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Synthesis, study and antimicrobial activity of new homo, copolymer maleic anhydridse with moiety heterocyclic creatinine

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Abstract: *The presented work involved the preparation of polymers homo and copoly containing heterocyclic (creatinine) derived from Maleic anhydride. The first step involved the preparation of maliamic acidcreatinine derivative,by reaction of maleic anhydride withcreatinine.The second step includes the polymerization of the prepared homo andcopolypolymersby free radical polymerization using (BPO) as initiator with heating. The third step involves study of degredation analysis of polymer in different at 37^{0}C using UV-Visible spectroscopy ,thermal analysis andSwelling studies . polymers were characterized by softening points , with other physical properties, FTIR, H1-NMR spectra, and thermal analysis (DSC),screening of the antimicrobial activity of the prepared polymers was evaluated against 3 types of bacteria.*

Keyword*: polymer, creatinine, maleic anhydride ,antimicrobial*

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I. Introduction

Polymers are macromolecules built up by the linking together of large numbers of much smaller molecules(!). The small molecules that combine with each other to form polymer molecules are termed monomers, and the reactions by which they combine are termed polymerizations, Some reactive olefin monomers, with heteroatom groups being more reactive than alkyl or aryl groups, Heterocyclic monomers that are polymerized are lactones, lactams, and cyclic amines. Upon addition of an initiator, cyclic monomers go on to form linear polymers. The reactivity of heterocyclic monomers depends on their ring strain. Heterocyclic chemistry is one of the largest branches of organic chemistry(2-5) It is particularly important in nature because of the wide variety of industrial significance and ysiological activities There has been recent interest in developing,synthetic routes for preparation of significant. Biopolymers,havedrawn considerable attention ide signing ,hydrogel wit ideally applied biopolymer is alginicafford the past few decades, biodegradable polymers have been,applied as carriers for controlled delivery of low molecular weight drugs as well as bioactive proteinsفريال[6,7].Biodegradable polymers, either synthetic or natural, are capable of being cleaved into biocompatible by,products through chemical or enzyme-catalyzed hydrolysis. This biodegradable property makes it possible to,implant them into the body without the need of subsequent removal by the surgical operation Drugs formulated,with these polymers can be released in a controlled manner, by which the drug concentration in the target site is,enhanced. The release rates of the drugs from biodegradable polymers can be controlled by a number of factors,,such as biodegradation kinetics of the polymers [8-10], ysicochemical properties of the polymers and drug,[11,12], thermodynamic compatibility between the polymers and drugs [13], and the shape of the devices [14-16]. Maleic anhydride is an excellent monomer which can provide reactive anhydride or carboxylic,groupswithnucleoilic molecules. [17,18]. MAN has an extremely low tendency to homopolymerize in a radical,polymerization condition; on the contrary, it copolymerizes with a variety of donor monomers[19]. The chemical,modification of synthetic polymers allows the control of their mechanical and thermal properties [20] and,expands their explicabilities, as introduction of MA on the non-polar backbone of polyolefins and rubbers has,overcome the disadvantage of low surface energy of these polymers, improving their surface hydroilicityfor,the benefit of printing and coating applications, and adhesion with polar polymers(polyamides), [21-]. One of the,most common monomers in the polymer modification is MA and its isostructural analogues such as Nsubstituted,maleimides, fumaric, citraconic and itaconic acids and their esters amides, imides, and anhydrides of,thesedicarboxylic acids[22]. synthetic polymers also constitute a wide area of materialscithe properties of pure, synthetic,polymersand pure biological polymers are often inadequate for producing materials with good chemical mechanical thermal, and biological charateristics,[23].recently modification study was carried out with maleic anhydride as a grafted
Copolymer[24,25]

Experimental

A- chemicals: All chemicals used in this work were from BDH, Merk, Fluka and were used without further purification. Compounds prepared were characterized by (FT- IR ,^{1}H-NMR & Mass spectral data). Melting points are uncorrected determined by using /SMP31 Thi-Qar University college of sciences

B-instruments: FTIR spectra were recorded using KBr discs on Shimadzu-8400 spectrootometer, Al-Shatra technical institute, Southern Technical University.^{1}H-NMR spectra were recorded on near magnetic resonance Bruker DRX System , 500 MHz Using TMS as internal standard and DMSO as solvent , Sharif University of Technology, Tehran ,IranMass spectra by (Mass Selective Detector 5973 Network) 70 e/v, Sharif University of Technology, Tehran, Iran.

1-Synthesis of AmicAcid .[26-29]

In a 150 mL two- necked flask equipped with magnetic stirrer ,droop funnel and reflux condenser were placed (0.005mole 0.5 g) of maleic anhydride and (25mL) of a dry acetone. When all anhydride had been dissolved by stirring.a solution of (0.005 mole , 0.5 g) of Creatinine in (25 mL) of acetone was allowed to run through the dropping funnel dropwise for 30 min under cooling range (0-5 C^0). continued stirring under room temperature for 2 hrs. precipitatesettled out and filtered by suction filtration. Washed with solvent dried and recrystallized from ethanol pale browncolor,mp(171-173),85%yiled.

POLYMERIZATION:[30,31]

Polymerization of creatininemaleamicacid(homo polymerization)

0.3g. of prepared monomer was dissolved in 5ml of DMF, and 0.05% weight of dibenzoyl peroxide was added, under nitrogen atmosere, the polymerization tube was covered, heated by water bath at 900C about 1hr. The pal yellow polymer was obtained when the reaction mix. poured on ice water with 85% yield with s.p about 143-151 ^{0}C

Polymerization of creatininemaleamic acid with acrylonitrile(co-polymerization)

0.3g. of prepared monomer and acrylonitrile was dissolved in 10 ml of DMF and 0.05% weight of dibenzoyl peroxide was added, under nitrogen atmosere, the polymerization tube was covered, heated by water bath at 90^0C about 1hr. The oily yellow polymer was obtained with 60% yield.

STUDIES:-

Swelling studies

swelling studies of polymer made as follows:-

Homo and co-Polymer was swollen in solution withPH 7 at 37 ^{o}C to determine the parameters of swelling and diffusion. Swollen metter removed from the water bath at regular intervals were dried superficially with filter paper..

Decomposition study:

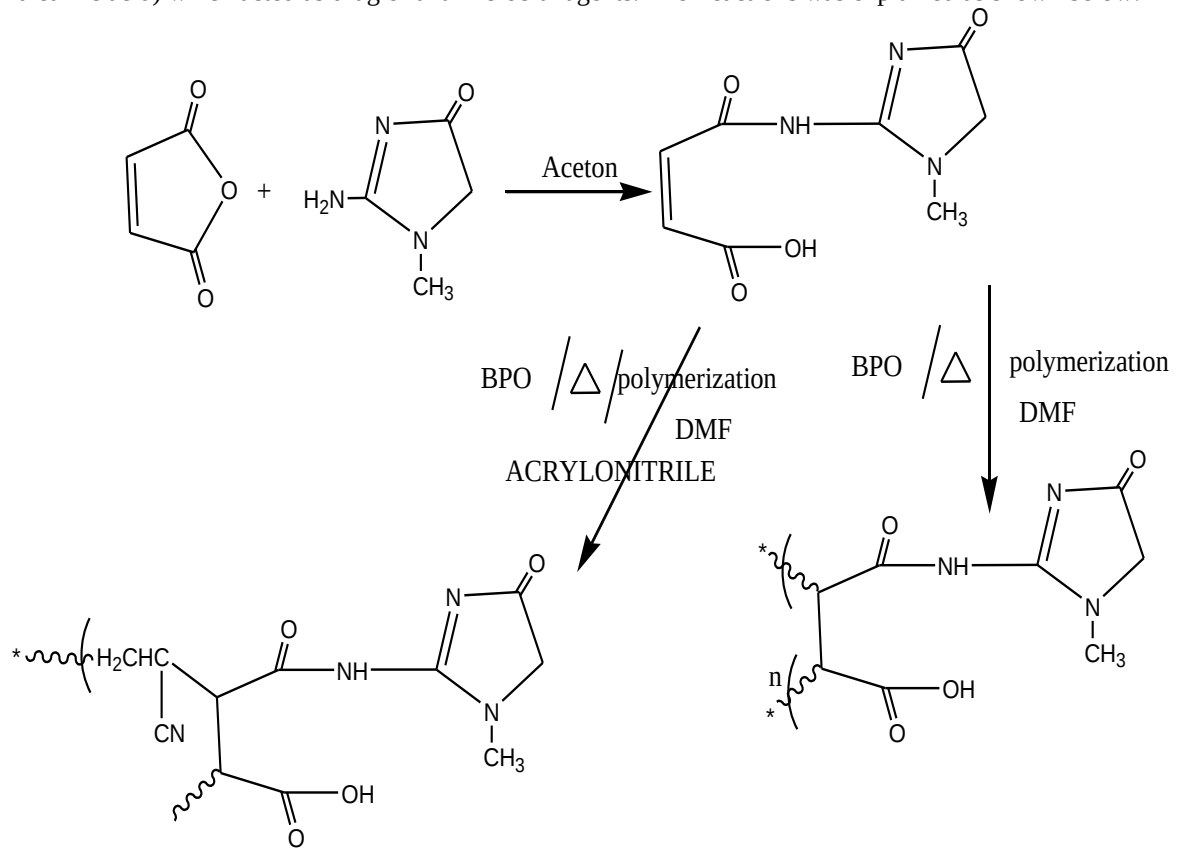
A study was conducted to measure the speed decomposition of polymer, A mixture of polymer and solution prepared using 1.5 and 7.4 , where first solution was prepared of 0.1N(HCL) ,the second solution (7.4) of Phosphate buffer ,the mixture of polymer and solution was kept in a contener, 50 mg of polymer was added, kept at 37^{o}C without stirring, release sample was periodically drown with an analysis by UV spectra at 279,294 nm to determine the amount of release creatinine. A calibration curve was constructed with software built in the computerized UV otometer and the controlled release polymer were carried out in different value (4, 10) at 37 0C .result show in table 3,4, fig 1 ,2

The Biological activity [32-35]

The synthesized compounds were exposed to antimicrobial activity. Antimicrobial activities were observed for some of the compounds using strain of gram positive such as (Staphylococcus aurous), gram negative (E. coli). The antimicrobial activities of the synthesized compounds were studied by disc diffusion method. Bacterial inoculums were spread on Nutrient agar. After the inoculums dried, 6 mm diameter wells were made in the agar plate with a sterile cork borer. The synthesized compounds were dissolved in DMSO at concentration of 10^{-2}M,Cefotaxime 10^{-2} M was used as standard for the antibacterial activity. The Petri plates were incubated at 37ºC for 24 hours. The Zone of inhibition was measured in mm and the results are listed in Table (5)

II. Results and Discussion

In this study the polymer was prepared containing creatininemoiety as pendant groups the homo and co-poly (maleamic acid) which acted as drug or antimicrobial agents. The reactions was explained as shown below:-



the structural elucidation of poly(creatininemaleamic acid) which functionalization chemistry, with carboxyl groups and lactam cycle along the backbone was analyzed using FTIR spectroscopy, and assignments for the characteristic groups were developed FTIR spectra of prepared polymer is given in Fig. (4) a new band appeared at 1710 cm-1 which confirmed the presence of carboxyl groups and the absorption of OH carboxylic was appeared at 3450-2962 cm-1 with comparing with Fig. (3) ofcreatininyl monomer alone. Supporting evidence for the structural elucidation was revealed by 1H NMR analysis, Fig. (7) indicated the content of protons at 2.6 ppm are assigned to –CH-CH- of succinamicd(7-8)ppm and the CH_2 ofcreatinien cycle was appeared at d(4.3) ppm in addition, the undetectable resonance of protons in the COOH may be due to the formation of hydrogen bonding between inter,or intra-molecules and the proton of carboxylic acid was appear at 9.3 ppm,wher" FTIR spectra of copolymer for LSe polyester is shown in the Figure 5. The pronounced peaks
around 1734 cm−1 suggest the presence of carbonyl (C=O) groups from the ester. The bands centered at around 2931 cm−1 was assigned to methylene(-CH2-) groups for diacids/diols and observed in all the spectra of the polyester. The C-H symmetric stretching of aliatic-CH2- group observed at 2931cm-1. Strong vibrational mode observed at 1217cm-1 is associated with C–O–C asymmetric stretching mode aliatic ester."[11]

Differential Scanning Calorimetry (DSC)

The DSC scans were recorded at a heating rate of 10° C/min using a Perkin-Elmer Pyris I analyser. calibration standard Differential Indium was used as the ScanningCalorimetry (DSC)Analysis. DSC is a technique for determining the quantity of heat either absorbed or released when a substance undergoes a physical or chemical change. Several parameters.[10], The thermal transition of polymer show stability even 800 ^{o}C, and the results shown in(fig.6).[18]

Table I Physical data of Polymers (homo,co)creatininylmaliamic

Compound	S. point ^{0}C		yield%	Rec.solvent
homo	143-152	-	80	DMF-WATER
Co-poly	oily	-	60	DMF-WATER

	Table II IR value data of polymers (homo,co-)creatininemaliamic							
Compound	C=O of β-lactam	C=O of carboxylic	C=O of amide	N-H bend of amide	N-H of amine	C ≡N	λmax	
homo	1770	1750	1650	1515	3290	……..	294	
Co-	1780	1755	1645	1520	3286	2255	279	

Table III absorbanceData(A) of homopolymer at =1-2 and =7.4 at λ_{max}294 nm

A at 1-2	A at 7.4
0.433	0.870
0.385	0.451
0.384	0.441
0.384	0.337
0.346	0.303

Note: the last reading take after 24 hr (over night)fig 4

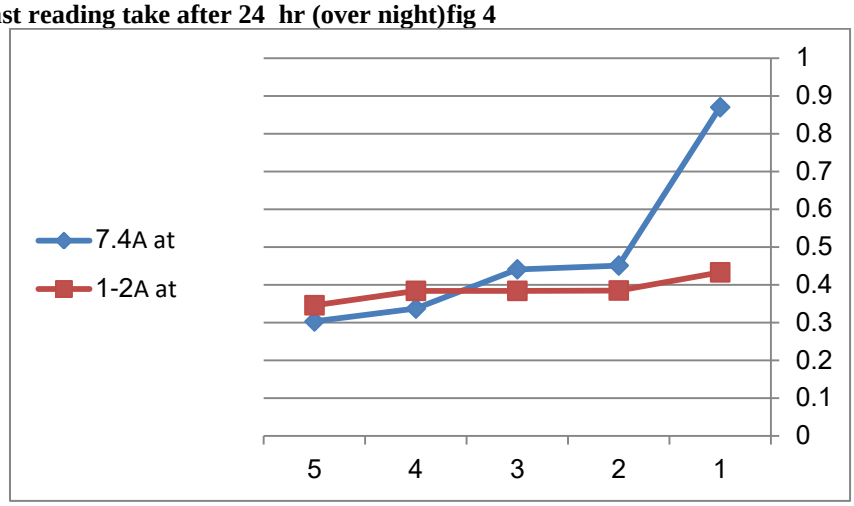


Fig1-speed decomposition of homo polymerin different buffer,pH value (pH1-2, pH 7.4) at 37^0C

Table IV absorbanceData(A) of co-polymer at =1-2 and =7.4 at λ_{max}279nm

A at 1-2	A at 7.4
0.983	0.167
0.362	0.166
0.361	0.165
0.353	0.114
0.557	0.257

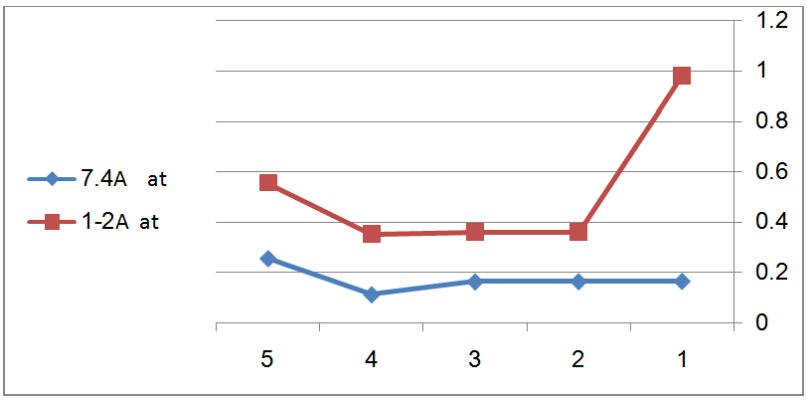


Fig-2-speed decomposition of co- polymer in different buffer,pH value (pH1-2, pH 7.4) at 37^0C

Table V Antimicrobial activity of polymers (Zone of inhibition in mm)

Samples/50 µg/ml			E.Coli	S.aureus	Pseudomonas
Homo polymer			10mm	12mm	12mm
C			-	-	-
Co-polymer	34mm	33mm	31mm		
C	28mm	25mm	26mm		

note: C = CONTROL SOLVENT ,and local bacteria using for test

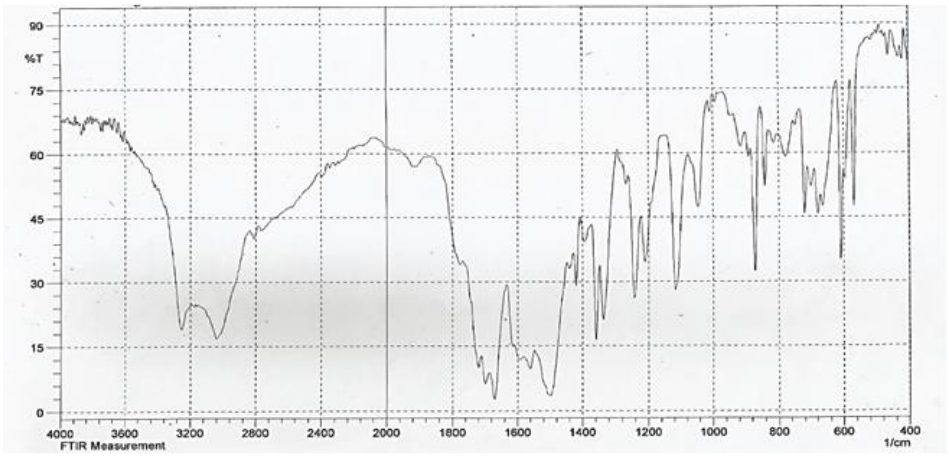


Fig 3-FTIR spectra of monomer (creatininylmaliamicacid

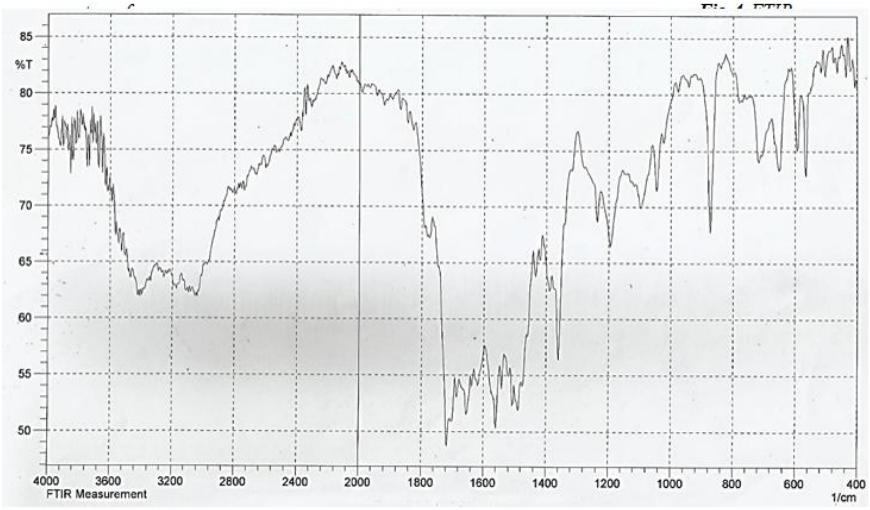


Fig 4-FTIR spectra of Homopolymer (creatininylmaliamicacid)

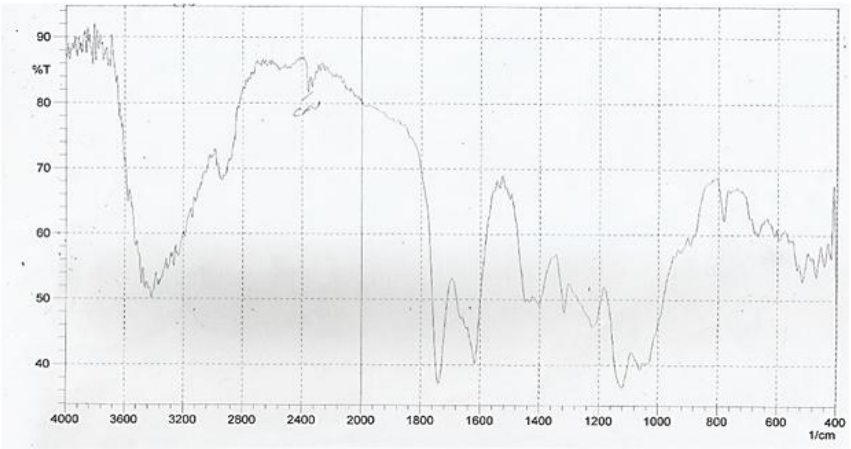


Fig 5-FTIR spectra of Copolyacrelonitryle with (creatininylmaliamicacid)

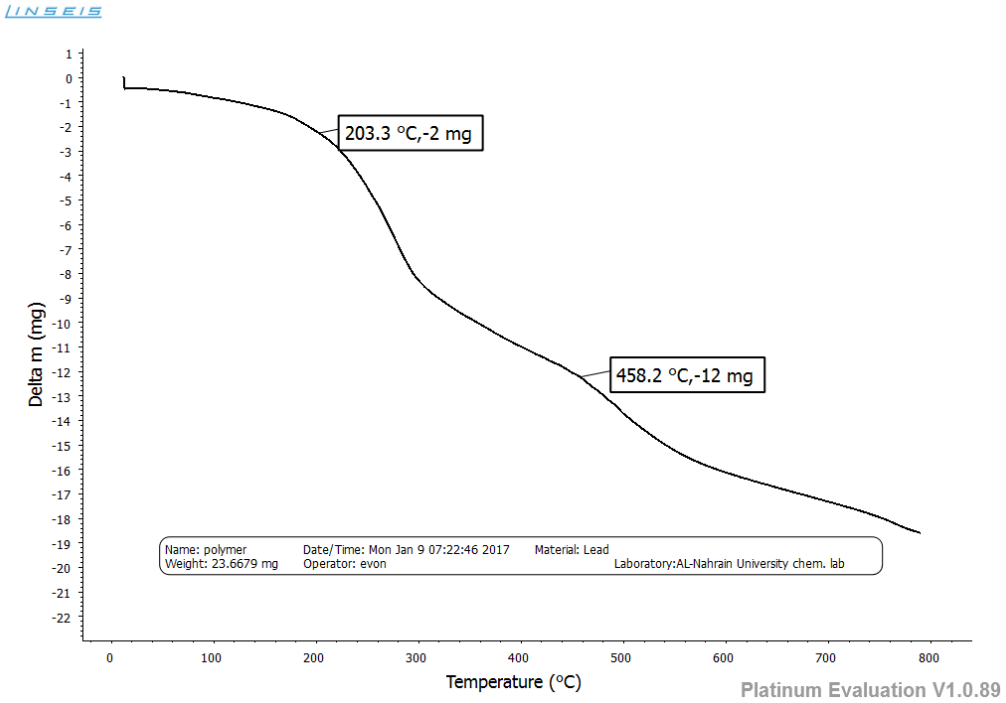


Fig 6-DSC-analysis of homo polymer

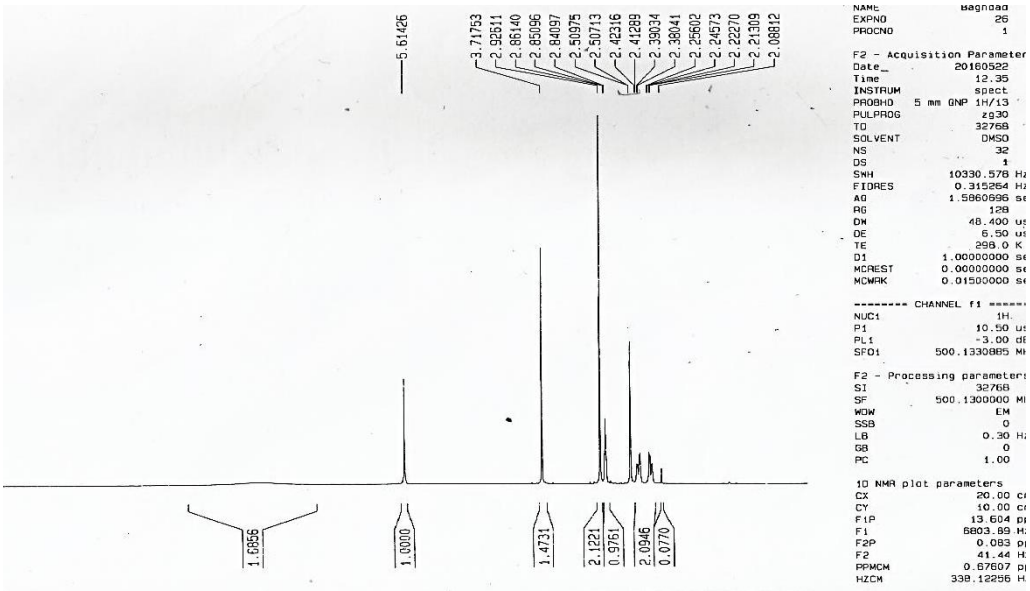


Fig-7–H-NMR spectra of Homopolymer (creatininylmaliamicacid)

References

[1] "Modern Size-Exclusion Liquid Chromatography: Practice of Gel Permeation and ... Andre Striegel"‹Wallace W. Yau‹Joseph J. Kirkland‹Donald D. Bly,2009

[2] Gullapalli, S.; Wong, M.S. (2011). "Nanotechnology: A Guide to Nano-Objects" (PDF). Chemical Engineering Progress. 107 (5): 28–32.

[3] Jump up^ "Glossary of basic terms in polymer science (IUPAC Recommendations 1996)" (PDF). Pure and Applied Chemistry. 68(12): 2287–2311. 1996. doi:10.1351/pac199668122287.

[4] Jump up^ Staudinger, H.; Fritschi, J. (1922)."ÜberIsopren und Kautschuk. 5. Mitteilung. Über die Hydrierung des Kautschuks und über seine Konstitution". Helvetica ChimicaActa. 5 (5): 785. doi:10.1002/hlca.19220050517.

[5] Jump up^ Jensen, William B. (2008)."The Origin of the PolymerConcept". Journal of Chemical Education. 85 (5): 624. Bibcode:2008JChEd..85..624J. doi:10.1021/ed085p624.

[6] Kim J.M., Ahnk K.D. and Wolff G. Macromol Chem. ys., 202, 1105, 2001.

[7] Dugas H. "Bioorganic Chemistry", 3rdedition, Springer-verlag, 6, P192. 1996.

[8] Al-Sabagh A, Noor MR, Din EL, Morsi RE, Elsabee MZ Styrene-maleic anhydride copolymers esters as flow improvers of waxy crude oil. (2009) J Pet SciEng 62:139–146

[9] Zhu LP, Yi Z, Liu F, Wei XZ, Zhu BK, Xu YY Amiilic graft copolymers based on ultrahigh molecular weight poly(styrene-alt-maleic anhydride) with poly(ethylene glycol) side chain for surface modification of polyethersulfone membranes. EurPolym (2008) J 44:1907–1914

[10] Tamizharuvi T and Jaisankar V,2015," A study on antifungal properties of biodegradable chitosan/lactic acid based polymer blend films"International Journal of armTech Research Vol.8, No.9, pp 139-147, 2015

[11] Nieuwhof R, Koudijs A, Marcelis A, Sudholter E) Modification of sidechain liquid-crystalline poly(maleic anhydride-co-alt-1-alkene)s with mesogen-containing alcohols. (1999 Macromol 32:6499–6506

[12] Priya Ganesan1, Amruta P. Barhanpurkar2, Mohan R. Wani,2016," Fabrication of cellulose based scaffolds for boneregenerationapplication",International Journal of ChemTech Research,Vol.9, No.06 pp 603-606

[13] Bruch M, Mader D, Bauers F, Loontjens T, Mulhaupt R Melt-modification of poly(styrene-co-maleic anhydride) with alcohols in the presence of 1,3-oxazolines. J PolymSci Part A: (2000) PolymChem 38:1222–1231

[14] Safa KD, Babazadeh M Glass transition temperature modification of acrylic and dienic type copolymers of 4-chloromethyl styrene with incorporation of (Me3Si)3C– groups. (2004) EurPolym J 40:1659–1669

[15] Boztug A, Basan S The modification and characterization of maleic anhydride-styrene-methyl methacrylate terpolymer by poly(ethylene adipate). (2007) J MolStruct 830:126–130

[16] Wang K, Huang W, Xia P, Gao C, Yan D Fluorescent polymer made from chemical modification of poly(styrene-co-maleic anhydride). (2002) ReactFunctPolym 52:143–148 Chemistry and Materials Research www.iiste.org ISSN 2224- 3224 (Print) ISSN 2225- 0956 (Online) Vol.7 No.5, 2015 8

[17] Safa KD, Eram HA, Nasirtabrizi MH Chemical modification of some4-chloromethylstyrene polymers with highlysterically hindered tris(trimethylsilyl)methyl groups. (2006) Iran Polym J 15:1249–1257

[18] Ravish S. Rajput, D.C. Rupainwar, Amarika Singh,2009," a study on styrene maleic anhydride modification by benzoic acid derivatives and dimethyl sulfoxide"International Journal of ChemTech Research,Vol.1, No.4, pp 915-919

[19] Mohammad Sadeghi and NahidGhasemi Preparation and swelling behavior of carrageenangraftpolymethacrylamide superabsorbent hydrogel as a releasing drug system. (2012) Indian J.Sci.Technol. 5 (2)

[20] Z. M. O. Rzayev, Ernur A. S¸ylemez, BurhanDavarcioğlu, Functional copolymer/organo-MMT nanoarchitectures. VII. Interlamellar controlled/living radical copolymerization of maleic anhydride with butyl methacrylate via preintercalated RAFT agent–organoclay complexes, Polym. Adv. Technol. 2011. DOI:

[21] Y. Zhang, Y. P. Huang, K. C. Mai, Crystallization and dynamic mechanical properties of polypropylene/ polystyrene blends modified with maleic anhydride and styrene, J. Appl. Polym. Sci. 96 (2005) 2038-2045

[22] C. Cartner, M. Suarez, B. L. Lopez, Grafting of maleic anhydride on polypropylene and its effect on blending with poly(ethylene terethalate), Polym. Eng. Sci. 48 (2008) 1910-1916

[23] C. Q. Yang, X. Wang, Y. Lu, Interfacial interactions of a novel mechanochemical composite of cellulose withmaleated polypropylene, J. Appl. Polym. Sci. 94 (2004) 1326-1335.

[24] Firyal M. Ali, Khudheyer and et-al,(2014), Preparation of Poly (N- Imidazolylmaleamic acid), Journal of Al-Nahrain University Vol.17 (1) pp.1-6

[25] Firyal M.Ali and et-al,(2015), "Synthesis of Substituted Gelatine Grafted Maleic Anhydride as Drug Copolymer",Chemistry and Materials Research ,Vol.7 No.5, 2015

[26] Pyridi, T.M., and AL-Majidi S. M. H. **2006**. Modification of poly[styrene-co-Butadiene] rubber to polymer containing pendant amic acid, isoimide and imide isomerization of the polymer containing isoimide to the corresponding imide.J. Um-salama, Sci., 3(4), pp:656-669

[27] Ali. E. T. ,Lazim K. M. and Tomma J. H.**2011**. Synthesis and Characterization of New Symmetrical Pyromellitdiimide Derivatives and Their Amic Acids, Ibn al- Haitham j. for pure & appl. sci., 24 (3),PP: 1-12

[28] Anil N. M., Hemmige S. Y., Narayana B., .Sarojini B. K, Kumari N. S. **2010.** Synthesis and Antimicrobial Studies on New Substituted 1,3,4-OxadiazoleDerivatives Bearing 6-Bromonaphthalene Moiety ,international journal of chemistry , 2 (1).pp:38 .

[29] Rakesh C., Anshu A., Manoj K. P.,Prabodh C., Der S., Sukumar M. **2010**. Synthesis of novel 1,3,4-oxadiazole derivatives as potential antimicrobial agents, Acta Pol Pharm. 67(3):pp247-253

[30] Hussein F. Abdul MahdiAndMuna.I.KhalafEntesar O. Al-Tamimi," Synthesis and Antimicrobial screening of some new azo compounds derived from thiazole ring modified" International Journal of ChemTech Research Vol.10No.1pp437-447,2017

[31] Entesar O Al Tamimi*, Muna I Khalaf, Raghad A Abd Al-Jabar. "Synthesis and characterization of some new N-substituted phthalimide "The Pharmaceutical and Chemical Journal, 2016, 3(4):202-207 The Pharmaceutical

[32] A. Pandey, P. Singh and L. Iyengar, Bacterial decolorization and degradation of azo dyes, Inter. Biodet.Biodeg.,2007, 59, 73-84.

[33] S. K. Zadafya, J. H. Tailor and G. M. Malic,Disperse Dyes Based on Thiazole, Their Dyeing Application on Polyester Fiber and Their Antimicrobial Activity, Journal of Chemistry, 2013, Article ID 851418.

[34] A. A. Chavan and N. R. Pai, Molecules, 2007, 12, 2467.

[35] K. M. Sujit et al., IJPPR Human, 2015, 2(3), 60-66.

Muna.I.Khalaf. "Synthesis, study and antimicrobial activity of new homo, copolymer maleic anhydridse with moiety heterocyclic creatinine." IOSR Journal of Applied Chemistry (IOSR-JAC), vol. 10, no. 8, 2017, pp. 60–66.