source at wavelength (356) nm and irradiation bazaan (0, 10,20, 40 and 80) hrs. The resulting iron oxide ($Fe_2O_{3\ NPS}$) was diagnosed using X-ray diffraction (XRD) and Atomic Force Microscope (AFM), which showed the size of the minutes (19.9) Nanometer and scanning electron microscope (SEM), irradiation on polymer chips were followed by Uv-vis spectrometer (UV-Visble for calculating the dissociation constant (K_d) as well as using (FT-IR) to calculate the growth of the hydroxyl group coefficient (I_{OH}) and the growth of the carbonyl coefficient (I_{CO}). As well as calculating the molar mass of the polymer, the degree of dissociation (á), and the numerical rate of the polymer chain cut-off (S) using the viscostometer. The speed of photosynthesis and the decrease in the rate of visual molecular weight is directly proportional to the added iron oxide concentration and irradiation time, consistent with what surface morphology has shown.

Key words : Polyvinyl alcohol, iron nanoxide, photosynthesis, viscosity.

How to cite : Sami Assaf Jiad and Hamid Khaled Ali (2021) Preparation and identification of Fe (III) nanooxide using fig leaf (*Ficus lyrata*) extract and study of its effect on the photosynthesis of poly (Vinyl alcohol). *Biochem. Cell. Arch.* **21**, 3205-3214. DocID: https://connectjournals.com/03896.2021.21.3205

INTRODUCTION

Polyvinyl alcohol (PVA) is a polymer in the form of a colorless white powder and the smell is non-toxic semi-polar decomposing in water (Gautam and Ram, 2010). Its density (1.19-1.31) gm/cm^3 and melting point is (320)^{o}C where it is exposed to high temperature thermal dissociation, and its molecular formula $(C_2H_4O)_X$ (Mustafa, 2013). It has good mechanical properties and an absolute glass (359K) (Saroj and Singh, 2012). It is of great importance as a result of its extensive industrial uses because of its excellent physical and chemical properties and possesses low electrical conductivity, biodegradability and thermally stable material over a wide range of high temperatures (Abdullah, 2016). A polyvinyl was discovered in 1924 by Herrman and Heanl scientists and first prepared by mixing a base solution with Polyvinyl acetate (PVAC) solution and obtaining a PVAMMT solution (Mark and Kroschwitz, 1985).The packaging is used for its high water absorption capacity and cotton-like texture (Ebewele, 2000). The study of polymer fragmentation and stabilization processes a multi-purpose process through which the properties of polymers can be modified or altered to overcome environmental contamination of polymer fragmentation and safe disposal (Hameed and Abdul Hameed, 2014). In recent years, great efforts have been made by scientists and researchers to try to understand the changes taking place in the polymer molecule and to understand its mechanic (Decker, 1989). Notably, there are many nanoparticles (both natural and industrial) that have captured the interest of researchers and specialists in various scientific fields. Fe_2O_{3NPS} is a chemical compound with the formula Fe_2O_{3NPS}, in the form of a reddish brown crystal powder, which is the main component of rust, its density is 5.24 gm/cm^3, its melting point is 1566°C, its boiling point is 1987°C and it is not dissolved in water. Nanomaterials (silver, gold, zinc, and iron) are used in various fields due to their extensive applications, such as nanoparticles, which are preferred iron nanoparticles for the following reasons: (In terms of economic cost, antimicrobial activity, high reactivity, smaller volume, so it gives a high ratio of

surface area to a volume that allows interaction with different chemical species and is also effective for binding with metal ions (Huber, 2005). Fe_2O_{3NPS} has a large area and a very stable and precise range gap in nature that provides a lot of important applications (Salehiabar, Marziyeh *et al*, 2018). Furthermore, the biological synthesis of Fe_2O_{3NPS} is low economic cost, and that is why new nanomaterials with extensive applications are manufactured, manufactured using different medicinal plants (Thema Beukes and Gurib-Fakim, 2015). It has many excellent traits, such as corrosion resistance under alkaline conditions (Song *et al*, 2020). It has been widely used for water treatment and cosmetics (Hashimoto *et al*, 2013).

MATERIAL AND METHODS

The current study aims to prepare and Identify a nanomaterial of iron trioxide with green synthesis methods and use it as a catalyst from the speed of photolysis of polymer (Vinyl alcohol) and to study the mechanics of dissociation through the use of Uv-Vis and IR techniques and the study of the rate of change in molecular weight using the lymeter.

Devices used

$FeCl_3$ iron chloride, ammonia NH_3, polyvinyl alcohol PVA, distilled water, ethanol, ion-free water, all of those materials are from BDH and British Sigma-Aldrich. The devices used X-ray diffraction (XRD), scanning electron microscope (SEM), atomic force microscope (AFM), UV-Vis ultraviolet spectroscopy, and Fourier transform infrared spectroscopy. The Measure of Viscosity is an Ostwald type.

Preparation of Iron Triple nanoxide

2.0gm of $FeCl_3$ was weighed in a glass flask and added 50mL ion-free distilled water to it with magnetic motor-mediated stirring Magnetic stirrer, heated to 70!, then added 12mL of fig extract 1.0gm fig leaves in 50ml of ion-free distilled water Gradually, slowly, by means of a train, we notice the solution shifting from light yellow to dark brown, and then gradually adding ammonia droplets up to a value (PH=7). Then raise the temperature to 90°C to get a sticky liquid. (Gel) Raise the heat to 110°C and turn it into a dry gel (Xerogel), then leave the gel solution to dry to cool, collect powder in the porcelain container, enter the oven and raise its temperature to 600°C for 2 hrs. The powder (Fe_2O_{3NPS}) is collected for the necessary tests (Sutka, Andris, and Gundars Mezinskis, 2012).

Preparation of polyvinyl alcohol

Dissolve 7 gm of a polymer (100 mL) of distilled water with continuous stirring by magnetic stirrer to obtain a more homogeneous solution at 80 °C for one hr (Hameed and Gazi, 2016).

Polymeric film preparation

Polymeric films of PVA polymer were attended following the following steps:

1. Addition of iron nanoxide prepared in the following weight ratios (0.005, 0.0025, 0.01, 0.02 and 0.04) % to (5mL) PVA solution (W\V) %.
2. Perform homogeneity between the solution and the iron trioxide mixture and ensure that there are no bubbles.
3. Pour the mixture into pre-prepared (4 mL) glass molds of slides attached to a piece of glass placed on a horizontal surface that has been leveled with the leveling scale to ensure the equal distribution of the solution in the template.
4. Leave the mixture at room temperature for 24 hrs to dry.
5. The films were removed by code and fish measured by a micrometer where the thickness of polymer films (65 ± 5 µm.
6. Polymer films with 3.5 - 1.5 cm dimensions were cut in proportion to spectral measuring devices (Uv-Vis, FT-IR).

Methods for tracking optical fragmentation of polyvinyl alcohol

UV- visible spectroscopy

The ultraviolet-visual radiator was used to calculate the absorption of polymer films at a wide wavelength range of 200 - 700 nm, enabling us to calculate the Kd decomposition rate constant by the optical oxidation process of polymer films using the law of first place as in equation no 1.

$$ln\ ln\ (A_\infty - A_t) = ln\ ln\ (A_\infty - A_o) - K_d t \quad (1)$$

We draw the relationship between $ln\ (A_\infty - A_o)$ and irradiation time (t). Where its slope represents the decomposition constant ($-K_d$).

Infrared spectroscopy

Optical fragmentation of PVA films was followed by measuring the IR spectrum of polymer films prepared prior to irradiation and after different irradiation times within the range (400-4000 cm^{-1}). The carbonyl group absorption site (C=o) was at 1720 $cm^{-1,}$ while the (OH) group was 3440 cm^{-1}. It is possible to find the Carbonyl index (I_{CO}) growth coefficient as well as the Hydroxyl index (I_{OH}) by applying equation (2) by adopting the band index method (Chandra and Handa, 1982). The site

selected 1241 cm^{-1} as the reference peak for PVA.

$$I_{(S)} = \frac{A_{(S)}}{A_{(R)}} \quad (2)$$

$I_{(S)}$: Group growth coefficient under consideration.

$A_{(S)}$: Absorption of the group under consideration.

$A_{(R)}$: Reference summit absorption.

Rate set Visual molecular weight

The molecular weight of the polymer was determined by calculating the viscosity rate using the Mark-Houwink equation (Wang *et al*, 2016).

$$[\eta] = K(M_V)^{\alpha} \quad (3)$$

Where, [ç]: Viscosity Intrinsic

K, α : Constants based on the nature of the polymer, solvent and temperature.

M_v : Molecular weight Visual rate using viscosity,

Viscosity was measured for multiple-Vinyl alcohol in water by following solvent flow time. And the flow time of the pure polymer solution and the polymer superposition solution in the solvent after each irradiation time. Where viscosity of pure polymer was measured at every irradiation time, also for the polymer super poster consisting of a polymer (Vinyl alcohol) and 0.0025% Fe_2O_{3NPS} (W/V) after each irradiation period; the molecular weight of a polymer was calculated in the presence and absence of the additive through intrinsic viscosity measurements of polymer films in water distilled at 25°C temperature using equation (4) (Hammed, 2019).

$$[\eta] = 2.0 \times 10^{-4} M_V^{0.76} (PVA) \quad (4)$$

Weak bonds are randomly distributed along the polymer chain, which breaks rapidly at the onset of irradiation and is calculated using the dissociation degree equation (α) equation (5).

$$\alpha = \frac{1}{P_t} - \frac{1}{P_o} \quad (5)$$

P_t : Numerical rate of polymerization at time (t) of irradiation, P_o : numerical rate of degree of polymerization before irradiation.

Using the equation 6, the numerical rate of the main polymer chain segments was calculated.

$$S = \alpha p_0 \quad (6)$$

RESULTS AND DISCUSSION

The results were obtained by studying the synthetic properties of Fe_2O_{3NPS} prepared using the green synthesis method using fig leaf (*Ficus lyrata*) extract of the irradiation effect on the nanopolymer super posters, and incorporating the most important conclusions reached through the research.

X-ray diffraction (XRD)

The crystallization and crystal stages of the nanoparticles of iron nanoparticles prepared in the green method were analysed by studying (XRD) and identifying the peaks that appear when these rays are shone at different angles on the sample. The diffraction peaks (012), (104), (110), (113), (024), (116), (018), (214), (300) and (119) are attributable at angles (24.39^0, 33.38^0, 35.95^0, 41.15^0, 49.84^0 and 54.4^0). These indicators indicate and confirm that they are for Fe_2O_{3NPS} powder prepared with the specified surface form as well as the XRD results indicating that the material is pure and well compared with the JCPDS card (Thema *et al*, 2015). Severe and sharp peaks undoubtedly revealed that (Fe_2O_3) nanoparticles formed from reduction by using fig leaf (*Ficus lyrata*) extract crystallized in nature.

Scanning electron microscope (SEM)

Scanning electron microscopy is used to determine the morphology and shape of particles as well as to measure the size of minutes of the prepared sample in a greenway and it is evident from scanning electron microscope images that the size of the minutes (15.77-18.14) nm. Images in Fig. 2 shows that Fe_2O_{3NPS} prepared in the green method by scanning electron microscopy with different magnification power that its particles possess spherical shapes compared to the reference (Mohammed and Saud, 2020).

Atomic force microscope

It is an important technique for studying the surface topography of nano oxide prepared in the greenway, giving information about the size of minutes (length, width and height) and other physical properties (surface topography, surface texture). Fig. 3 shows two-dimensional and three-dimensional AFM images of the structure of the prepared iron trioxide surface, showing particle minute diameters of 19.9 nm.

Follow-up optical fractionation for PVA

The optical fragmentation of pure multiple (phenyl alcohol) films containing different concentrations of Fe_2O_{3NPS} has been followed to see how the increased concentration of Fe_2O_{3NPS} affects the disintegration of the polymer during different irradiation times.

(Uv-Vis) spectroscopy

A peak has been observed at 280 nanometres of polyvinyl alcohol and through this summit the change is followed by absorption values at different times. The

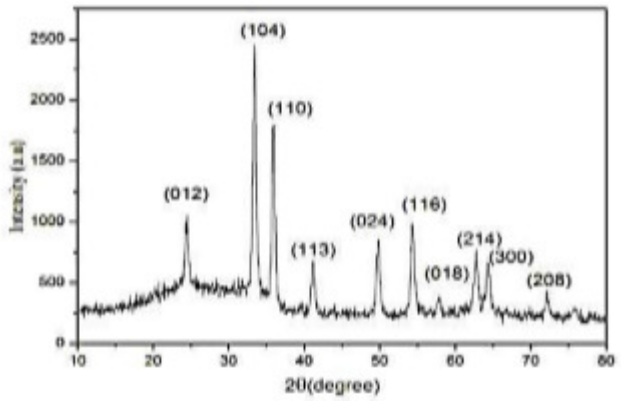

Fig. 1 : XRD patterns of iron oxide nanoparticles manufactured by a leafy fig extract compared to the reference for standard iron oxide (33-0644).

Table 1 : Structural parameters of iron trioxide nanoparticles obtained from XRD analysis.

2θ (degree)		
hk1	**Observed**	**JCPDS**
012	24.39°	24.13°
104	33.38°	33.15°
110	35.95°	35.61°
113	41.15°	40.85°
024	49.84°	49.47°
116	54.25°	54.08°
018	57.82°	57.59°
214	62.80°	62.44°
300	64.32°	64.00°
208	72.20°	72.26°

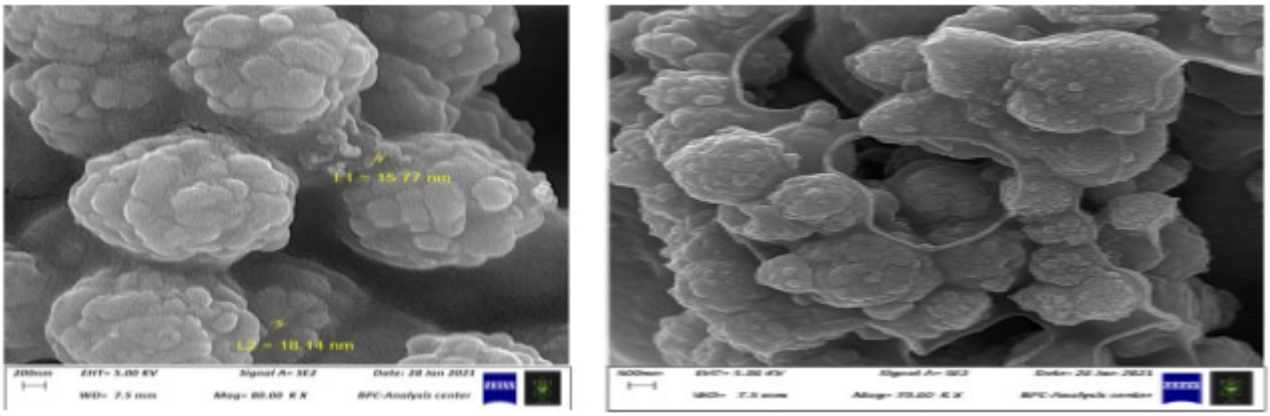

Fig. 2 : Images of iron nanoxide prepared by green synthesis with scanning electron microscopy with different magnification power.

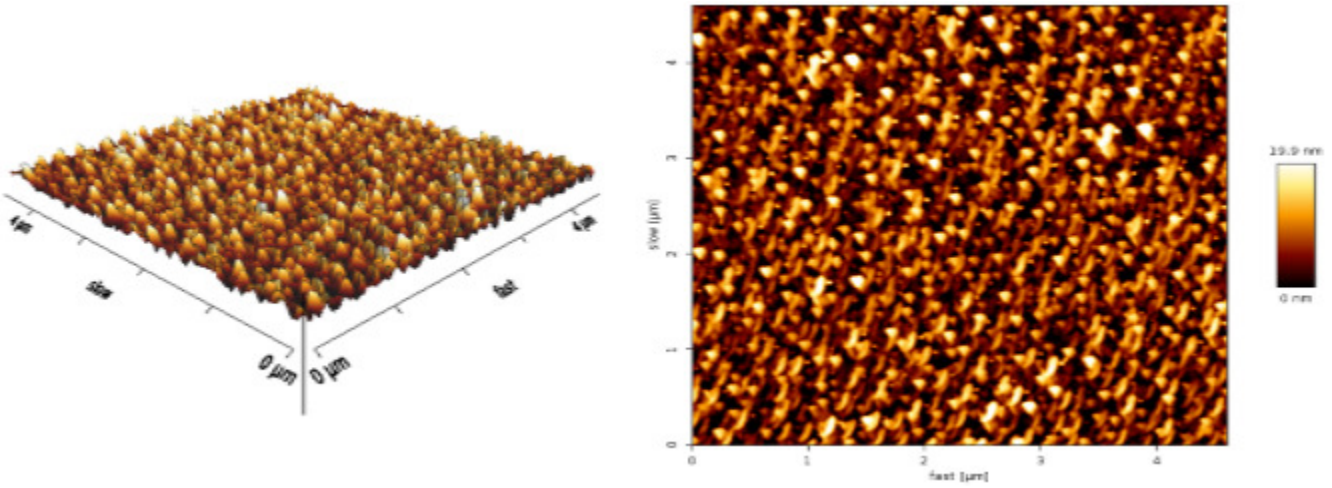

Fig. 3 : A 2D and 3D (AFM) image of iron nanoxide prepared by green synthesis method.

optical fragmentation of pure PVA films and films containing different weight ratios of Fe_2O_3 nanoscale can be followed through the Uv-Vis spectrum. When pure PVA films (65±5)μm of radiation (U.v) and at different times, we observe that absorption values are proportional to the time of irradiation and the concentration of Fe_2O_{3NPS} as shown in Table 2. The absorption of films increases as the concentrations of nanomaterials added to them increase due to increased effective totals as in Figs. 4 and 5. The polymeric film photosynthesis K_d was calculated in the presence of added nanomaterial by drawing the relationship between $\ln(A_o - A_\infty)$ with irradiation time as shown in form (6) and (7) and obtaining a straight line indicating that the optical fragmentation reaction of iron nanoxide is a first-order reaction From the rectal line inclination calculation (Slop), the K_d values of PVA are calculated by the aforementioned concentrations. The optical decomposition velocity

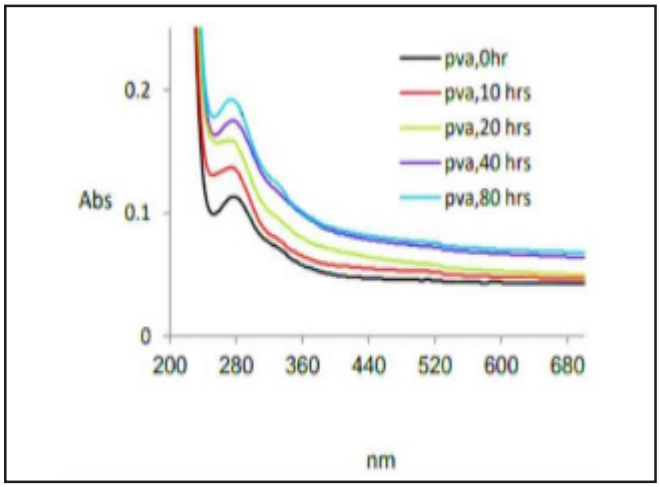

Fig. 4 : Change in UV-Vis spectrum of additive-free PVA films (65 ± 5) µm at irradiation.

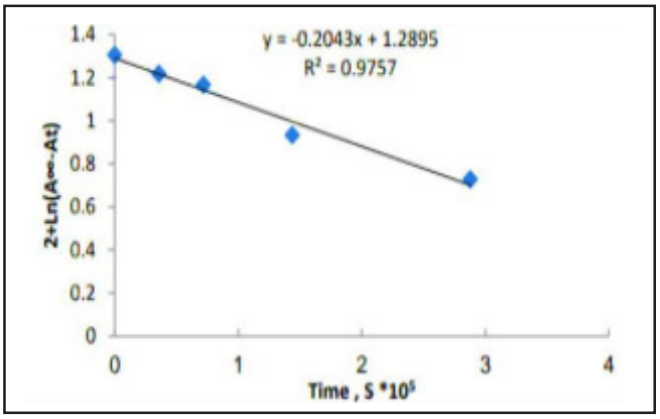

Fig. 6 : The relationship between the natural logarithm of iron oxide absorption (Fe_2O_3) at a concentration of 0.0025% in PVA films (65 ± 5) µm with irradiation time.

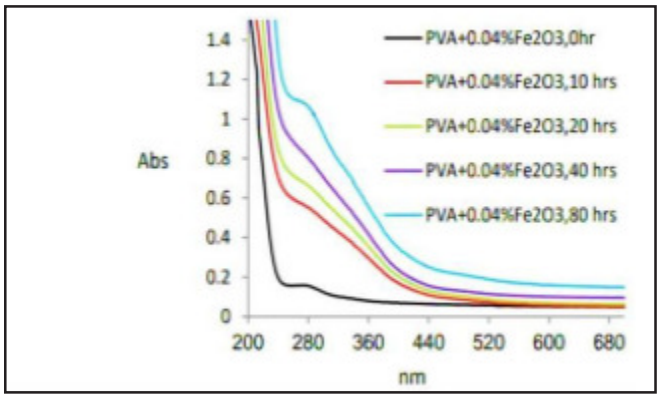

Fig. 5 : Change in the UV-Vis spectrum of PVA films containing a concentration of 0.04% of iron nanoxide (Fe_2O_3) thickness (65 ± 5) µm at irradiation times.

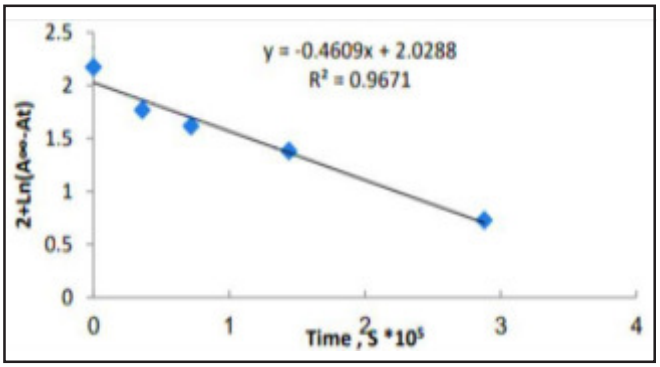

Fig. 7 : The relationship between the natural logarithm of iron oxide absorption (Fe_2O_3) at a concentration of 0.04% in PVA films (65 ± 5) µm with irradiation time.

Table 2 : Absorption values for PVA films 65 ± 5 pure micron as well For those containing different concentrations of iron oxide (Fe_2O_3) nanoscale calculated at 280 nm from UV-Vis spectroscopy measurements.

Irradiation time (hour) / Type of chips	Absorption A_t				
	0.0	**20**	**40**	**80**	**120**
PVA	0.113	0.135	0.156	0.174	0.19
PVA+ 0.0025 % Fe_2O_3	0.135	0.177	0.200	0.29	0.354
PVA+ 0.005 % Fe_2O_3	0. 136	0.223	0.308	0.346	0.494
PVA+ 0.01 % Fe_2O_3	0.140	0.289	0.353	0.501	0.620
PVA+ 0.02 % Fe_2O_3	0.141	0.367	0.456	0.709	0.819
PVA+ 0.04 % Fe_2O_3	0.156	0.552	0.662	0.804	1.062

constant is shown to be directly proportional to the concentration of the added nanomaterial as shown in Table 3. This indicates that Fe_2O_{3NPS} increases the speed of the interaction of light with the polymer.

IR spectroscopy

(FT-IR) was used to follow the optical fragmentation of pure multiple films (Vinyl alcohol) containing different concentrations of Fe_2O_{3NPS} during different irradiation periods. Following the absorption packages of pure PVA films (5 ± 65 µm), changes were observed in the IR

Table 3 : Values the Kd decomposition velocity constants of iron oxide (Fe_2O_3) nanoscale in PVA films.

K_d $(Sec)^{-1}x10^{-5}$	Concentration %
0.204	**0.0025**
0.271	**0.005**
0.338	**0.01**
0.424	**0.02**
0.460	**0.04**

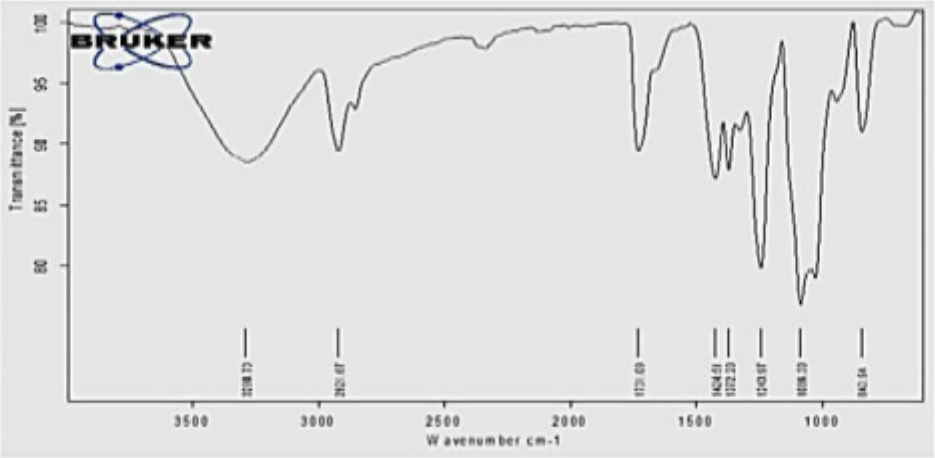

Fig. 8 : Infrared spectrum of a thin PVA that has no additives before irradiation.

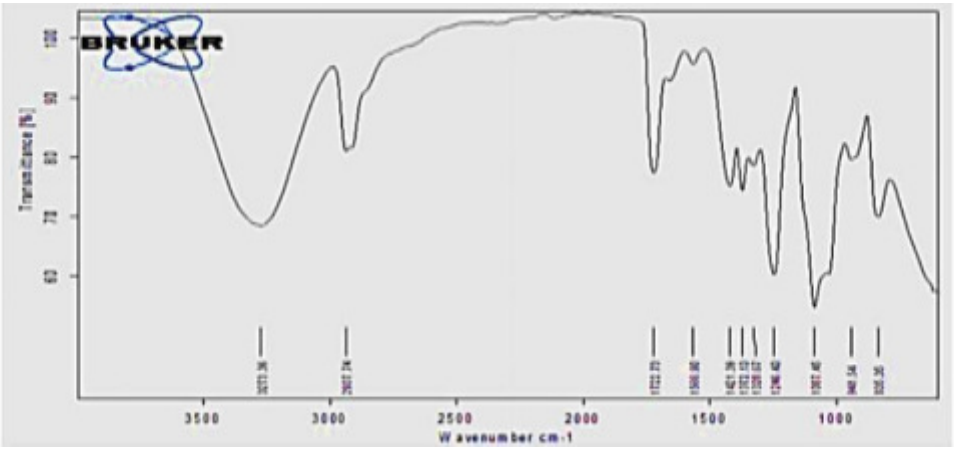

Fig. 9 : Infrared spectrum of an additive-free PVA thin with irradiation time of 80 hrs.

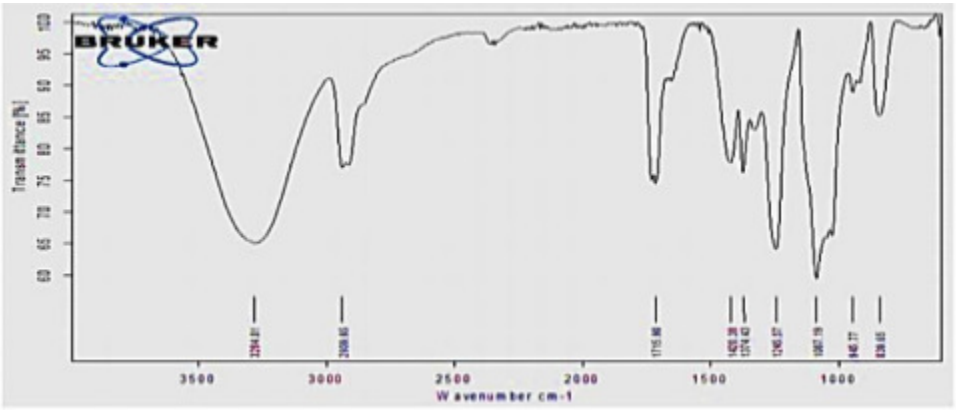

Fig. 10 : The infrared spectrum of a PVA thin containing the nanomaterial Fe_2O_3 with a concentration of (0.04%) and irradiation time of (80) hrs.

spectrum prior to irradiation as shown in Fig. 8 compared to the IR spectrum of pure PVA after an 80hrs irradiation process as shown in Fig. 9. The difference is observed in the peaks of the (C=o) and (OH) groups of beams before and after irradiation of pure PVA. As for the film PVA containing a concentration of Fe_2O_{3NPS} after irradiation, we observe that the change in the peaks of the (C=o) and OH groups of the film containing the nanomaterial is higher than in the pure film, meaning that the Fe_2O_{3NPS} accelerates the photosynthesis of the polymetallic. The values of the (I_{CO} and I_{OH}) are calculated for pure PVA film plus films containing different concentrations of Fe_2O_{3NPS} as shown in Tables 4 and 5, respectively are observed to increase with increased irradiation time and a different increase in material (Fe_2O_{3NPS}) increases the speed of disintegration by optical oxidation as this increase is associated with increased absorption of Uv by polymer films during irradiation. As shown in Figs. 11 and 12, respectively.

Table 4 : Values of the hydroxyl group absorption coefficient (I_{CO}) with the irradiation time of a PVA containing different concentrations of the nanomaterial Fe_2O_3.

Percentage for additives w% / Irradiation time (hour)	I_{CO}				
	0.0	**10**	**20**	**40**	**80**
PVA	0.505	0.552	0.603	0.685	0.812
PVA + 0.0025 % Fe_2O_3	0.517	0.611	0.656	0.740	0.885
PVA + 0.005% Fe_2O_3	0.519	0.643	0.710	0.793	0.941
PVA + 0.01 % Fe_2O_3	0.521	0.680	0.762	0.852	1.01
PVA + 0.02 % Fe_2O_3	0.523	0.733	0.831	0.920	1.07
PVA + 0.04% Fe_2O_3	0.526	0.784	0.885	0.991	1.136

Table 5 : Values of the hydroxyl group absorption coefficient (I_{OH}) with the irradiation time of PVA containing different concentrations of the nanomaterial Fe_2O_3.

Irradiation time (hour) / Percentage for additives w%	I_{OH}				
	0.0	**10**	**20**	**40**	**80**
PVA	0.512	0.616	0.688	0.803	**1.203**
PVA + 0.0025 % Fe_2O_3	0.522	0.691	0.780	0.924	**1.281**
PVA + 0.005% Fe_2O_3	0.524	0.763	0.904	1.06	**1.362**
PVA + 0.01 % Fe_2O_3	0.526	0.817	1.01	1.152	**1.460**
PVA + 0.02 % Fe_2O_3	0.528	0.873	1.08	1.230	**1.543**
PVA + 0.04% Fe_2O_3	**0.531**	**0.971**	**1.17**	**1.320**	**1.631**

Table 6 : Calculated Values from Visual Molecular weight measurements for pure PVA Chips.

Time Irradiation (hrs.)	$\underline{(M_v)}x10^3$	**Degree of Polymerization P**	$\frac{1}{P}x10^{-4}$	**Deg. Degree** $a\ x\ 10^{-3}$	**Ava. Chain Scission (S)**
0	74.264	1787.818	5.593	0.0	0.0
10	63.911	1425.522	6.884	0.129	0.320
20	56.090	1274.772	7.844	0.225	0.402
40	50.280	1142.727	8.750	0.315	0.563
80	45.280	1029.090	9.717	0.412	0.763

Table 7 : Calculated values from visual molecular weight measurements of PVA chips containing a concentration of 0.00 0025% of Fe_2O_3 nanomaterials.

Time Irradiation (hrs.)	$\underline{(M_v)}x10^3$	**Degree of Polymerization P**	$\frac{1}{P}x10^{-4}$	**Deg. Degree** $a\ x\ 10^{-3}$	**Ava. Chain Scission (S)**
0	74.264	1787.818	5.593	**0.0**	0.0
10	60.200	1368.181	7.308	0.171	0.305
20	49.487	1124.704	8.891	0.329	0.588
40	41.988	954.272	10.479	0.488	0.872
80	36.258	824.045	12.135	0.654	1.169

Viscosity measurement

The polymer, when exposed to Uv radiation, has several sequential processes, including interlocking, secondary oxidation reactions and polymer chain cutting, which result in fractured bonds, *i.e.* cutting the polymer (Chain Shawaphun *et al*, 2010). Polymer chips' visual molecular weight ratio was calculated prior to and after irradiation from the study of photosynthesis of pure polyvinyl films containing different concentrations of Fe_2O_{3NPS}. It was observed that the rate of visual

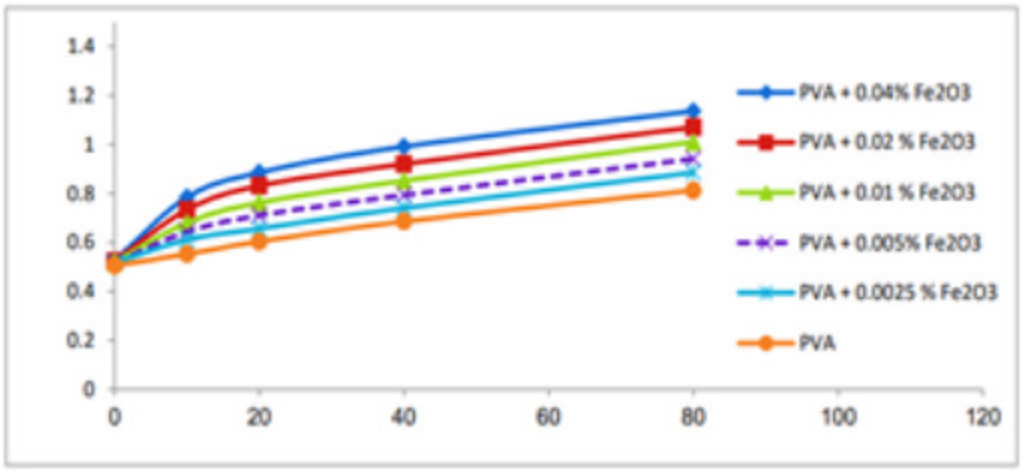

Fig. 11 : Relationship between the carbonyl group absorption coefficient and irradiation time for the results listed in Table 4.

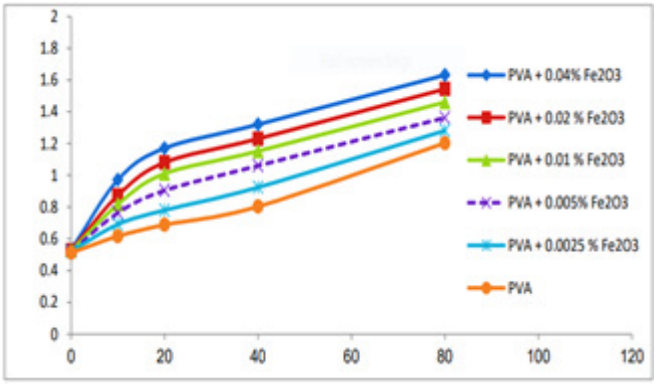

Fig. 12 : Relationship between the hydroxyl group absorption coefficient and irradiation time for the results listed in Table 5.

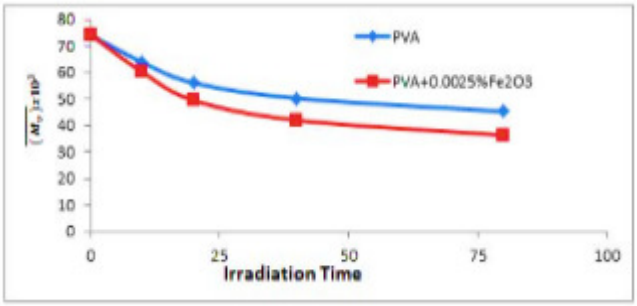

Fig. 13 : The relationship of visual molecular weight rate to irradiation time of PVA chips with the presence and absence of 0 concentration. 0.0025% of the nanomaterial Fe_2O_3.

molecular weight was inversely proportional to irradiation time due to increased rates of dissociation Tables 6 and 7 showed that pure PVA films were the highest partial mass of films containing a concentration of 0.0025% Fe_2O_{3NPS}, because polymer-added Fe_2O_{3NPS} had accelerated the rates of low visual molecular weight compared to pure polymer films, as well as Mustafa (2013). It is also evident from those data that the hierarchy values and (α) the numerical rate values of polymeric chain cutting (S) increase in conjunction with irradiation as in Salehiabar *et al* (2018) and Saroj and Singh (2012),

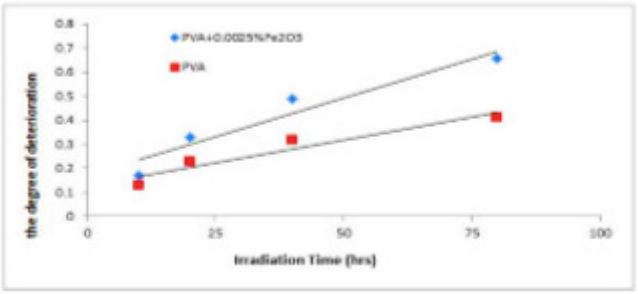

Fig. 14 : The degree of fragmentation relationship with the irradiation time of PVA chips with the presence and absence of a 0.0025% concentration of Fe_2O_3 nanomaterials.

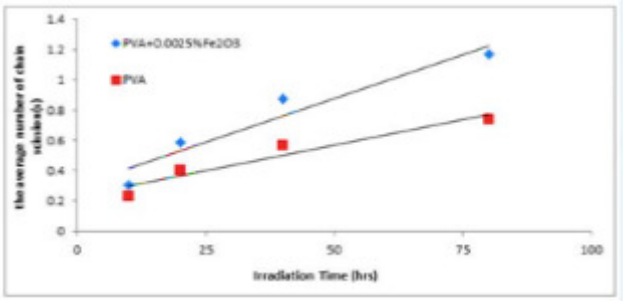

Fig. 15 : The relationship of the numerical rate of chain cutting with the irradiation time of PVA chips with the presence and absence of a 0.0025% concentration of Fe_2O_3 nanomaterials.

respectively; this confirms the existence of weak bonds distributed randomly along the polymer chain.

PVA optical microscope

Photographic microscopy images of pure PVA films containing a concentration of 0.0025% of iron nanoxide through which we observe the surface being affected by ultraviolet energy that shows the difference before and after irradiation. After the 80-hrs irradiation, we observed the distortion of the surface of polymer films resulting from the interaction of light with the added nanomaterial, which accelerates the disintegration process, as shown in both Figs. 16 and 17.

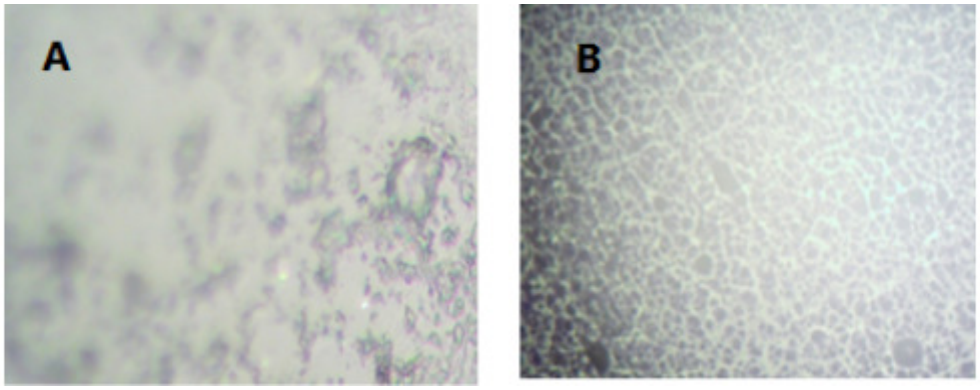

Fig. 16 : Pure PVA (A) image before irradiation and (B) after irradiation for 80 hours.

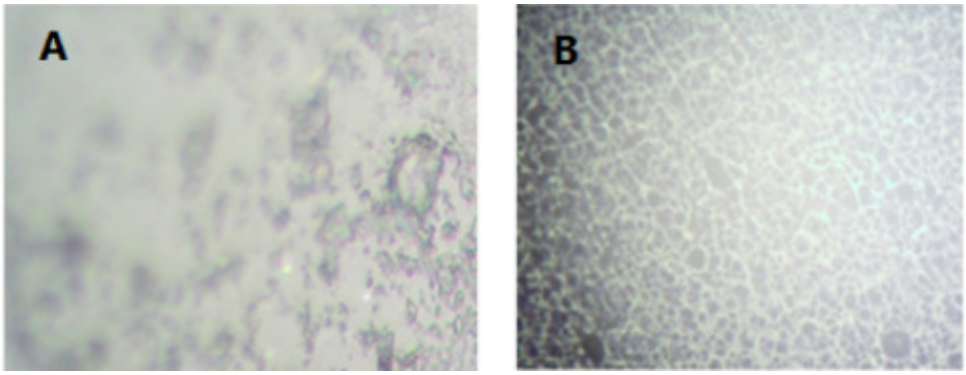

Fig. 17 : Formed a PVA image containing a concentration of 0.0025% nanomaterial (A) before irradiation and (B) after irradiation for 80 hours.

CONCLUSION

Fe_2O_{3NPS} was prepared by green synthesis using fig leaf (*Ficus lyrata*) extract and studying its synthetic properties by: (XRD), (SEM), (AFM) and FT-IR spectra). The optical fragmentation of PVA films was studied after the addition of different weight ratios of Fe_2O_{3NPS} prepared using Uv spectroscopy and IR spectroscopy as well as viscosity measurements for the purpose of calculating the rate of visual molecular weight. (K_d) (I_{CO}) and (I_{OH}) are directly proportional to the added iron trioxide concentration and irradiation time.B- By calculating the degree of α fragmentation and the numerical rate of the S-series cut, the presence of Fe_2O_{3NPS} lowers the visual molecular weight and thus packs accelerated material for the optical fragmentation process, and the photosynthesis of the polymer is randomly performed C-The $K_{d(rate)}$ of photolysis is directly proportional to the concentration of the nanomaterial added to the polymer. Fe_2O_{3NPS} increases the absorption of light, which stimulates the use of PVA/ Fe_2O_3 in water processing and cosmetics.

REFERENCES

Abdullah O G (2016) Synthesis of single-phase zinc chromite nano-spinel embedded in polyvinyl alcohol films and its effects on energy band gap. *J. Materials Sci.: Materials in Electronics* **27**(11), 12106-12111.

Chandra R and Handa S P (1982) Sensitized photodegradation of polyisobutylene film by addition of tris(α thiopicolinanilide)–cobalt(III). *Appl. Polym. Sci*. **27**(6) , 1945-1958.

Decker C (1989) Handbook of polymer science and technology (edited by Cheremisi off). Vol. **3**, 541549-Dekker , New-York.

Ebewele R O (2000) *Polymer science and technology*. CRC press.

Gautam A and Ram S (2010) Preparation and thermomechanical properties of Ag-PVA nanocomposite films. *Materials Chemistry and Physics* **119**(1-2), 266-271.

Hameed K and Abdul Hameed H (2014) A study of effect copper (Ð)-complex(Cu- BHBH)on the photo degradation of poly styrene films. *Int. J. Appl. and Nat. Sci*. **3**, 123-134.

Hameed N J and Gazi H S (2016) Studying the effect of silica (SiO2) addition on the adhesive properties of polyvinyl alcohol. *Iraqi J. Physics* **14**(29), 107-124.

Hammed K (2019) Studying the effect of adding pulverized egg shell on the photophysical properties of polyvinyl alcohol. *J. Education and Scientific Studies Chem. Sci.* **14** (4), 2413-2423.

Hashimoto H, Itadani A, Kudoh T, Fukui S, Kuroda Y, Seno M and Takada J (2013) Nano–Micrometer-Architectural Acidic Silica Prepared from Iron oxide of *Leptothrix ochracea* Origin. *ACS applied materials & interfaces* **5**(11), 5194-5200.

Huber D L (2005) Synthesis, properties and applications of iron nanoparticles. *Small* **1**(5), 482-50.

Mark H F and Kroschwitz J I (1985) Encyclopedia of polymer science and engineering.

Mohammed A M, Saud W M and Ali M M (2020) Green synthesis of Fe_2O_{3NPS} using olea europaea leaf and their antibacterialactivity. *Digest J. Nanomaterials and Biostructures* **15.1**, 175-183.

Mustafa F A (2013) Optical properties of NaI doped polyvinyl alcohol films. *Physical Sci. Res. Int*. **1**(1), 1-9.

Salehiabar M, Nosrati H, Davaran S, Danafar H and Manjili H K (2018) Facile synthesis and characterization of l-aspartic acid coated iron oxide magnetic nanoparticles (IONPs) for biomedical applications. *Drug Res.* **68**(05), 280-285.

Saroj A L and Singh R K (2012) Thermal, dielectric and conductivity studies on PVA/Ionic liquid [EMIM][$EtSO_4$] based polymer electrolytes. *J. Physics and Chem. Solids* **73**(2), 162-168.

Shawaphun S, Manangan T and Wacharawichanant S (2010) Thermo- and photo-degradation of LDPE and PP films using metal oxides as catalysts. *Adv. Materials Res.* **93**, 505-508.

Song Z, Chen H, Bao S, Xie Z, Kuang Q and Zheng L (2020) Nanosheet-assembled, hollowed-out hierarchical γ-Fe_2O_3 microrods for high-performance gas sensing. *J. Materials Chem. A* **8**(7), 3754-3762.

Sutka Andris and Gundars Mezinskis (2012) Sol-gel auto-combustion synthesis of spinel-type ferrite nanomaterials. *Frontiers of Materials Science* **6**(2), 128-141.

Thema F T, Beukes P, Gurib-Fakim A and Maaza M (2015) Green synthesis of Monteponite CdO nanoparticles by *Agathosma betulina* natural extract. *J. Alloys and Compounds* **646**, 1043-1048.

Wang J, Huang H and Huang X (2016) Molecular weight and the Mark Houwink relation for ultra high molecular weight charged polyacrylamide determined using automatic batch mode multi angle light scattering. *J. Appl. Polymer Sci.* **133**(31).