Synthesis and Characterization Some of Imidazol Derivatives

Rasha Nazik T. Al-Daemi[1*], Hasan Thamer Ghanim[2]

Abstract

The research includes the preparation of heterocyclic compounds by the interaction of metronidazole with p-aminoacetofenone, the formation of the azo product was interacted with the amino derivatives and the validity of the compounds prepared by melting point and FTIR, H^1NMR and C^{13}NMR Spectroscopy.

Key Words: Amine, Formation, Interaction.

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Introduction

Imidazole is a bio-compound and essential core in types of drugs., it is a heterocyclic compound containing three atoms and two nitrogen atoms (Fahimah M. et al 2018)(1) and it is considered a high melting may rise to 256c due to the hydrogen bounds formed between its molecules (Asmaa. S. et al 2015.,Poonam G. et al 2015)(2, 3), The imidazole found in many biological molecules, such as histidine, which is enter in combination of many enzymes and protiens (Iftikhar A. et al 2015., Samuelson. J. 1999)(4,5), as well as enter in various types of drugs, and it derivatives show various biological effects (Bergan T. 1980)(6),including Metronidazole is an industrial biological derivative derived from azomycin, which is nitroimidazole produced from the genera of action bacteria and proteobacteria (Matila J, et al 1983., Muller M, et al 1983)(7, 8). In 1959, this compound was used to treat trichomoniasis, an infection caused by the protozoan vaginal trichomonas. Moreover, metronidazole was effective against dysentery and liver abscess caused by the intestinal parasite parasite, Tamoeba histolytica (Houghton W, et al 1979)(9). It was also effective against Giardia lamblia, another that causes malabsorption and epigastric pain. Metrondazole is available as an oral (Chong.P et al 2007., Wright. P et al. 2014) intravenous(10, 11), vaginal and rectal presentation, although the most frequently used presentation is oral. Its oral dosage forms of 250 or 500mg are rapidly absorbed and distributed almost to the entire body intestinal parasite (Husam H. et al 2019, Khdur R. et al 2018)(12, 13).

Materials and Methods

high purity chemicals compounds as provided by sigma and GCC company, Melting point of vehicles registered by Elctrical engineering 9300, melting point LTD, All compounds synthesizing measurements were recorded by: FTIR spectra, shifting four infrared shimadzu (8400), H^1NMR and C^1NMR –spectra in (ppm) in DMSO solvent by Bruker –AVANCE AQS-300MH_Z,Iran, Thin layer chromatography (TLC) used silica gel in (Benzene: methanol) solvent.

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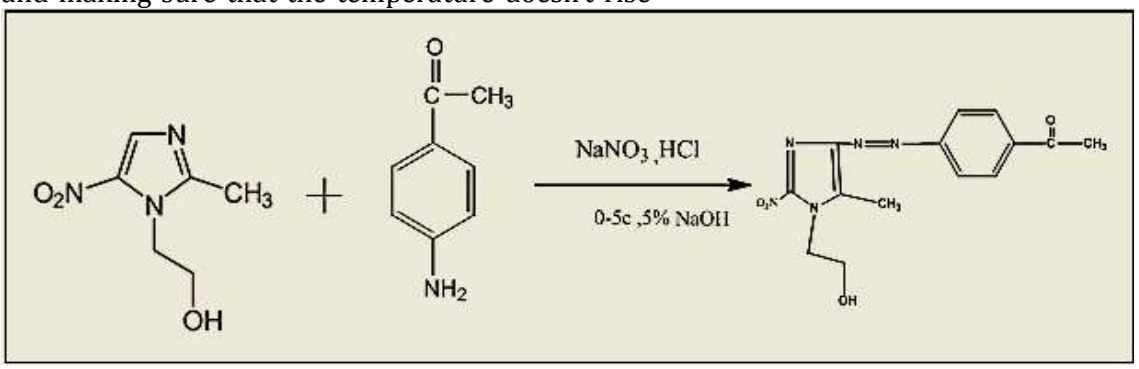
Experimental

Synthesis of the Compound (R)

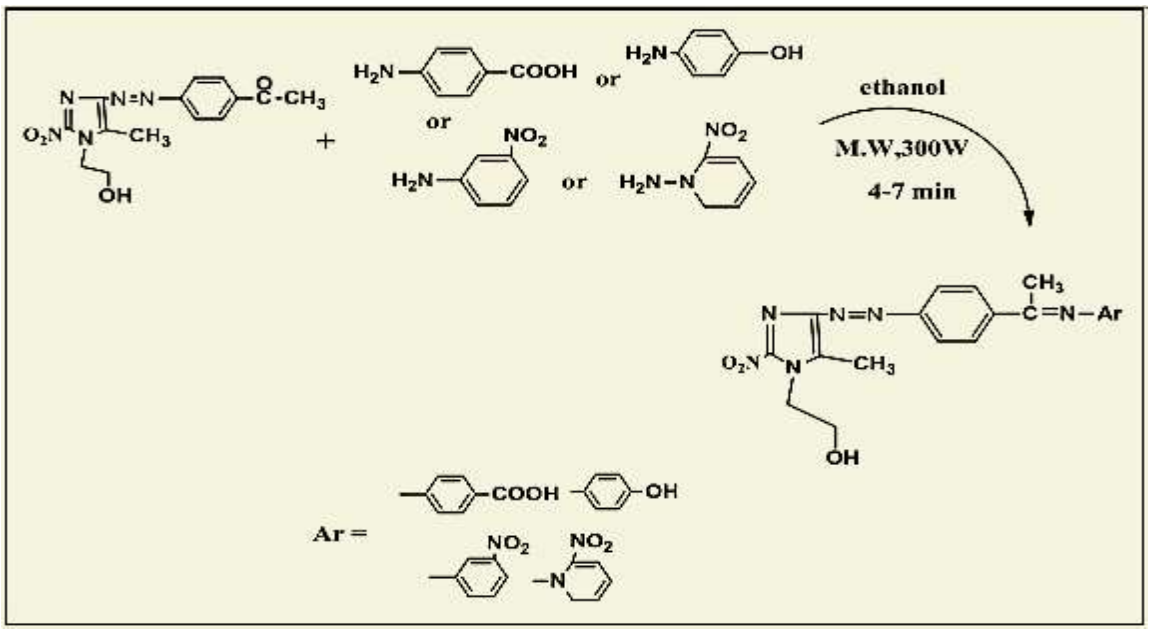
Prepare the compound by dissolving p-aminoacetofenone (3.2gm.0.02 mol) in a mixture (5)ml of HCl and (20ml) of distilled water and cool the mixture in geothermal bath at a temperature of (0-5) and then add solution (1.8gm.0.02mol) of $NaNO_3$ dissolved (20ml)of cold distilled water is added, by instilling a drop with constant stirring and making sure that the temperature doesn·t rise above (5 C) and leaving the formed solution for a period (20min) to fully stabilize the process[13] of diazha, then add the diaonium transducer formed drop by drop with continuous stirring into a solution consisting of (4gm.0.02mol)of the metronidazole dissolved in a mixture of (60ml) ethanol and (20ml) of NaOH concernated(5%), then leave solution for(3h) and then filter[14, 15] it (Hawaiz F et al 2016., Ameen M et al 2015).



Scheme 1. Synthesis of compounds (R)

Synthesis of Compound (R1,R2,R3,R4)

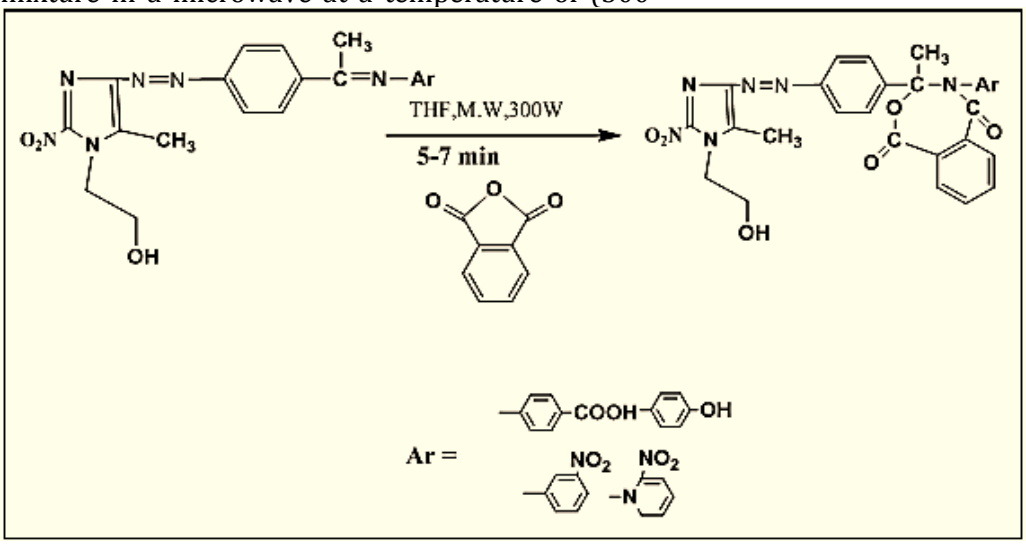
Schiff basses prepared from dissolving (0.5 gm 0.001mol) in (10 ml) of the absolute ethanol in the presence of a drop of snowy acetic acid and then adding each of (0.2 gm0.001mol p-aminophenol, 0.22 gm 0.001mol p-aminobenzoicacid, 0.15gm0.001mol 2-aminopridine, 0.22gm 0.001mol 3-aminoaniline) and then put the mixture in the microwave at a temperature of 300 watts for (4 -7 min) (Patel P. 2012., Murtaza.S. 2016)[16, 17]. the reaction was followed by (TLC) using (3;1 ethanol; drybenzen) and then cooled and crystallized using ethanol.



Scheme 2. Synthesis of compounds (R_1 to R_4)

Synthesis of Compound (R5,R6,R7,R8)

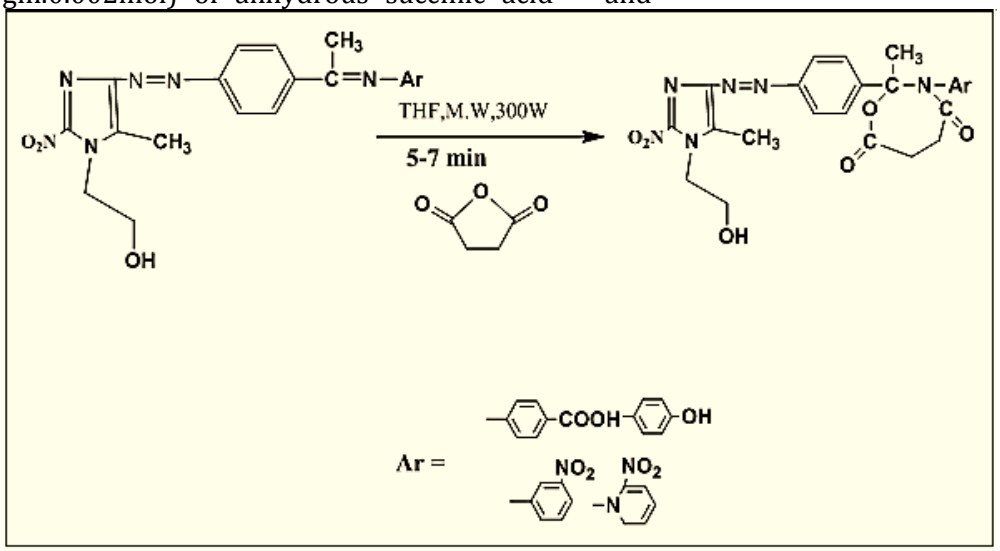
Dissolve (0.3 gm.0.0007mol, 0.15 gm.0.0003mol, 0.1 gm.0.0002mol, 0.1 gm.0.0002mol) of the sghiff basses of preparation (R_1,R_2,R_3,R_4) in (5 ml) of Toluene after thawing and then added (0.1 gm 0.0006mol) of anhydrous phthalic acid and put the mixture in a microwave at a temperature of (300 watts) for (5-7 min) the reaction is followed by (TLC) (3;1 ethanol ; drybenzen) after the reaction was completed the mixture was cooled and crystallied by absolute ethanol (Halawa A et al 2017)[18].



Scheme 3. Synthesis of compounds (R_5 to R_8)

Synthesis of Compound (R9,R10,R11,R12)

Dissolve (0.2 gm.0.0004mol, 0.2 gm.0.0004mol, 0.12 gm.0.0003mol, 0.1 gm.0.0002mol) of the sghiff basses of preparation (R_1,R_2,R_3,R_4) in (5 ml) of (Toluene) after thawing and then added (0.2 gm.0.002mol) of anhydrous succinic acid[19] and put the mixture in a microwave at a temperature of (300 watts) for (5-7 min) the reaction is followed by (TLC) (4;1 ethanol; drybenzen) after the reaction was completed the mixture was cooled and crystallied by absolute ethanol (Nadeesha R. et al 2017)[20]

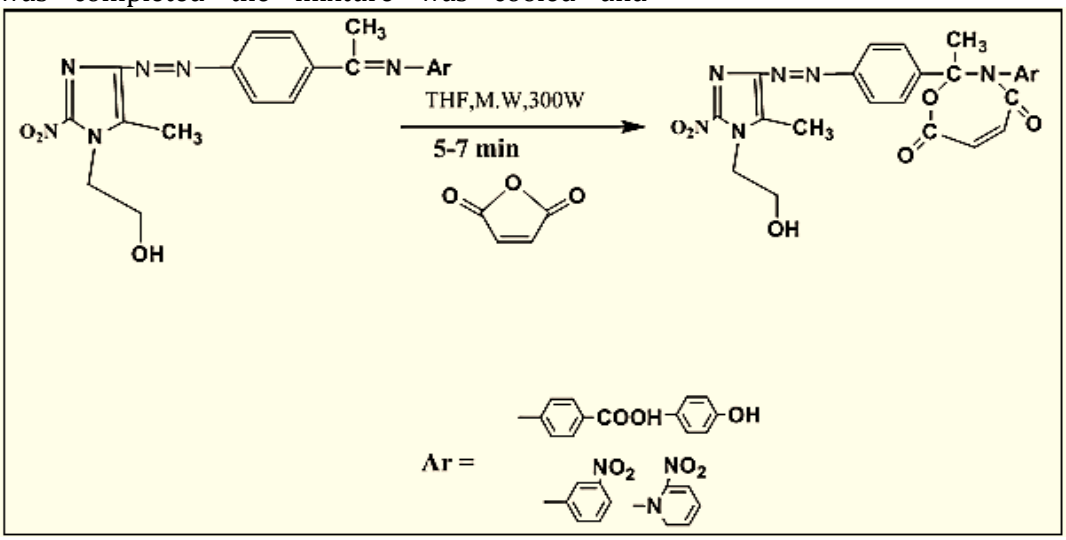


Scheme 4. Synthesis of compounds (R_9 to R_{12})

Synthesis of Compound (R13,R14,R15,R16)

Dissolve (0.1 gm.0.0002mol, 0.12 gm.0.0002mol, 0.2 gm.0.0005mol, 0.1 gm 0.0002mol) of the sghiff basses of preparation (R_1,R_2,R_3,R_4) in (5 ml) of Toluene after thawing and then added (0.1 gm.0.001mol) of anhydrous malic acid and put the mixture in a microwave at a temperature of (300

watts) for (5-7 min) the reaction is followed by (TLC) (3;1 ethanol ; drybenzen) after the reaction was completed the mixture was cooled and crystallied by absolute ethanol (Jia X et al 2017., Vunnam S et al 2017)[20, 21].



Scheme 5. Synthesis of compounds (R_{13} to R_{16})

Results and Discussion

R: FT-IR (KBr) cm^{-1} v3311.78 (OH), v3199.91 ($CH_{aromatic}$), v 2812.21 ($CH_{aliphatic}$), v1683.86 (C=O), v 1498.69 (N=N) v1527.62 ($C=N_{imidazol}$), v1566.20 ($C=C_{aromatic}$), v 1369.46 ($CH_{3imidazol}$).

R/:, M.P(74-76)C^0, yield 86%, FT-IR(KBr)cm^{-1}, v3338.78(OH), v3099.61 ($CH_{aromatic}$), v2956.87 ($CH_{aliphatic}$), v 1726 (OH, imidazole group), v1598.99 $(C=C)_{aromatic}$, v1535.43 $(C=N_{imidazol})$, v1479.40(N=N) v1367.53(CH_3), v 1676.14 (H-C=N).

R2:, M.P(192-194)C^0, yield 85% FT-IR(KBr)cm^{-1}, 3435.22(OH carboxal), v1535.34 $(C=N_{imidazol})$, v 3097.66 ($CH_{aromatic}$), v2981.95 ($CH_{aliphatic}$), v1600.92$(C=C)_{aromatic}$, v 1683.86 (H-C=N) v 1365.60 (CH_3) v 1699.80 (C=O) v 1479.40 (N=N).

R3:, M.P(219-221)C^0, yield 88%, FT-IR(KBr)cm^{-1}, v3221.12(OH), v3097.66($CH_{aromatic}$), v2953.02 ($CH_{aliphatic}$), v1680.00 (H-C=N), v1535.34 $(C=N_{imidazol})$, v 1481.33 (N=N), v1365.60 (CH_3), v1598.99 $(C=C)_{aromatic}$.

R4:, FT-IR (KBr) cmv3219.19 (OH), v3099.61 ($CH_{aromatic}$), 2954.95($CH_{aliphatic}$), v 1680.00 (H-C=N) v 1597.06 $(C=C)_{aromatic}$, v 1533.41 (C=N), v 1479.40 (N=N), v 1367.53 (CH_3)

R5: FT-IR(KBr) cm, v 3414.00 (OH), v 3223.05 (OH), v3099.61 ($CH_{aromatic}$), v2958.80 ($CH_{aliphatic}$), v1714.72 (O-C=O)lacton, v1685.79 (N-C=O)lactam, v1537.27 (C=N), v1598.99 $(C=C)_{aromatic}$, ^{1}H-NMR(DMSO), δ 10.04(s,OH,1H), δ 9.74 (CH oxazepine ring) δ 5.01($OH_{imidazole}$), δ 6.60-6.88 $(C=C)_{Oxazepine\ ring}$, δ 2.45 (CH_3), δ7.2-8.02 ($C=C_{aromatic}$), ^{13}C NMR(DMSO): δ 168.46 $(C\text{-}C=O)_{Lactone\ ring}$, δ 167.37 $(N\text{-}C=O)_{Lactam\ group}$, δ 157.26 (C-N) ring, δ 123.27-134.56 $(C=C)_{aromatic}$, δ 59.74 (C-OH), δ 14.23 (CH_3), δ 48.25 (CH_2) methene group.

R6: FT-IR(KBr) cm, v3217.27 (OH), v3099.61 ($CH_{aromatic}$), v 2956.87 ($CH_{aliphatic}$), v1683.86 (O-C=O)lacton, v1635.64 (N-C=O)lactam, v 1598.99 $(C=C)_{aromatic}$, v 1481.33 (N=N), v1537.27 (C=N), v1367.53 (CH_3) ^{1}H-NMR(DMSO), : δ 10.65 $(C=O)_{carboxal}$ δ8.18(CH Oxazepine ring), δ 7.11-8.10 $(C=C)_{aromatic}$, δ 6.53-6.81 $(C=C)_{Oxazepine\ ring}$, δ 5.01 (OH), δ 2.45 (CH_3), δ 4.33 $(CH_2)_{Methene\ group}$ ^{13}C NMR (CNMR): δ 174.56(C- C=O) Lactone group, δ 168.65 $(N\text{-}C=O)_{Lactam\ group}$, δ 112.59-131.87 $(C=C)_{aromatic}$, 59.77 $(C\text{-}OH)_{imidazol}$, 151.96(C of N-CH)$_{Oxazepine\ ring}$, δ 14.25 (CH3), δ 48.28 (CH_2) methene group.

R7: FT-IR(KBr)cm^{-1}, v3219.19 (OH), v3097.68 ($CH_{aromatic}$), v2958.80 ($CH_{aliphatic}$),v1722.43 (O-C=O)lacton, v1681.93 (N-C=O)lactam, v1537.27 (C=N), v 1471.69 (N=N), v1367.53 (CH_3), v 1597.06 $(C=C)_{aromatic}$, ^{1}H-NMR(DMSO), δ 5.01(s,OH,1H)$_{hydroxyl\ group}$, δ 7.49-8.19 $(C=C)_{aromatic}$ δ 6.75-6.86 $(C=C)_{oxazepine\ ring}$,, δ 8.90(-CH)$_{Oxazepine\ ring}$, δ4.33 (CH_2) methane group, ^{13}C NMR(DMSO): δ 174.81$(C\text{-}C=O)_{Lactone\ group}$, δ 168.61$(N\text{-}C=O)_{Lactam\ group}$, δ151.95 (C of N-CH)$_{Oxazepine\ ring}$, δ 59.76$(C\text{-}OH)_{imidazol}$,128.89-138.41(C=C aromatic), δ 48.26(CH_2))$_{imidazol\ group}$, δ 14.24 (CH_3).

R8: FT-IR(KBr)cm^{-1}, v3221.12 (OH), v3099.61 ($CH_{aromatic}$), v2954.95 ($CH_{aliphatic}$), v1724,36 (O-C=O), v1683.86 (N-C=O), v1591.27 $(C=C)_{aromatic}$, v1535.34 (C=N), v1479.40 (N=N), ^{1}H-NMR(DMSO), δ 5.02

(OH), δ 7.20-8.18 $(C=C)_{aromatic}$ δ2.61 (CH_3), δ 10.43(-CH)$_{Oxazepine\ ring}$, δ 4.22 (CH_2). ^{13}C NMR(DMSO): δ 174.83(C- C=O)$_{Lactone\ group}$, δ 168.67(N- C=O)$_{Lactam\ group}$, δ151.95 $(CH)_{Oxazepine\ ring}$, δ 59.77(C of C-OH)$_{imidazol}$,127.90-138.42 $(C=C)_{aromatic}$, δ48.27 (CH_2), δ 14.24 (CH_3).

R9 : FT-IR(KBr)cm^{-1}, v3221.12 (OH), v3099.61 $(CH_{aromatic})$, v2956.87 $(CH_{aliphatic})$, v1722.43(O-C=O), v1653.00 $(C=C)_{aromatic}$, v 1683.88 (N-C=O), v1535.34 $(C=N)_{imidazole}$, v1473.62(N=N), ^{1}H-NMR(DMSO), δ 10.43 (OH), δ 7.20-8.19 $(C=C)_{aromatic}$ δ2.45 (CH_3), δ 4.22 (CH_2) ^{13}C NMR(DMSO): δ 174.83(C- C=O)$_{Lactone\ group}$, δ 168.67(N- C=O)$_{Lactam\ group}$, δ151.95 $(CH)_{Oxazepine\ ring}$, δ 59.77(C of C-OH)$_{imidazol}$, 127.90-138.42 $(C=C)_{aromatic}$, δ48.27 (CH_2), δ 14.24 (CH_3)

R10 : FT-IR(KBr) cm, v3458.37 (OH), v3099.61 $(CH_{aromatic})$, v 2956.87$(CH_{aliphatic})$, v1687.71(O-C=O)lacton, v1629.85 (N-C=O)lactam, v 1600.00 $(C=C)_{aromatic}$, v 1479.40 (N=N), v1535.34 (C=N), v1369.46 (CH_3) ^{1}H-NMR(DMSO),: δ 10.26 $(C=O)_{carboxal}$, δ 7.60 -8.18 $(C=C)_{aromatic}$, δ 5.80 (OH), δ 2.45 (CH_3), δ 4.33 $(CH_2)_{Methene\ group}$

^{13}C NMR (CNMR): δ 173.82(C- C=O)$_{Lactone\ group}$, δ 167.51 (N- C=O)$_{Lactam\ group}$, δ 112.59-138.42 $(C=C)_{aromatic}$, 59.78 $(C\text{-}OH)_{imidazol}$, 153 15 (C of N-CH)$_{Oxazepine\ ring}$, δ 14.25 (CH3), δ 48.28 (CH_2) methene group.

R11: FT-IR(KBr)cm^{-1}, v3223.05 (OH), v3099.61 $(CH_{aromatic})$, v2958.80 $(CH_{aliphatic})$, v1722.43 (O-C=O)lacton, v1683.86 (N-C=O)lactam, v1535.34 (C=N), v 1479.40 (N=N), v1367.53 (CH_3), v 1598.99 $(C=C)_{aromatic}$, ^{1}H-NMR(DMSO), δ 5.00(,OH)$_{hydroxyl\ group}$, δ 7.35-8.19 $(C=C)_{aromatic}$, δ4.36 (CH_2) methane group, ^{13}C NMR(DMSO): δ 173.64(C- C=O)$_{Lactone\ group}$, δ 169.46 (N-C=O)$_{Lactam\ group}$, δ 59.77 $(C\text{-}OH)_{imidazol}$,122.99-138.46 (C=C $_{aromatic}$), δ 48.28(CH_2))$_{imidazol\ group}$, δ 14.25 (CH_3).

R12:, FT-IR(KBr)cm^{-1}, v3219.19 (OH), v3099.61 $(CH_{aromatic})$, v2954.87 $(CH_{aliphatic})$,v1720.50 (O-C=O), v1691.57 (N-C=O), v1535.34 (C=N), v1479.40 (N=N), ^{1}H-NMR(DMSO), δ 5.00 (OH), δ 7.20-8.19 $(C=C)_{aromatic}$ δ2.41 (CH_3), δ 4.34 (CH_2), ^{13}C NMR(DMSO): δ 173.62 (C- C=O)$_{Lactone\ group}$, δ 168.93(N- C=O)$_{Lactam\ group}$, δ 59.77(C of C-OH)$_{imidazol}$,129.47-138.41 $(C=C)_{aromatic}$, δ48.27 (CH_2), δ 14.24 (CH_3)

R13: FT-IR(KBr) cm, v 3215.34 (OH), v3099.61 $(CH_{aromatic})$, v2960.73 $(CH_{aliphatic})$, v1703.14 (O-C=O)lacton, v1664.57 (N-C=O)lactam, v1539.20 (C=N), v1602.85 $(C=C)_{aromatic}$, ^{1}H-NMR(DMSO), δ 10.56 (OH), δ 9.31 (CH $_{Oxazepine\ ring}$) δ 5.01($OH_{imidazole}$), δ 6.03-6.74 $(C=C)_{Oxazepine\ ring}$, δ 2.45 (CH_3), δ7.13-8.01 $(C=C_{aromatic})$, ^{13}C NMR(DMSO): δ 166.56 (C-C=O)$_{Lactone\ ring}$, δ 162.79 (N- C=O)$_{Lactam\ group}$, δ 154.18 (C-N) ring, δ 115.25-138.39 $(C=C)_{aromatic}$, δ 59.77 (C-OH), δ 14.24 (CH_3), δ 48.27 (CH_2) methene group.

R14: FT-IR(KBr) cm, v3211.48 (OH), v3099.61 $(CH_{aromatic})$, v 2958.80 $(CH_{aliphatic})$, v1699.29 (O-C=O)lacton, v1687.71 (N-C=O)lactam, v 1931.78 $(C=C)_{aromatic}$, v 1487.12 (N=N), v1537.27 (C=N), v1369.46 (CH_3) ^{1}H-NMR(DMSO),: δ 10.66 $(C=O)_{carboxal}$, δ 7.13-8.18 $(C=C)_{aromatic}$, δ 6.06-6.55 $(C=C)_{Oxazepine\ ring}$, δ 5.01 (OH), δ 2.45 (CH_3), δ 4.33 $(CH_2)_{Methene\ group}$

^{13}C NMR (CNMR): δ 172.67(C- C=O)$_{Lactone\ group}$, δ 166.95 (N- C=O)$_{Lactam\ group}$, δ 112.57-138.40 $(C=C)_{aromatic}$, 59.77 $(C\text{-}OH)_{imidazol}$, 153.15 (C of N-CH)$_{Oxazepine\ ring}$, δ 14.24 (CH3), δ 48.27 (CH_2) methene group.

R15: FT-IR(KBr)cm^{-1}, v3221.12 (OH), v3099.61 $(CH_{aromatic})$, v2956.87 $(CH_{aliphatic})$, v1724.36 (O-C=O)lacton, v1680.00 (N-C=O)lactam, v1537.27 (C=N), v 1477.47 (N=N), v1367.53 (CH_3), v 1598.99 $(C=C)_{aromatic}$, ^{1}H-NMR(DMSO), δ 4.99 (,OH), δ 7.20-8.07 $(C=C)_{aromatic}$ δ 6.75-6.86 $(C=C)_{oxazepine\ ring}$,, δ 8.90(-CH)$_{Oxazepine\ ring}$, δ4.33 (CH_2) methane group, ^{13}C NMR(DMSO): δ 174.93(C- C=O)$_{Lactone\ group}$, δ 172.47(N-C=O)$_{Lactam\ group}$, δ151.95 (C of N-CH)$_{Oxazepine\ ring}$, δ 59.76(C-OH)$_{imidazol}$,129.47-138.39(C=C $_{aromatic}$), δ 48.26(CH_2))$_{imidazol\ group}$, δ 14.24 (CH_3).

R16: FT-IR(KBr)cm^{-1}, v3221.12 (OH), v3099.61 $(CH_{aromatic})$, v2956.87 $(CH_{aliphatic})$, v1722.43 (O-C=O), v1689.64 (N-C=O), v1631.00 $(C=C)_{aromatic}$, v1535.34 (C=N), v1479.40 (N=N), ^{1}H-NMR(DMSO), δ 5.02 (OH), δ 7.01-8.08 $(C=C)_{aromatic}$ δ2.41 (CH_3), δ 9.67(-CH)$_{Oxazepine\ ring}$, δ 4.34 (CH_2). 6.40-6.83 $(C=C)_{imidazol}$. ^{13}C NMR (DMSO): δ 182.66 (C- C=O)$_{Lactone\ group}$, δ 173.73(N- C=O)$_{Lactam\ group}$, δ151.95 $(CH)_{Oxazepine\ ring}$, δ 59.77$(C\text{-}OH)_{imidazol}$,115.00-129.49 $(C=C)_{aromatic}$, δ48.26 (CH_2), δ 14.24 (CH_3).

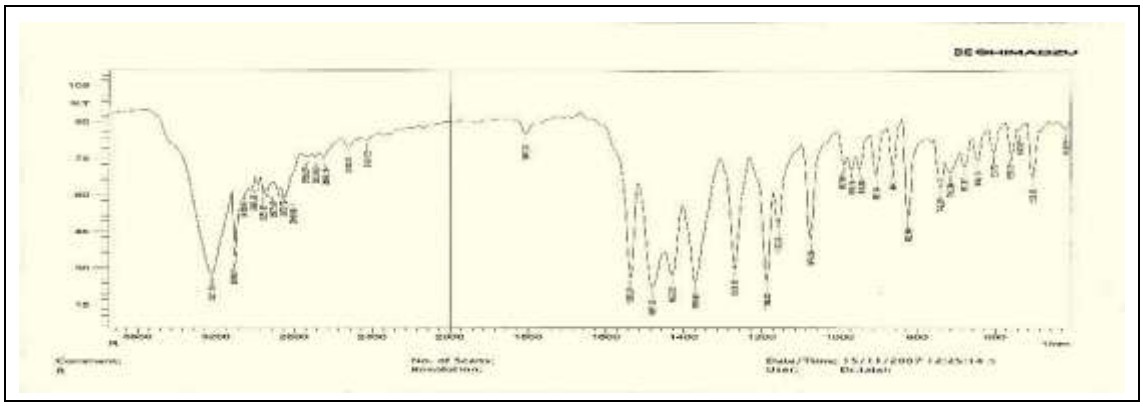


Fig. 1. IR Spectrum of the compound (R)

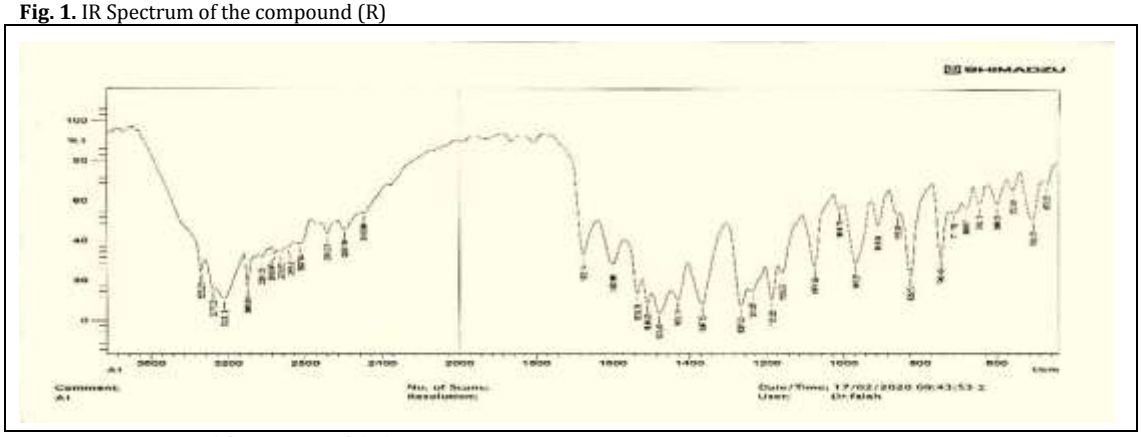


Fig. 2. IR Spectrum of the compound (R_1)

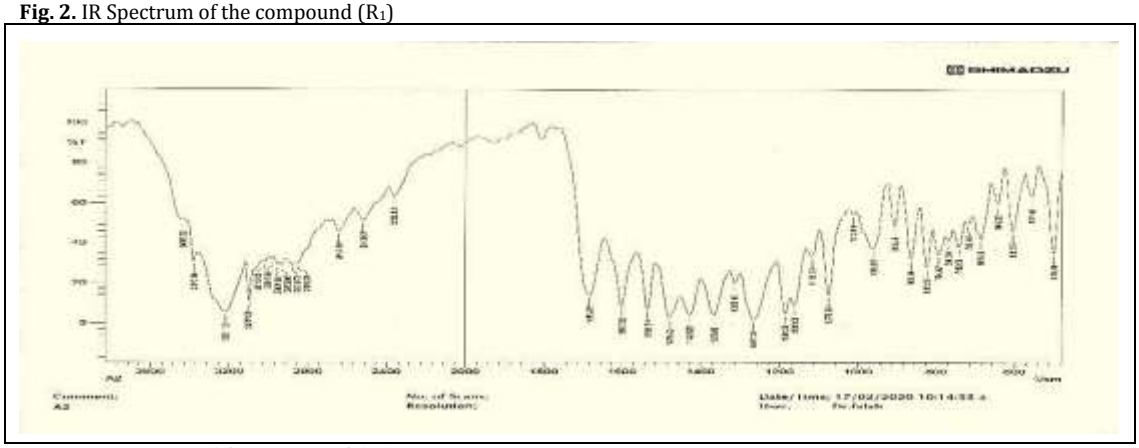


Fig. 3. IR Spectrum of the compound (R_2)

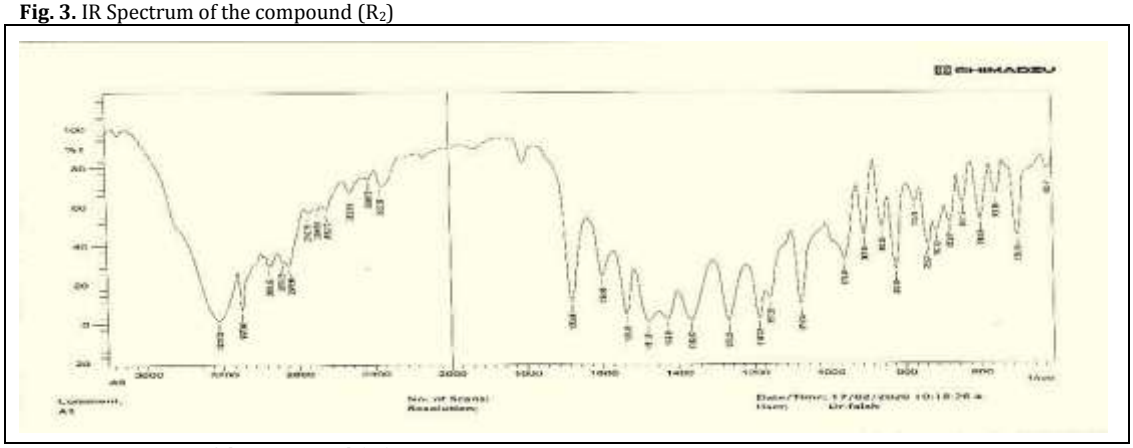


Fig. 4. IR Spectrum of the compound (R_3)

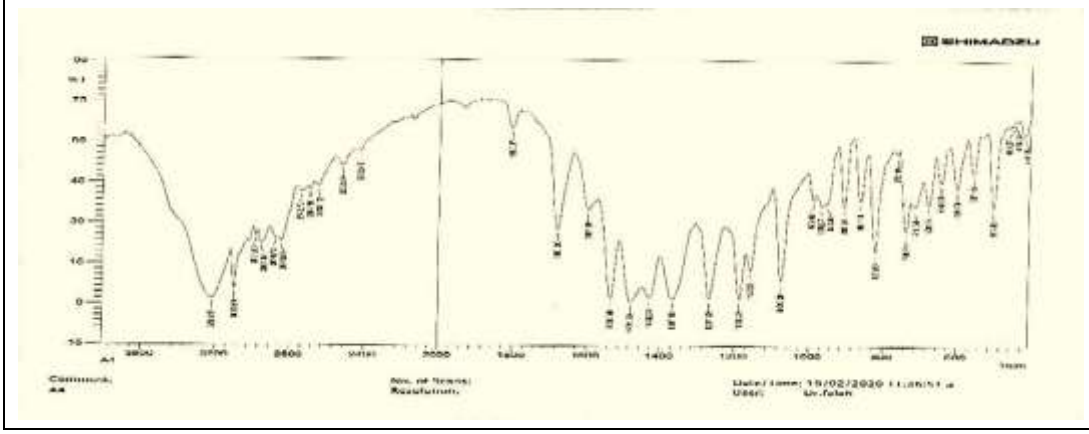


Fig. 5. IR Spectrum of the compound (R_4)

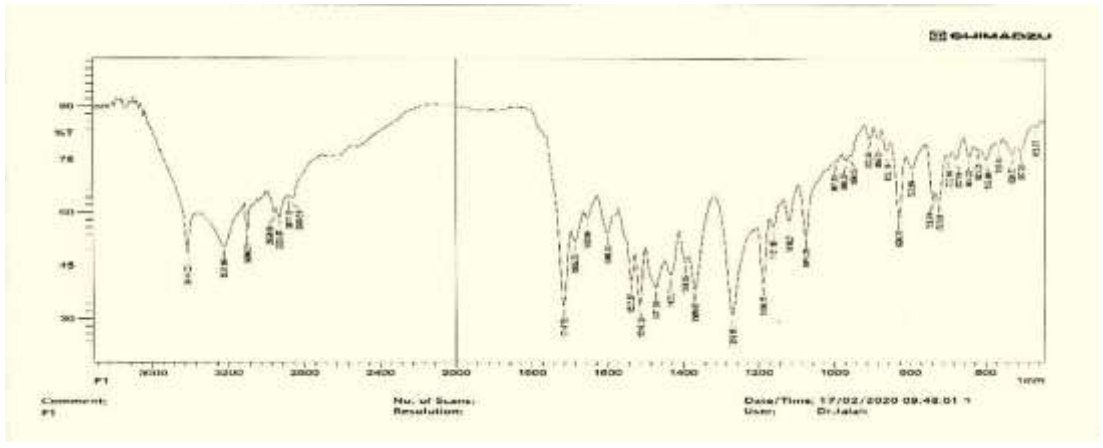


Fig. 6. IR Spectrum of the compound (R_5)

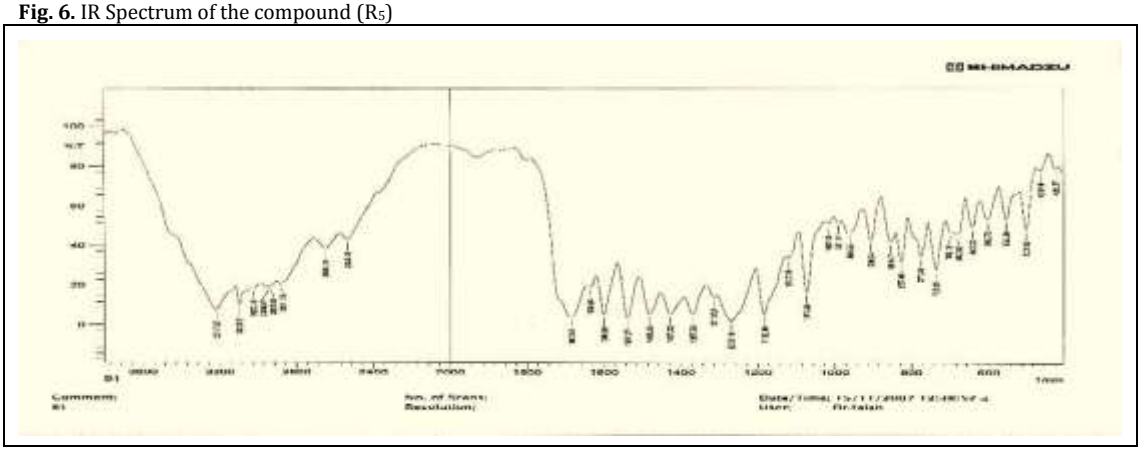


Fig. 7. IR Spectrum of the compound (R_6)

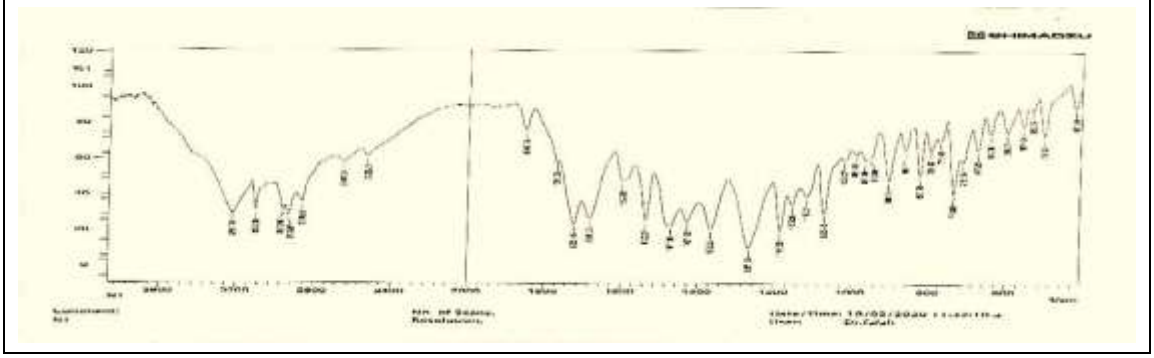


Fig. 8. IR Spectrum of the compound (R_7)

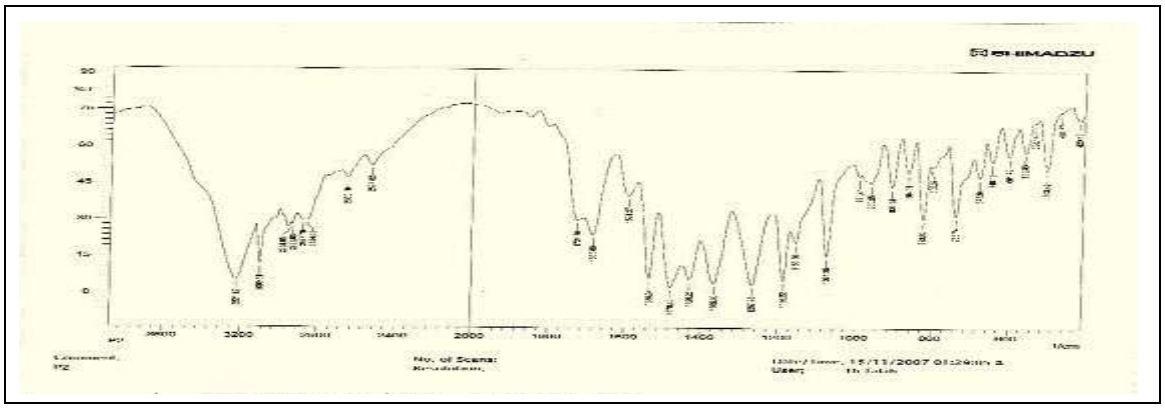


Fig. 9. IR Spectrum of the compound (R_8)

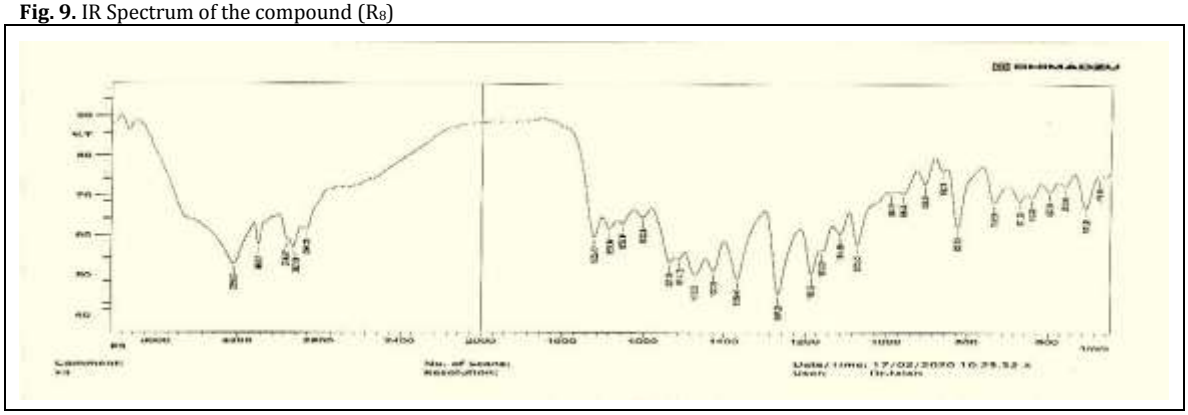


Fig. 10. IR Spectrum of the compound (R_9)

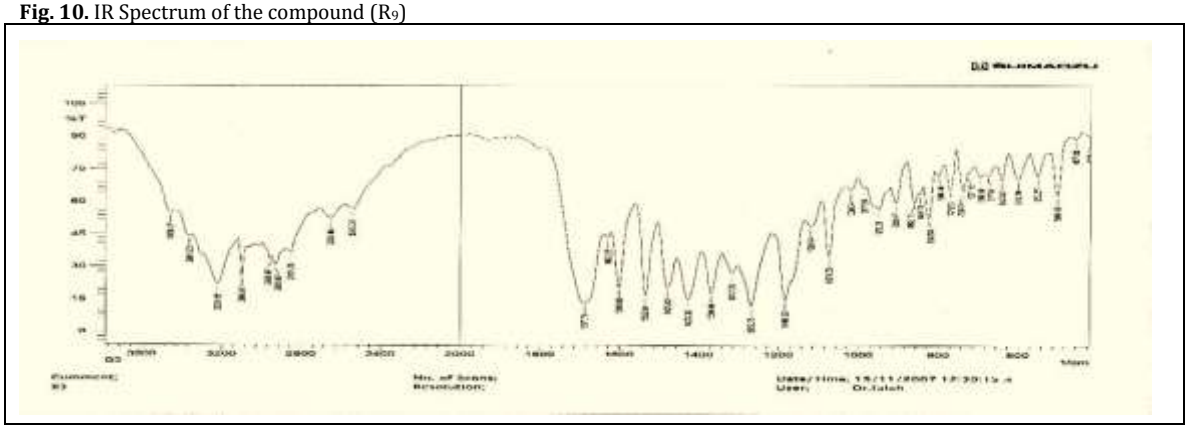


Fig. 11. IR Spectrum of the compound (R_{10})

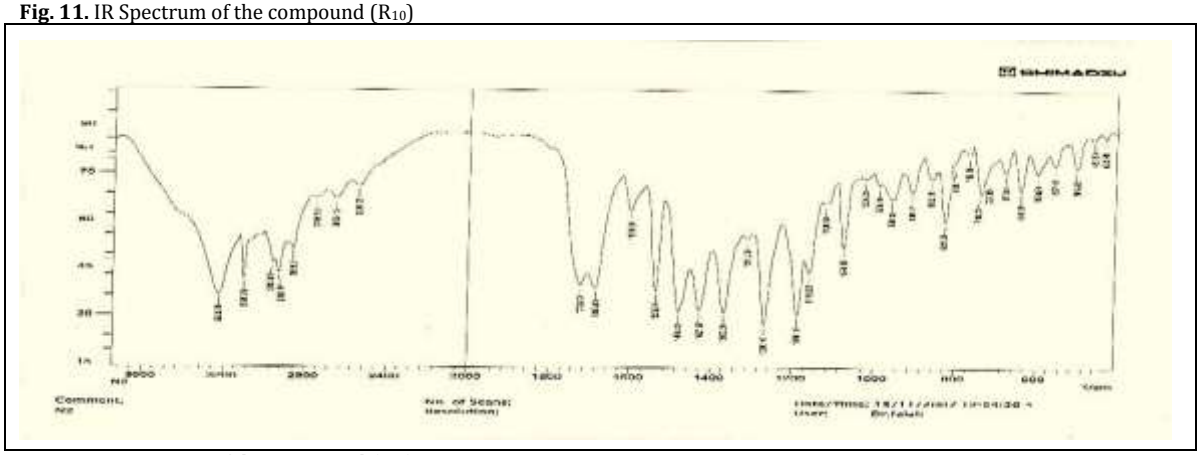


Fig. 12: IR Spectrum of the compound (R_{11})

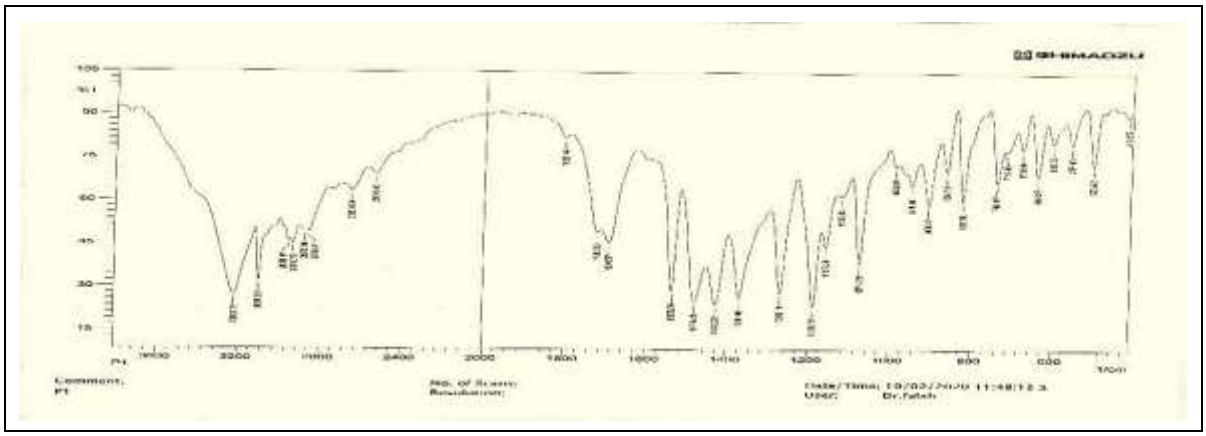


Fig. 13. IR Spectrum of the compound (R_{12})

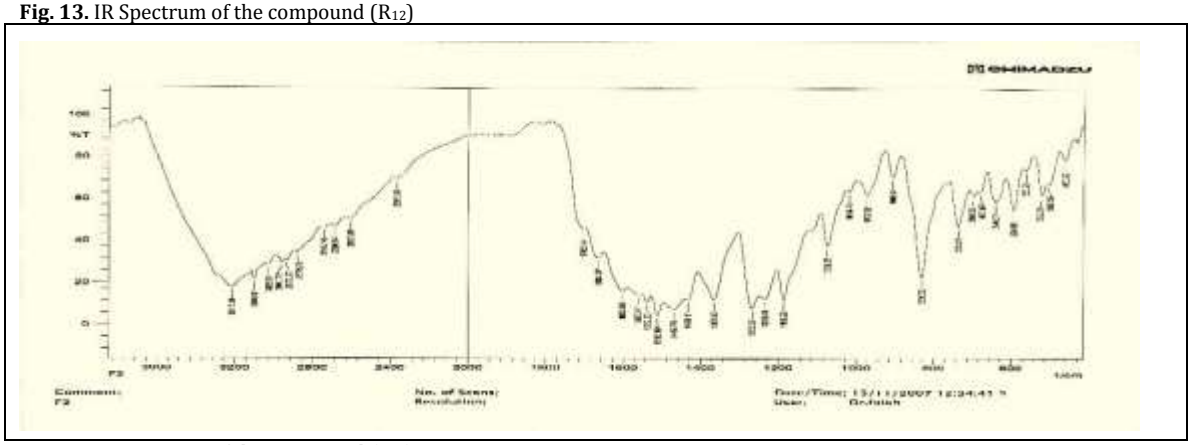


Fig. 14. IR Spectrum of the compound (R_{13})

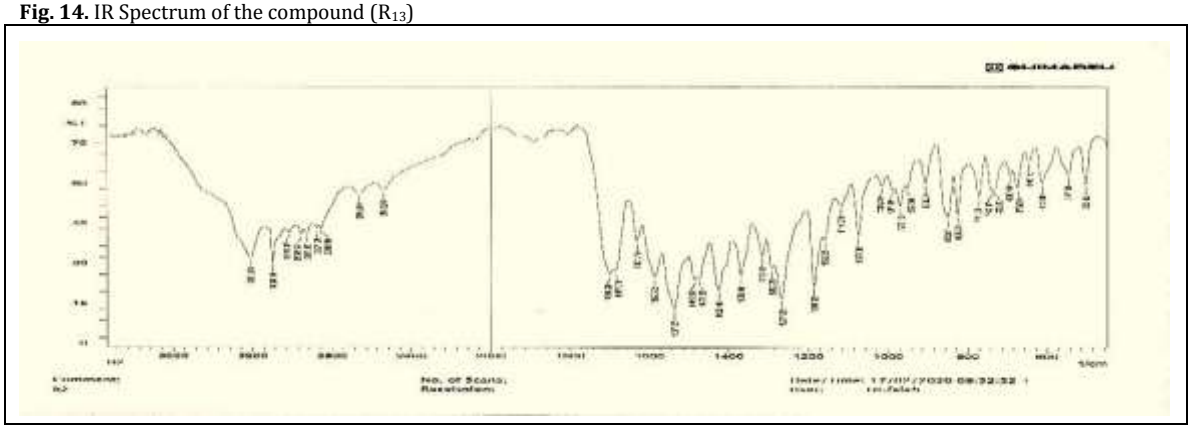


Fig. 15. IR Spectrum of the compound (R_{14})

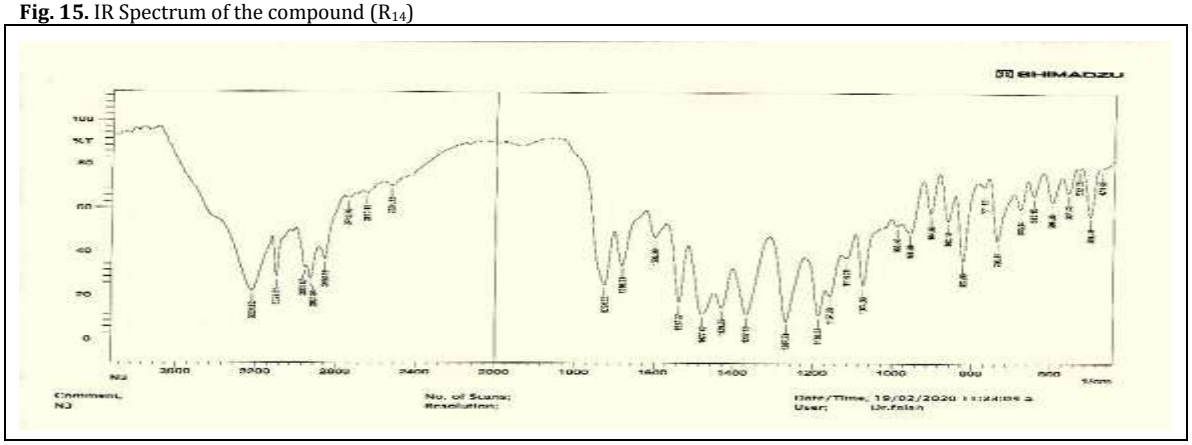


Fig. 16. IR Spectrum of the compound (R_{15})

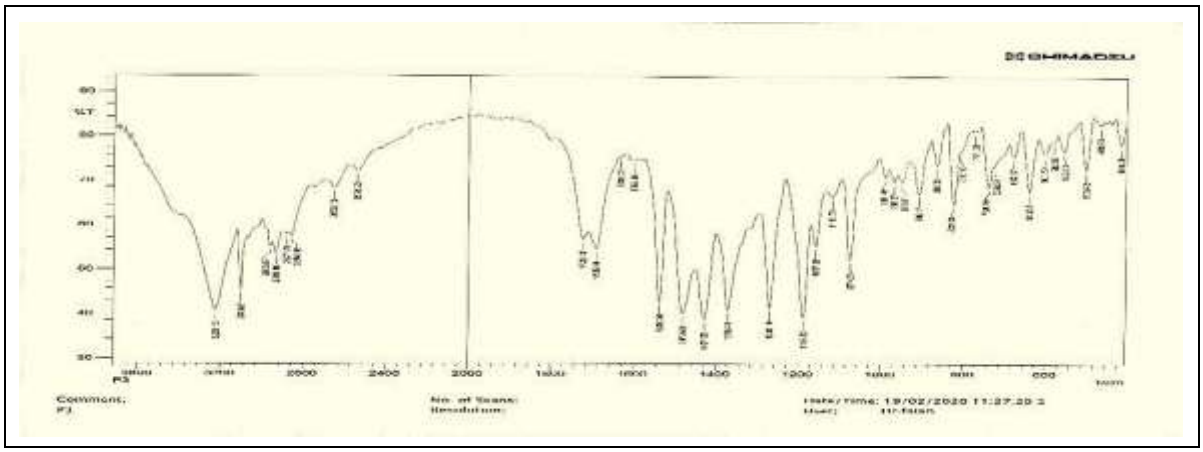


Fig. 17. IR Spectrum of the compound (R_{16})

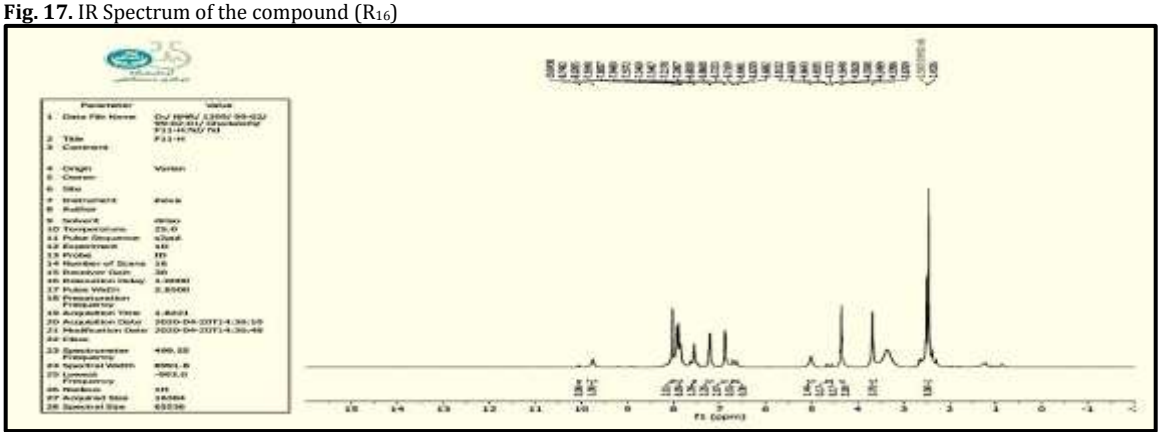


Fig. 18. ^{1}HNMR Spectrum of the compound (R_5)

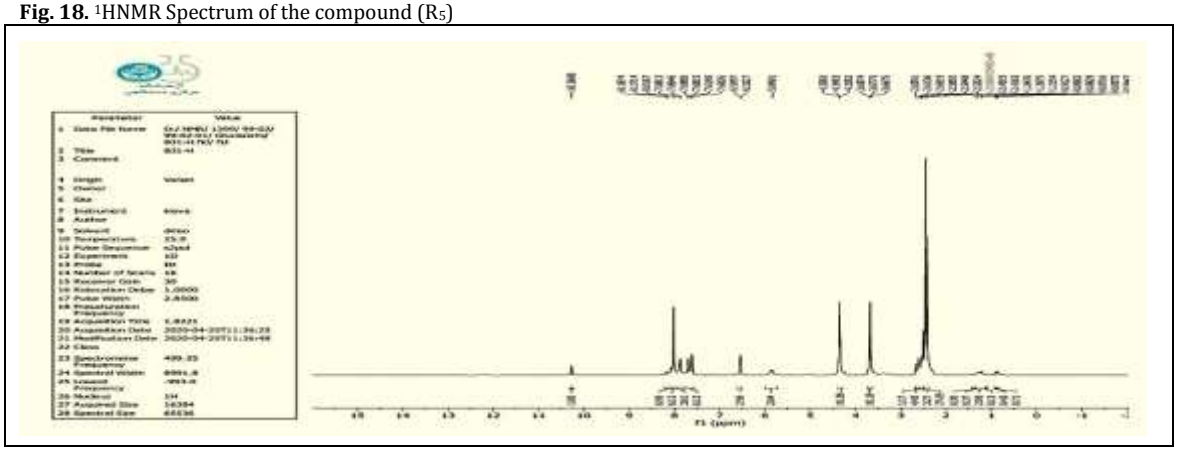


Fig. 19. ^{1}HNMR Spectrum of the compound (R_6)

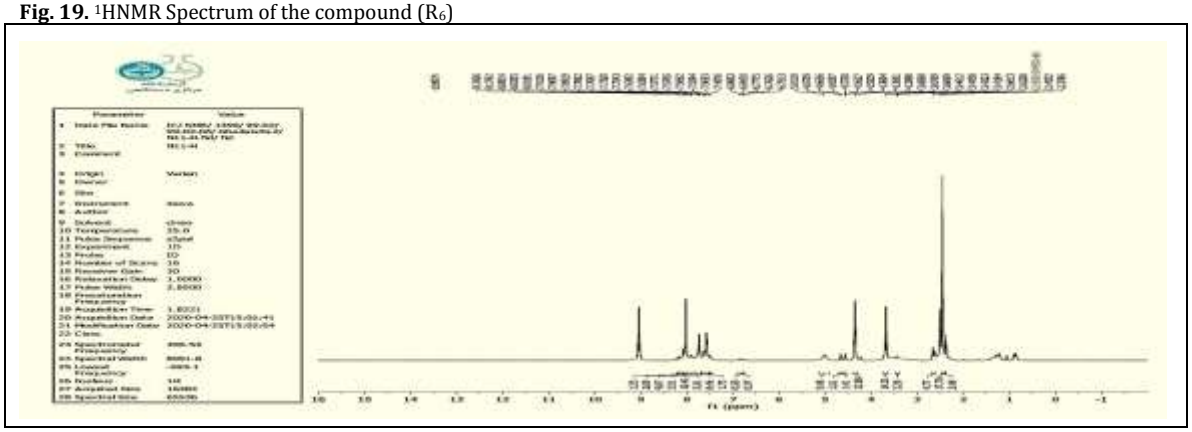


Fig. 20. ^{1}HNMR Spectrum of the compound (R_7)

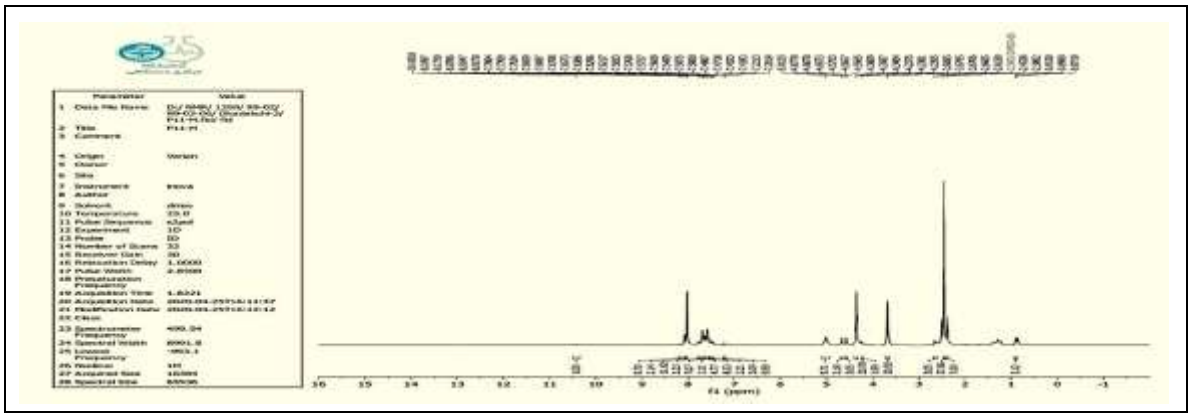


Fig. 21. ^{1}HNMR Spectrum of the compound (R_8)

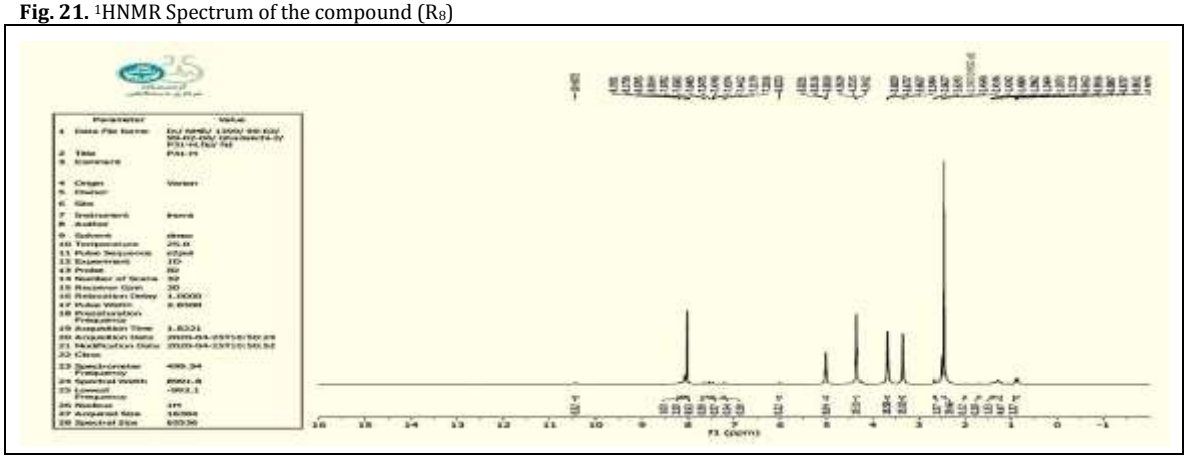


Fig. 22. ^{1}HNMR Spectrum of the compound (R_9)

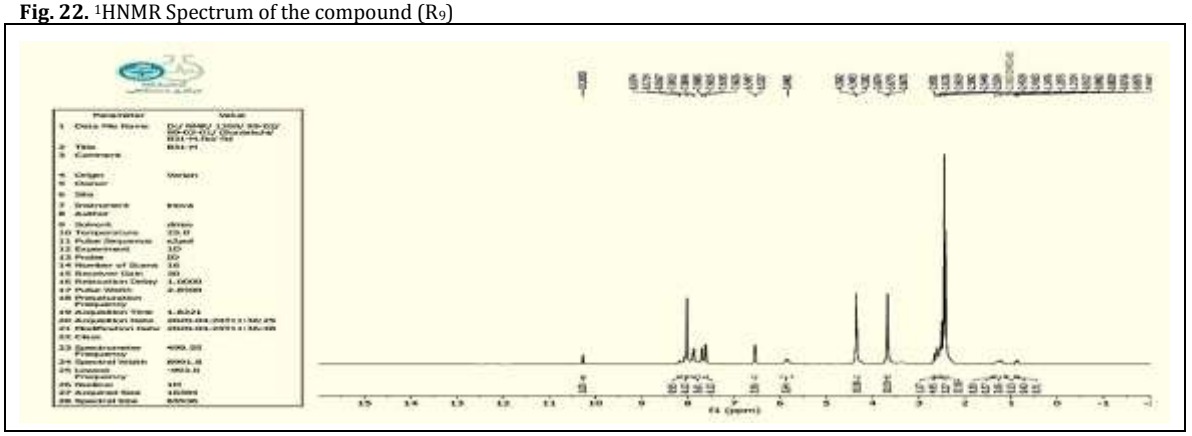


Fig. 23. ^{1}HNMR Spectrum of the compound (R_{10})

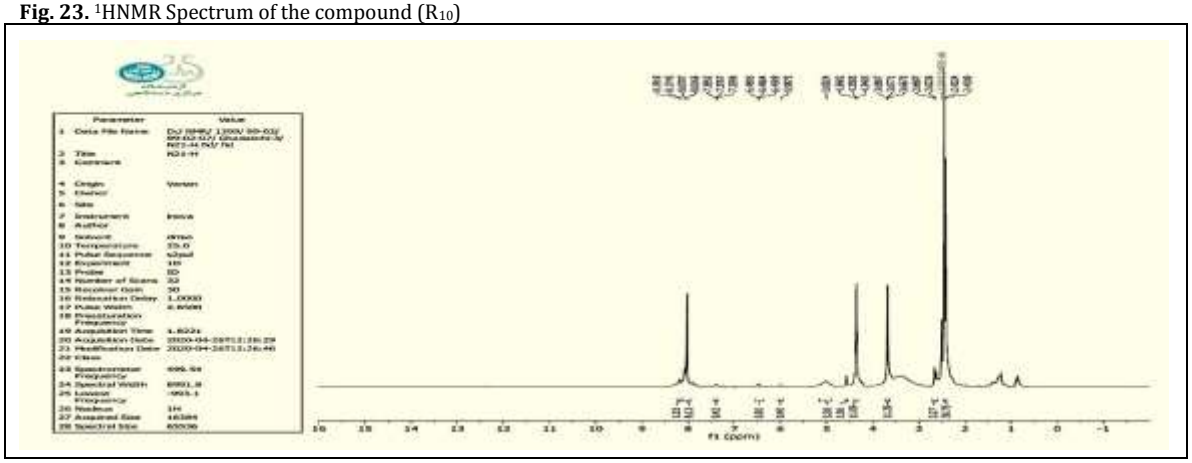


Fig. 24. ^{1}HNMR Spectrum of the compound (R_{11})

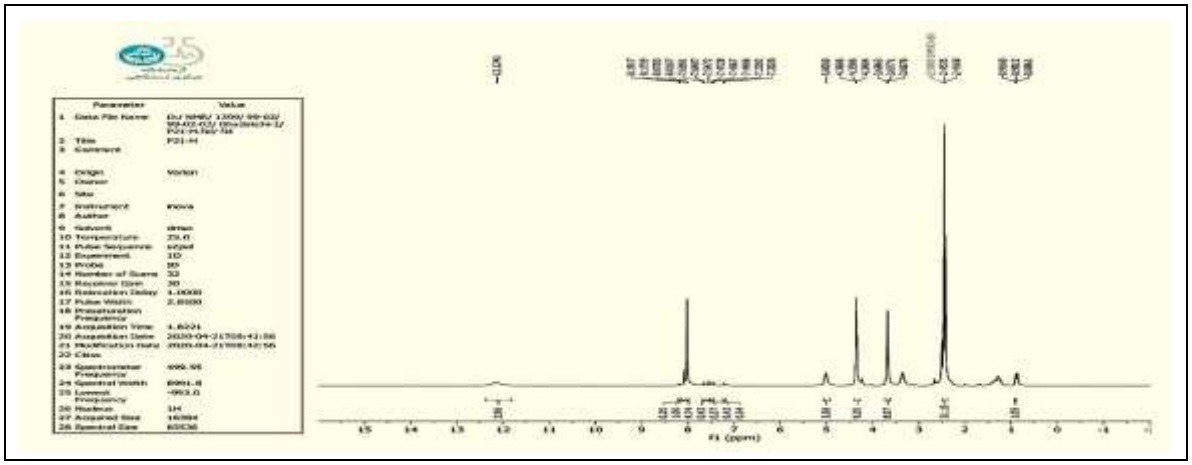


Fig. 25. ^{1}HNMR Spectrum of the compound (R_{12})

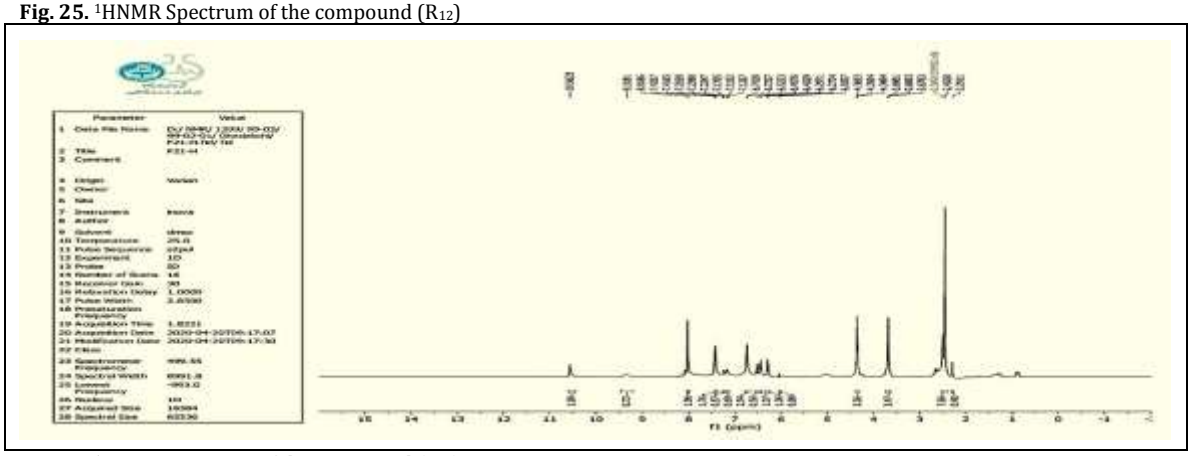


Fig. 26. ^{1}HNMR Spectrum of the compound (R_{13})

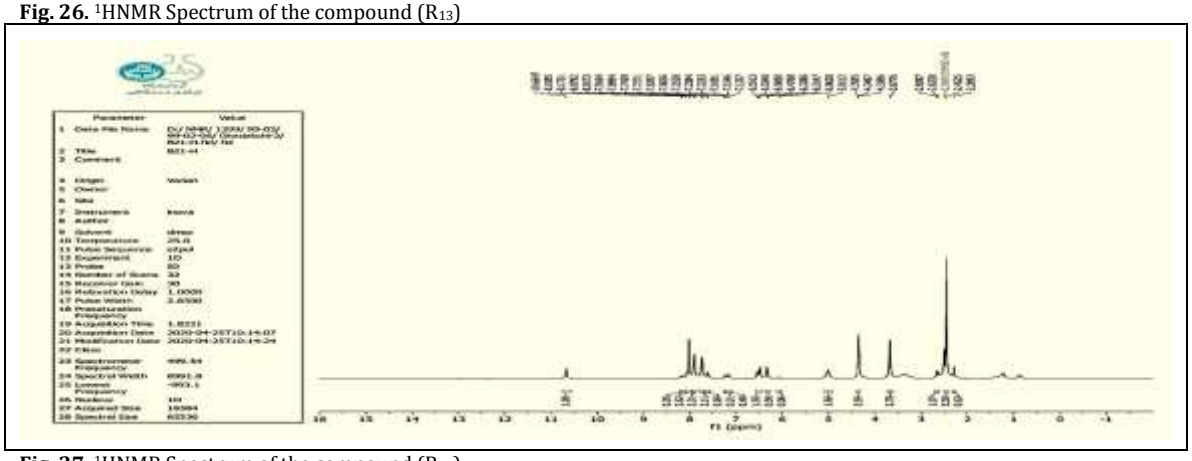


Fig. 27. ^{1}HNMR Spectrum of the compound (R_{14})

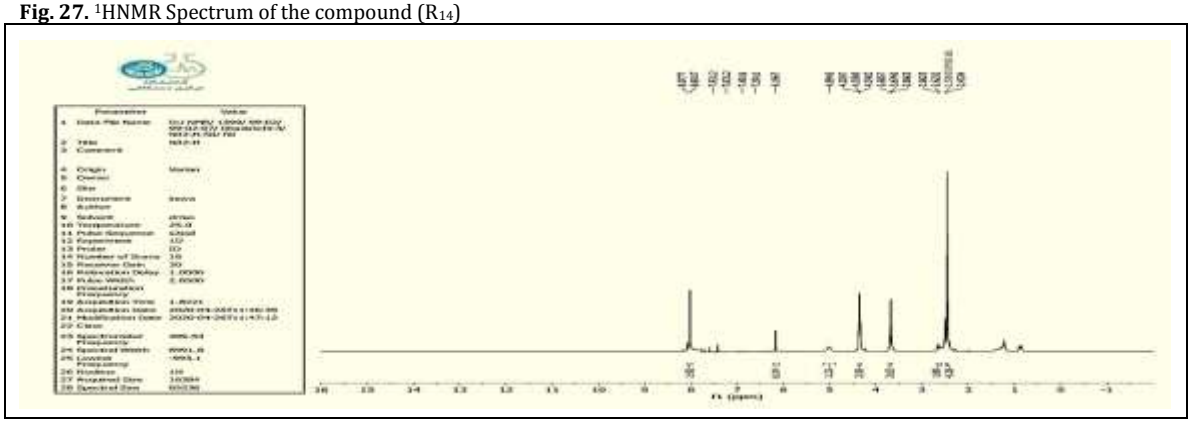


Fig. 28. ^{1}HNMR Spectrum of the compound (R_{15})

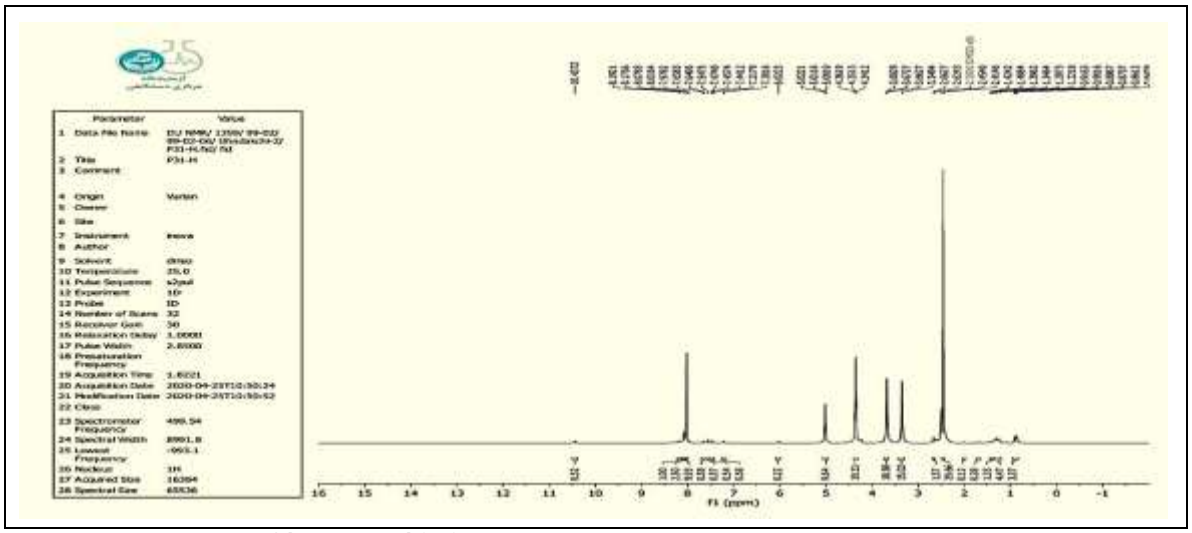


Fig. 29. ^{1}HNMR Spectrum of the compound (R_{16})

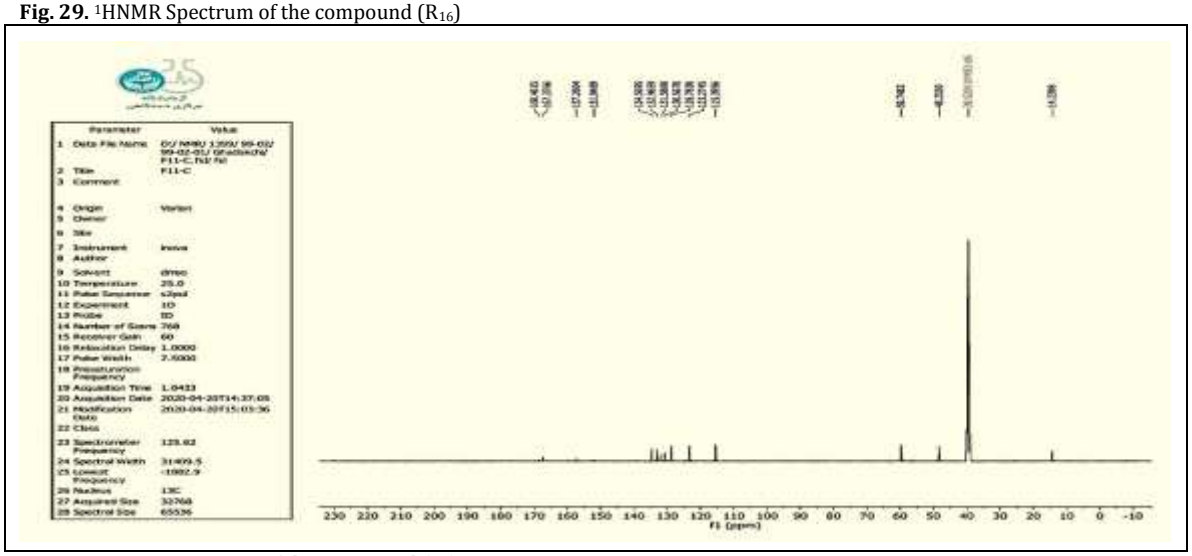


Fig. 30. ^{13}CNMR Spectrum of the compound (R_5)

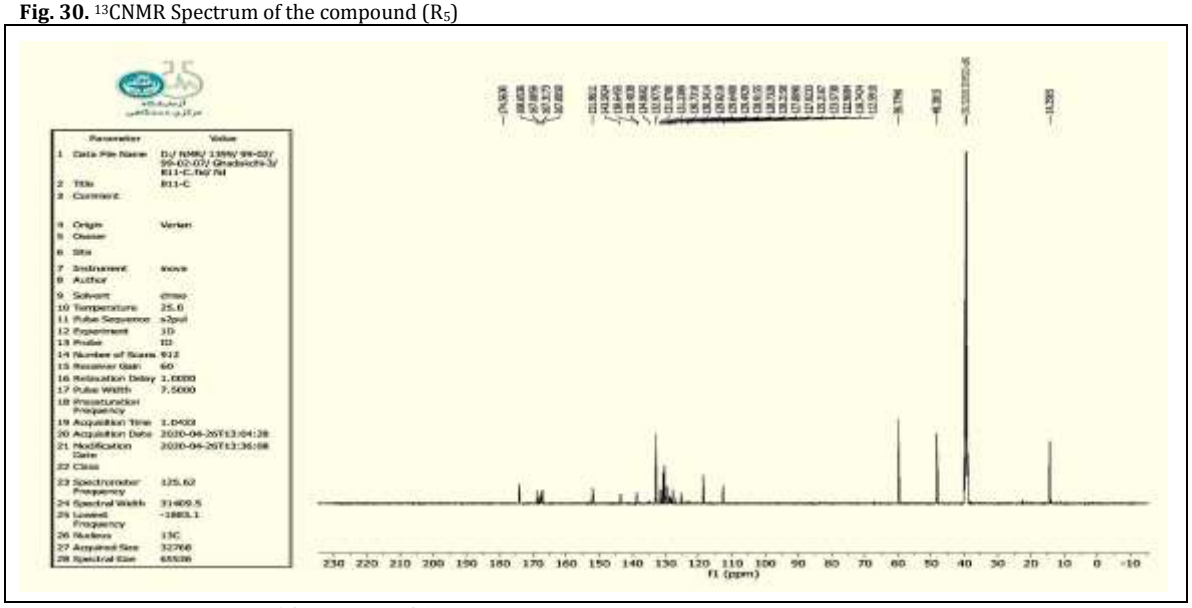


Fig. 31. ^{13}CNMR Spectrum of the compound (R_6)

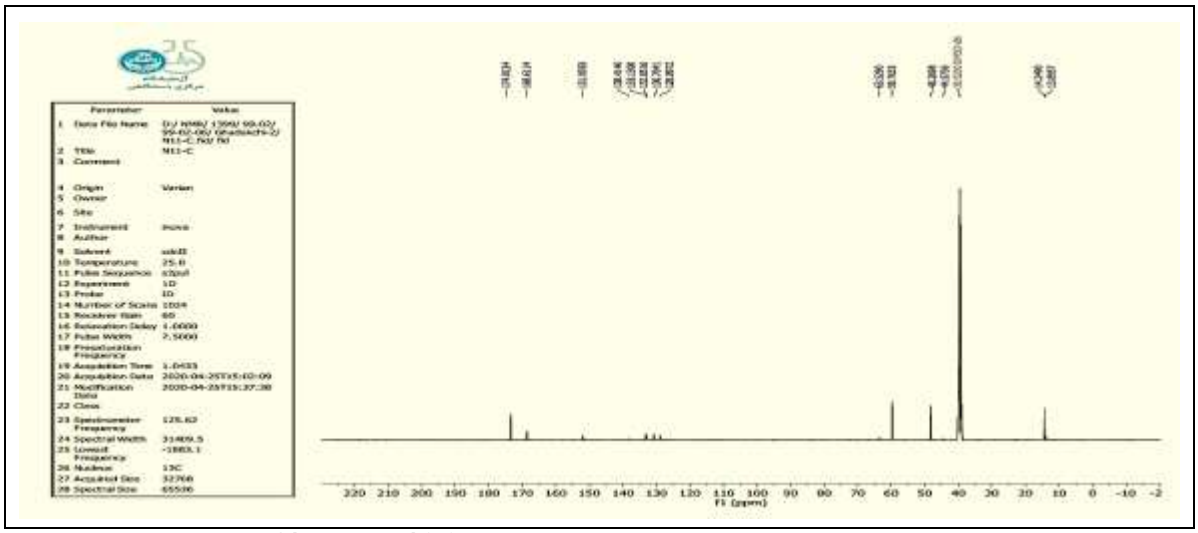


Fig. 32. ^{13}CNMR Spectrum of the compound (R_7)

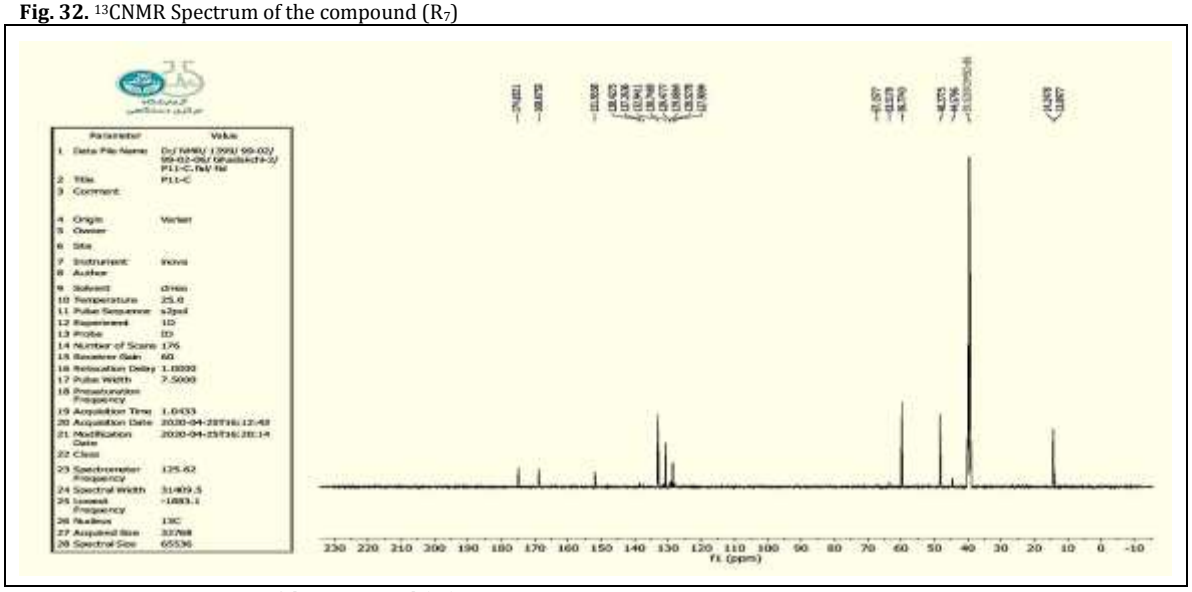


Fig. 33. ^{13}CNMR Spectrum of the compound (R_8)

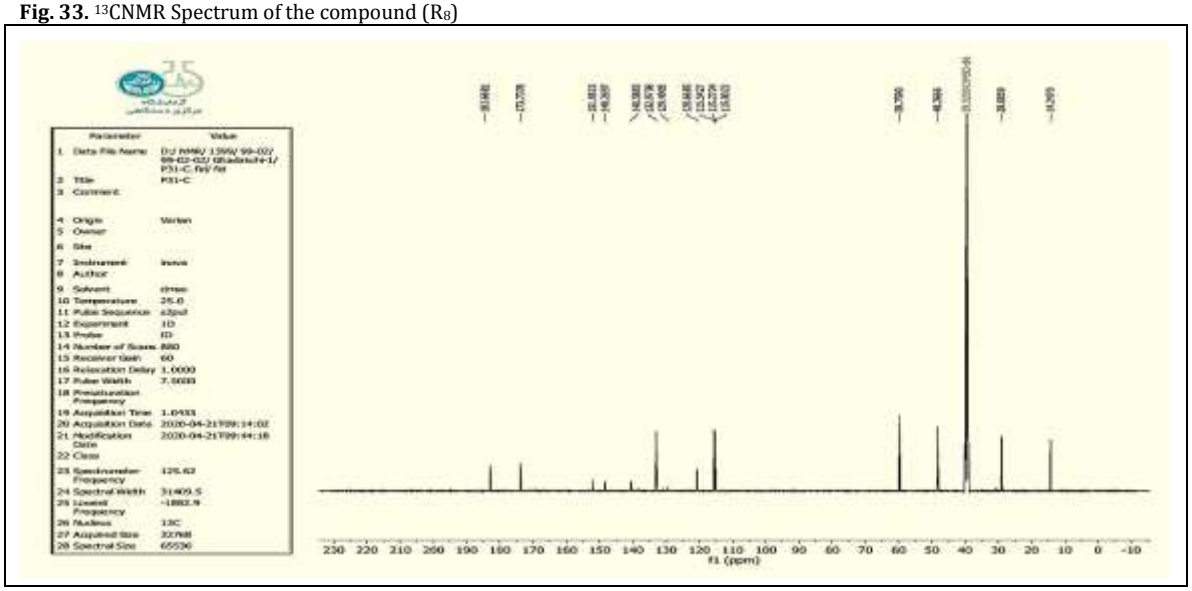


Fig. 34. ^{13}CNMR Spectrum of the compound (R_9)

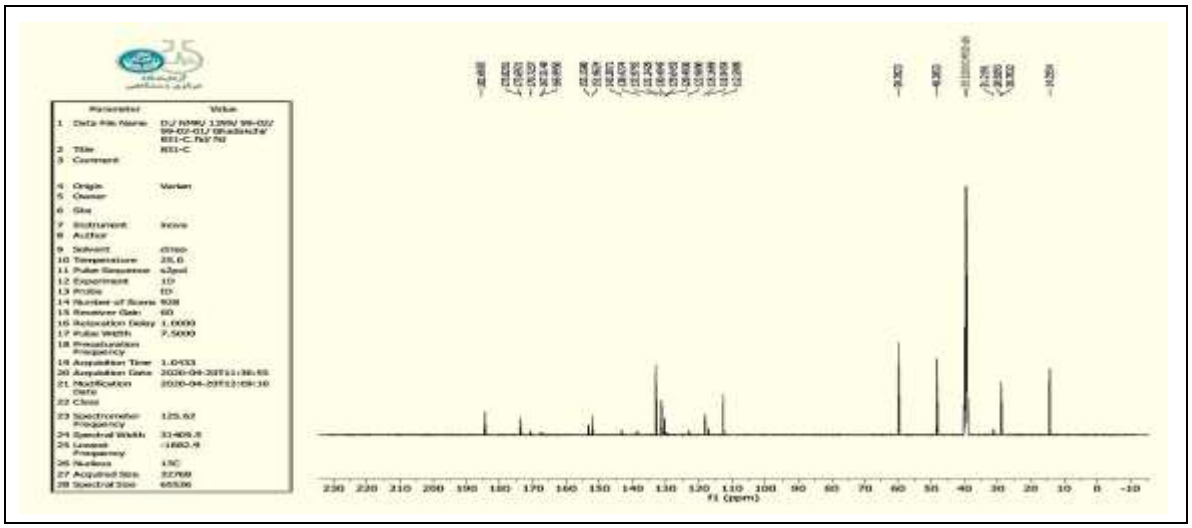


Fig. 35. ^{13}CNMR Spectrum of the compound (R_{10})

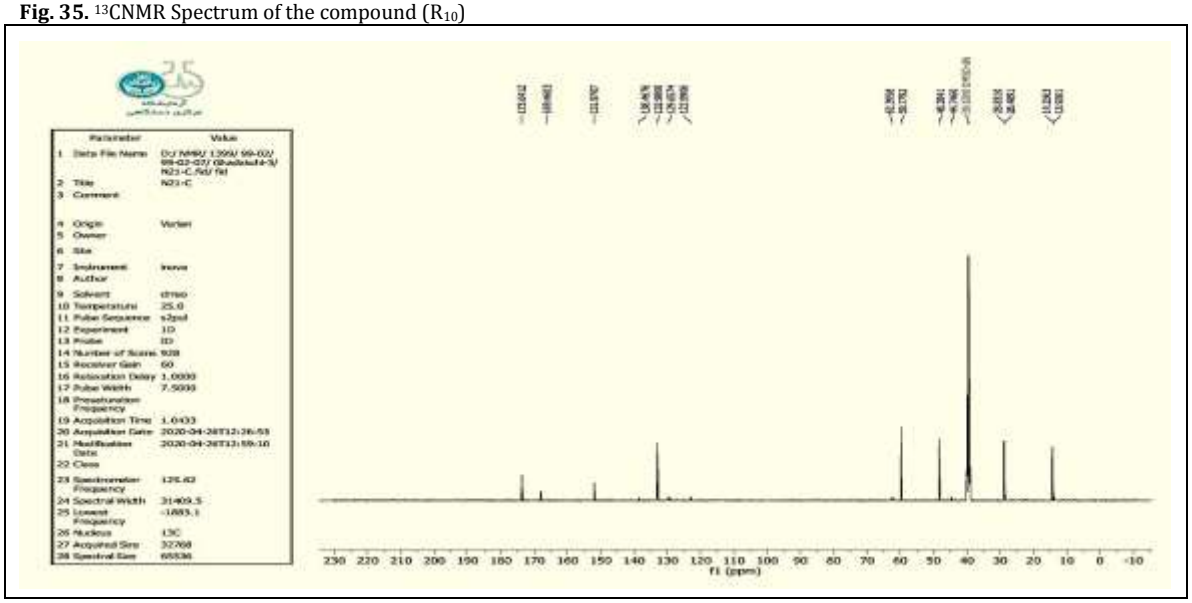


Fig. 36. ^{13}CNMR Spectrum of the compound (R_{11})

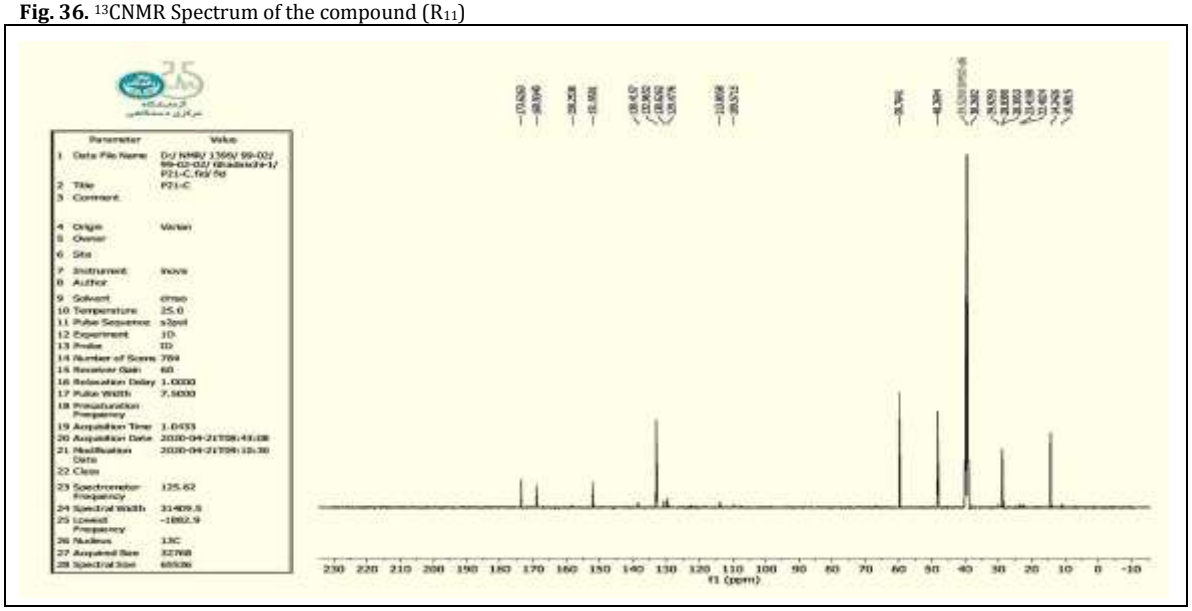


Fig. 37: ^{13} CNMR Spectrum of the compound (R_{12})

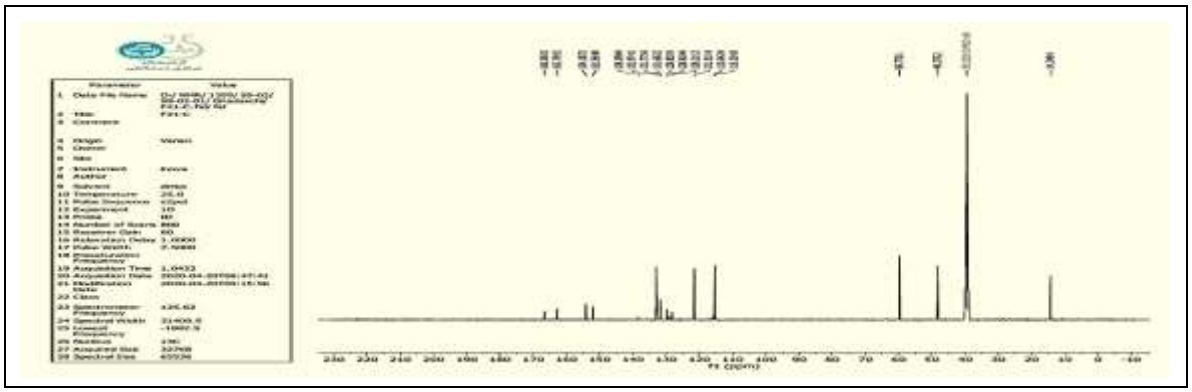


Fig. 38: ^{13}CNMR Spectrum of the compound (R_{13})

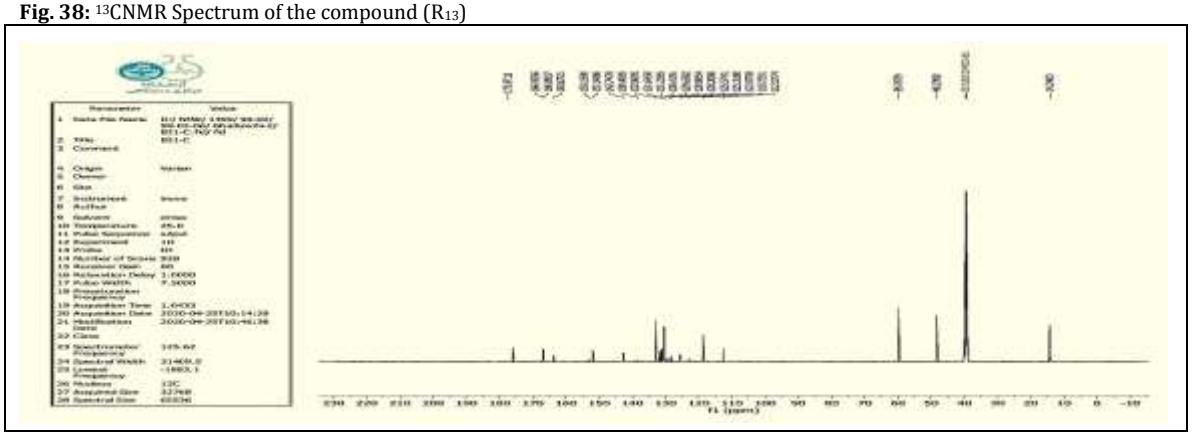


Fig. 39. ^{13}CNMR Spectrum of the compound (R_{14})

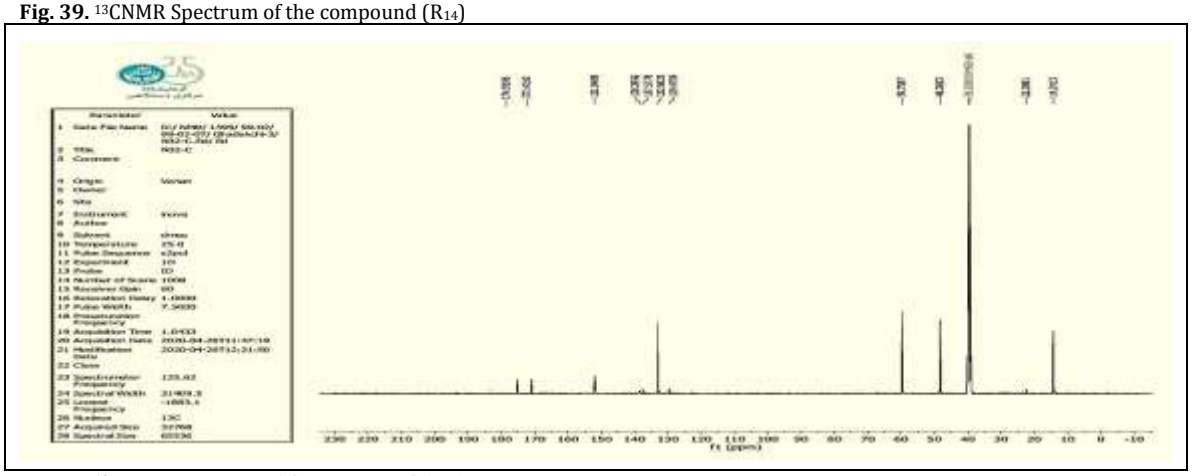


Fig. 40. ^{13}CNMR Spectrum of the compound (R_{15})

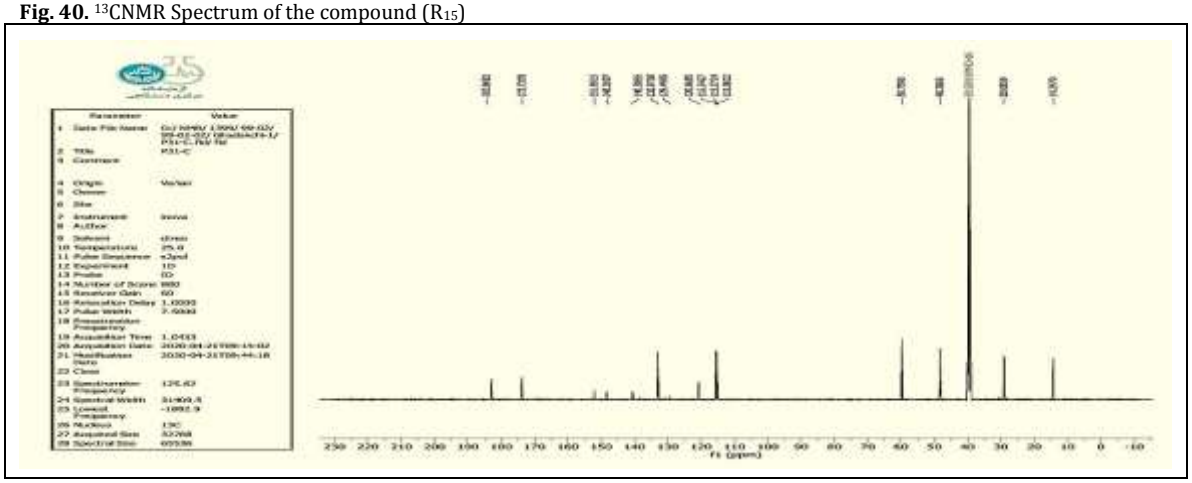


Fig. 41. ^{13}CNMR Spectrum of the compound (R_{16})

Table 1. Physical properties of compounds

NO	M.F	M.WT gm\mol	M.F	Rf	Color	Yield %	Solvent
R	$C_{14}H_{15}N_5O_4$	317	286-288		Red dark	80	ethanol
R_1	$C_{20}H_{20}N_6O_4$	408	233-235	0.8	Red	88	ethanol
R_2	$C_{21}H_{20}N_6O_5$	436	199-201	0.6	Orange dark	85	ethanol
R_3	$C_{19}H_{19}N_7O_3$	393	255-257	0.75	Red dark	85	ethanol
R_4	$C_{20}H_{19}N_7O_5$	437	190-193	0.81	Red dark	87	ethanol
R_5	$C_{28}H_{26}N_6O_8$	560	244-246	0.79	Brown	76	Toluene
R_6	$C_{29}H_{26}N_6O_8$	586	290-292	0.69	Orange	77	Toluene
R_7	$C_{27}H_{25}N_7O_6$	543	301-303	0.73	Brown dark	80	Toluene
R_8	$C_{28}H_{25}N_7O_8$	587	295-297	0.6	Brown dark	87	Toluene
R_9	$C_{24}H_{24}N_6O_7$	510	298-300	0.74	Brown	78	Toluene
R_{10}	$C_{25}H_{24}N_6O_8$	536	289-291	0.65	Orange light	75	Toluene
R_{11}	$C_{27}H_{25}N_7O_6$	543	300-303	0.83	Brown light	83	Toluene
R_{12}	$C_{24}H_{23}N_7O_8$	537	277-279	0.7	Red dark	85	Toluene
R_{13}	$C_{24}H_{22}N_6O_7$	508	283-285	0.91	Brown dark	72	Toluene
R_{14}	$C_{25}H_{22}N_6O_8$	534	296-298	0.75	Orange	76	Toluene
R_{15}	$C_{23}H_{21}N_7O_6$	491	200-203	0.81	Brown dark	78	Toluene
R_{16}	$C_{24}H_{21}N_7O_8$	535	277-279	0.73	Brown dark	80	Toluene

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