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RESEARCH ARTICLE
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Biological characterization of some nano pro drug polymer

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ABSTRACT

In this work three new biopolymers were synthesized. We could design new polymer by reacting Itaconic acid with Amino acid to obtain ester –amide polymers (A1, A2). Malonic acid was utilized as di-functional spacer that could reacted with glycerol to alter to its corresponding ester(A3). The prepared polymers (A1), (A2), (A3) were characterized by FTIR and spectroscopy and physical were determined. In addition, A1, A2 and A3 biological properties were allocated with and without Nano-silver particles.

Keywords: *Glycerol, malonic acid, Itaconic acid, ester amide polymers*

INTRODUCTION

Polymers symbolize a fundamental constituent of pharmaceutical dose forms. It is recognized that the formulation and clinical performing of pharmaceutical dose forms ,e.g. solid dosage forms implants, transdermal patches systems, is dependent on the physicochemical characteristics of the polymers utilized in the formulation pharmaceutical polymers The food and Drugs Administration, sensitively influence the standards of the polymers to be certain that no opposing results from their use (1,2).

Bio-degradable polymer, are inert compounds, and slowly vanishes from the site of management in reaction to a chemical reaction for example hydrolysis e.g. proteins, carbohydrates etc.(3) in addition, concentration polymerization is a chemical consequence in which polymer is formed and a minor molecule of result with a lower molecular mass produced. The result removed is namede as condensate. (4)

Biodegradable techniques, define as therapeutic factor that has been combined into medium that is comprised of a biodegradable polymer, Consequently, following impantation, the molecular mass of the polymer medium will be decreased such as hydrolysis of crosslinks or hydrolysis of the major polymer chain (5) Through the past few decades, silver nanoparticles (AgNPs) is one of the greatest tested and searched nanotechnology-drived nanostructure which gains particular attention as unconventional antimicrobial agents.(6)

The main goal of formed designs to decrease undesirable medication characteristics, for example low solubility in aqueous membrane, chemical uncertainty, unwanted taste, irritation or discomfort afterward local government, pre systemic metabolism and toxicity.

EXPERMENTAL

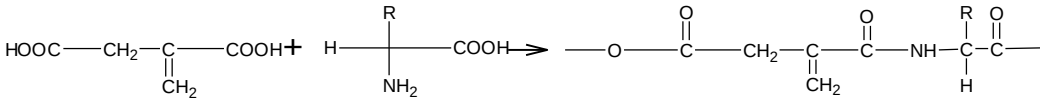
Materials & Instruments

Alanine , itaconic acid , malonic acid , glycerol were purchased from Al, Dimethyl for amide was acquired from Merck .FTIR spectra by (4000-900)cm^{-1}on shimatau spectrometer using KBr pellet.

Ultra violet spectra were registered with shimadzu (UV-Vis)-160.

Poly condensation of some amino acids with Itaconic acid (A1,A2).

Mole , 1.9 gm) of Itaconic acid was dissolve in 5 ml mature of dioxane and DMF (1:1) and (0.015 mole ,1.5gm) of amino acid was added ,the mixture was reflaxed at 90C˚about 2hr .The solvent was distilled and washed with ether for three times.

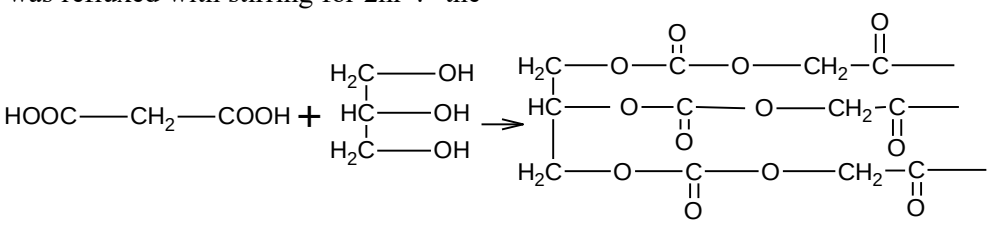


Comp.No.	R	Color	Yield%	Softening point C˚
A1	-CH3	Brown	90	280
A2	-H	Black	85	260

Esterification of Glycerol with malonic acid (A3)

In" round bottom flask provided with condenser (4.2gm,0.041 mole)of glycerol was added to (0.124mole,1.14gm) "of malonic" acid the mixture was refluxed with stirring for 2hr". "the viscouse product was obtained , washed with ether and dried at room temperature" .

The polymer was obtained with 86%.The softening point of the drug polymer was (200-210) C˚.



Antibacterial assay – Agar Well Diffussion Method:

The agar well diffusion method was employed for the determination of antimicrobial activity. To brief, Mueller Hinton agar were swabbed on the above bacterial isolates with a sterile swab separately. Then wells are made in plates using cork borer (7mm diameter) and filled by the help of micropipette with 50µl of CDA. The plates were incubated at 37C˚for 24 hours for bacteria. The diameter for the zone of inhibition was measured in millimeter(mm)

RESULT & DISCUSSION

Recently, researches on biodegradable polymers has added in significance because of widespread range of biomedicine applications. In addition, "polymers have revealed an integral function in the advancement of drug delivery system by

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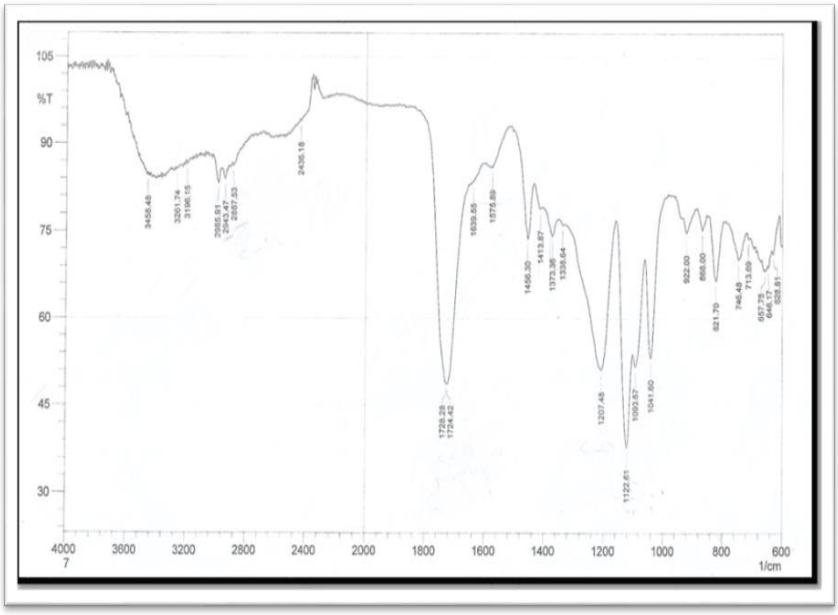
offering controlled release of therapeutic agents in continuous doses over long times".(5)

Fourier transform infrared

FTIR spectrum of (A1) reveals absorption of bands at (3355)cm^{-1}owing to (OH) group of carboxylic acid , (1714)cm^{-1}owing to (C=O) carboxylic acid and (1234)cm^{-1} to (C-O) carboxylic acid ,we can see also absorption of band at (1298)$cm^{-1}$to (C-O) ester ,(1633)$cm^{-1}$to (C=O)amide ,(1458)cm^{-1}due to (C-N),(3271)cm^{-1}due to (N-H) amide .At last, figure reveals absorption of bands of (C-H)aliphatic at (2877-2980)cm^{-1}, figure 1.



"FIGURE 1: FTIR spectrum of A1"

Figure (2):- FTIR spectrum of (A2) shows absorption bands at (3350)cm^{-1}due to (O-H) carboxylic acid , (1716)cm^{-1}due to (C=O) carboxylic acid and (1222)$cm^{-1}$to (C-O)carboxylic acid , also absorption of band at (1157)cm^{-1}owing to (C-O) ester ,(1645)cm^{-1}due to (C=O)amide ,(3267)cm^{-1}due to (N-H)amide ,and (2991,2802)cm^{-1}because of (C-H)aliphatic.

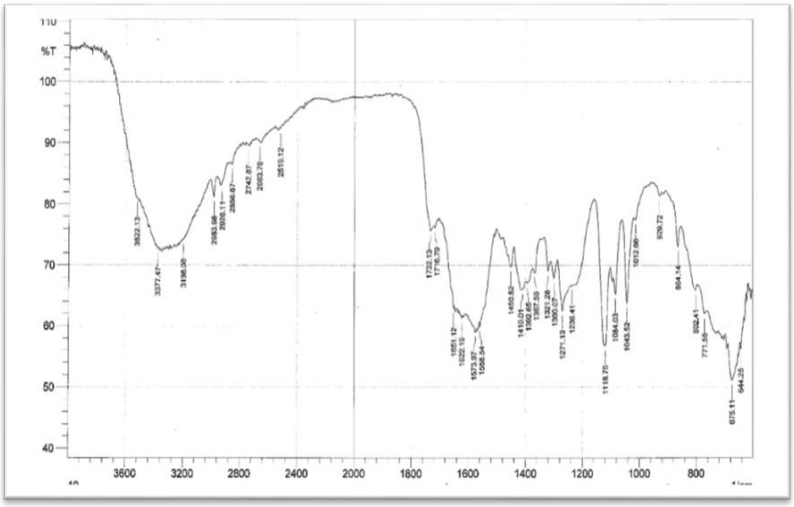


FIGURE 2: FTIR spectrum of (A2)

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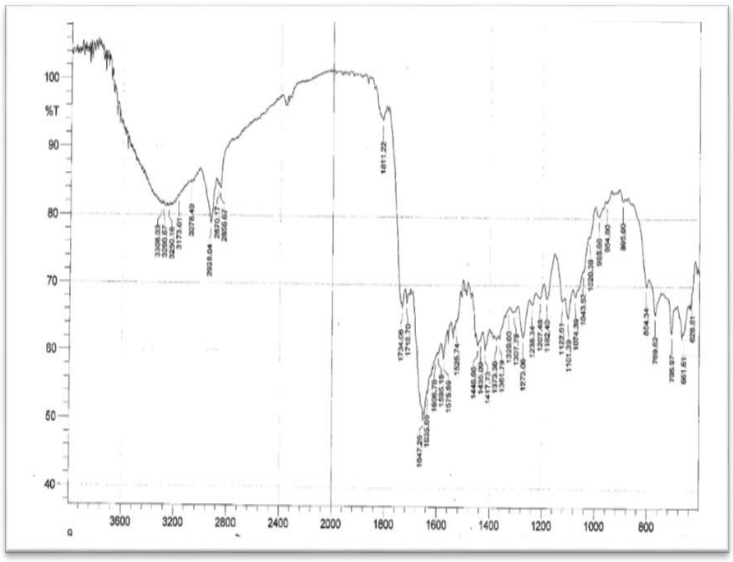
Figure(3):-FTIR spectrum of (A3) shows absorption bands at (2929,2877)cm^{-1}owing to (C-H) aliphatic ,(1234)cm^{-1}because of(C-O)ester , (3282)cm^{-1}owing to (O-H)group of carboxylic acid.



"FIGURE 3: FTIR spectrum of (A3)"

Ultraviolet technique

Figure (4):- Ultraviolet spectrum of (A1) show an absorption at (280)nm due to π-π*and (380)nm due to n-π*.

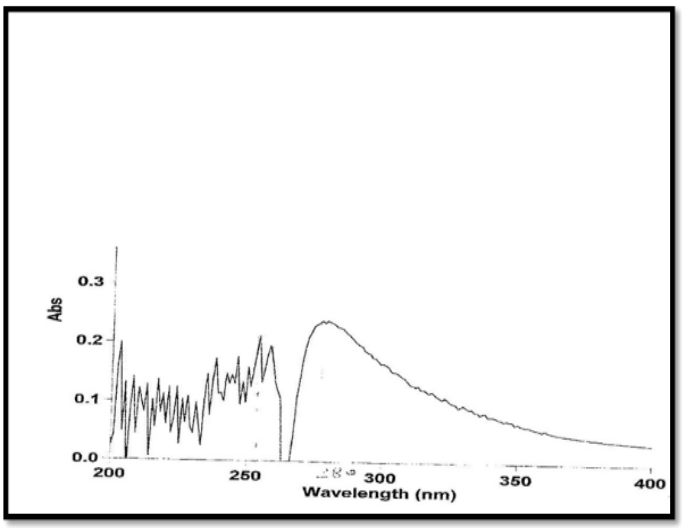


FIGURE 4: Ultraviolet spectrum of A1

Figure(5):- Ultraviolet spectrum of (A2)show an absorption at (380)nm due to π-π*and (420)nm due to n-π*.

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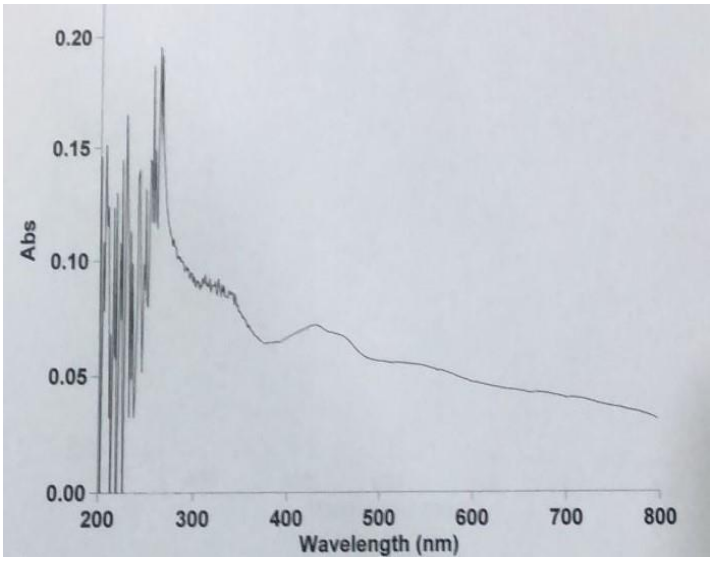

FIGURE 5: Ultraviolet spectrum of A2

Figure(6):-Ultraviolet spectrum of (A3)show an absorption at (290)nm due to π-π*and (390)nm due to n-π*.

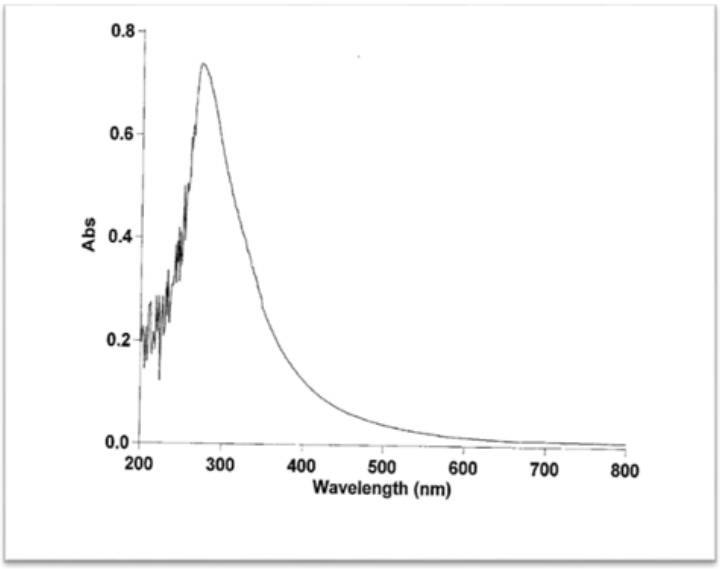

FIGURE 6: Ultraviolet spectrum of A3

In vitro antibacterial assay

The antibacterial materials incidencein biomedicine and associated areas of science and technology has been important .Annually,a lot of individuals die because of infections caused via pathogens.Among the various pathogens(bacteria,virus,fungi,algae, and others ,pharmaceutical industryis paying special attention to bacteria ,mainly due to the appearance of what is called multidrug resistant bacteria (MDR).According to the World Health Organization (WHO),antibiotics resistance is one of the main risks to healthand food security universally,as antibiotic resistance can influence anyoneof world .The major common bacteria are Acinetobacter and some enterobacteria such as Klebsiella and E.Coli.Thesebacteria can leadto dangerousinfections such as blood stream infection and peneumonia,and even death.(7)

(AgNPs) have been considered as an outstanding antimicrobial agent being capable to fight bacteria in vitro and in vivo causing infections. AgNPs antibacterial ability for covering Gram-negative and Gram-positive bacteria. AgNPs

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show multiple and simultaneous mechanisms of action and in combination with antibacterial agents as organic compounds or antibiotics it has shown synergistic effect against pathogens bacteria such as E. coli and Staphylococcus aureus. These features make them appropriate for their utilization in medical fields to treat infections or avoid them activity. (8-9) The antibacterial activity of A1, A2 and A3 was measured by agar well diffusion method. The results indicated that the prepared polymers had excellent antibacterial ability against gram negative and gram positive bacteria such as Staphylococcuse aureus, Sterptococcuse epidermidis, E. coli, Klebsiella sp. and Candida albicans. Table (1). The diameter of inhibition zone (DIZ) value was between 30 and 10 mm was recorded, Figure (2 & 3). The antibacterial activity of the polymers was likely because of mainly the reaction between carboxyl and amino groups in cell membrane proteins and may also have been owing to damage of the peptide links in cell wall peptidoglycan.(10)

TABLE 1: Antibacterial activity of the A1, A2, and A3 with and without Nano silver against different bacterial isolates

Bacterial isolates	A1 mm	A2 mm	A3 mm	A1 mm	A2 mm	A3 mm
	Without Nano silver			With Nano silver		
Staphylococcus aureus	10	11	13	12	11	13
Streptococcus epidermidis	12	11	13	25	27	30
Escherichia coli	10	12	11	12	13	13
Klebsiella sp.	11	10	11	15	16	18
Candida albicans	12	15	15	13	15	16

CONCLUSION

In this work, three biopolymers were successfully prepared from simple and low cost materials, and studying the chemical compositions of the polymers via FTIR and ultraviolet spectroscopic. More importantly, A1, A2 and A3 polymers with Nano silver particles showed excellent antibacterial activity against a wide range of microorganisms which could be safe for medical applications.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

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