



Pyrimidine-Sulphone Ligands (Formation, Characterization, Bio Evaluation) as Bio-Compounds

Muhammed Abdel Hasan Shallal

Lecturer, M.Sc in Chemistry Field, Educational Directorate Thi-Qar, Thi-Qar, Iraq



Abstract

In view of the great importance of the pyrimidine ring and its entry into many aspects of life, including aspects of medical and vital importance, where it was known to be a part of the synthesis of the amino acid histidine, in addition to its entry into the composition of many treatments such as anti-tumor, inflammatory and anti-fungal. Including that the electronic density of this ring is concentrated in the two sites containing the two nitrogen atoms, and then it becomes clear that when a suitable electrophile is available, it can bind with the imidazole ring in one of the two mentioned sites. It has been customary to prove the structures and specificity of the prepared ligands through chemical automated means to diagnose ligands, and then conduct vital studies for them to evaluate their effectiveness and all ligands are multi dentate. The synthesized ligands are type (Imidazole, pyrimidine, sulphone) that have high effect on DNA of bacteria, we noted that Ligands [6, 4] have high activity towards resistance of bacteria due to their ability to inhibition wall of bacterial cell then kill it for this reason these ligands have more activity, also these ligands involved sulphone group in its structure.

Keyword: ligand; pyrimidine; azo; sulpho; derivative; biocompounds; bio evaluation; bacteria.

1. Introduction

The pyrimidine derivatives are colored compounds due to the occurrence of electronic transitions that cause bright colors in their structures, including red, purple, black, orange and blue. It depends on the structures of the derivatives to which this color belongs [1-4]. It has wide uses, as a ligands are used in inorganic chemistry and as a textile dye, whether in industry or the field of Pathological analyzes [5-9]. Micro-organisms are the causes of many diseases, so we find a lot of research in the field of studying the biological activity of compounds [10-15] containing pyrimidine rings on various types of pathogenic bacteria: Spherical and helical. Nowadays there are increasing numbers of infections caused by bacteria that are resistant to most of the antibacterial treatments currently available. In some experiments conducted on mice, results were given that the association of pyrimidine [16-20] with some compounds used as chemotherapy for tumors improves its effectiveness and reduces the spread of

the tumor as well as reduces the toxic effects that result from the chemotherapy itself. In reducing the spread of breast cancer in mice., The pyrimidine substitutes have similar efficacy to the pharmaceutical-pharmaceutical compounds [21-27] used in the treatment of ulcers and infections, nerve paralysis, ulcers, and they are also used as lipid oxidation inhibitors in experiments conducted on rats. The pyrimidine substitutes are effective in the industrial field [28-32]. Pyrimidine derivatives have been used in the manufacture of dyes for fabrics that contain nylon to give colors [33-37] between yellow and coffee.

EXPERIMENTAL PART:

The pyrimidine derivatives that contain the sulfone or sulfur group in their composition have high biological activity, high absorption in the body, and low toxicity, so they are widely used in the pharmaceutical industry, so they are characterized by being highly sensitive, so high purity materials were

*Corresponding author e-mail; Muhammed-abdel@yahoo.com; (Muhammed Abdel Hasan).

Receive Date: 05 August 2022, Revise Date: 28 August 2022, Accept Date: 02 October 2022

DOI: 10.21608/EJCHEM.2022.154542.6675

©2023 National Information and Documentation Centre (NIDOC)

used to prepare them. Spectrophotometers with extremely high accuracy for its diagnosis and measurement from the University of Isfahan in the Chemical Research Center.

Production of Pyrimidine-Anile Ligand {1}:

2-methyl-4-formal mercaptophenyl (0.01 mole) condensed with aminopyrimidine (0.01 mole) in occurrence of acid-drops in refluxing step (2 hrs), then separation ,desiccating ,manifestation with absolute ethanol to Pyrimidine- Anile Ligand {1} appreciative to studies [4,6] .This reaction carried out via folloeing imination reaction of (Hugo-Schiff) that accurs between carbonyl of aldehyde and aromatic amine.

Production of Pyrimidine-Imidazole Ligand {2}:

Pyrimidine- Anile Ligand {1}(0.01 mole) condensed with amino acetic acid (0.01 mole) in occurrence of benzene as a solvent in refluxing step (5 hrs), then separation ,desiccating ,manifestation with absolute ethanol to Pyrimidine- Imidazole Ligand {2} appreciative to studies[4,6] .By following Ring clousure reaction with compound involving di terminal (neucleophile and electrophile) in condensation step to yiels cyclic compound.

Production of Pyrimidine-Imidazole Sulfide Ligand {3}:

Pyrimidine- Imidazole Ligand {2} (0.01 mole) condensed with p-nitro benzoyl chloride (0.01 mole) in occurrence of potassium carbonate in refluxing step (3 hrs), then separation ,desiccating ,manifestation with absolute ethanol to Pyrimidine-Imidazole Sulfide Ligand {3} appreciative to studies [4,6]

Production of Pyrimidine-Imidazole Sulfide Ligand {4}:

Pyrimidine- Imidazole Ligand {2} (0.01 mole) condensed with p-chloro ethylbenzoate (0.01 mole) in occurrence of acetone as a solvent (more favorable in this step) in refluxing step (2 hrs), then separation ,desiccating ,manifestation with absolute ethanol to Pyrimidine- Imidazole Sulfide Ligand {4} appreciative to studies [4, 6].

Production of Pyrimidine-Imine Ligand {5} :

4-Formal benzaldehyde (0.01 mole) condensed with aminopyrimidine (0.02 mole) in occurrence of acid-drops in refluxing step (2 hrs), then separation ,desiccating ,manifestation with absolute ethanol to

Pyrimidine-Imine Ligand {5} appreciative to studies [4, 6] .

Production of Pyrimidine-Sulphone Ligand {6}:

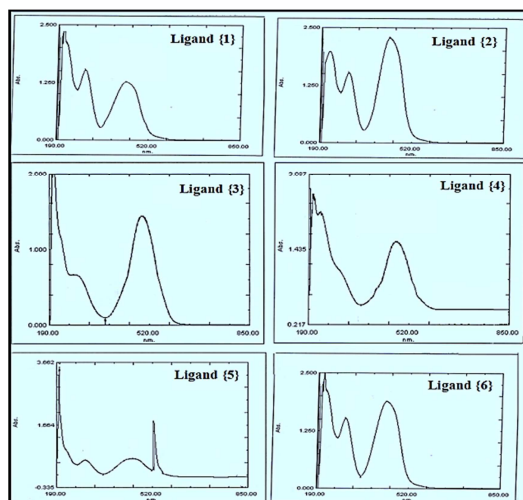
Pyrimidine-Imine Ligand {5} (0.01 mole) condensed with p-toluine sulphonyl chloride (0.02 mole) in occurrence of benzene as a splvent in refluxing step (2 hrs), then separation ,desiccating ,manifestation with absolute ethanol to Pyrimidine-Imidazole Sulphone Ligand {6} appreciative to studies[4,6] .

RESULTS AND DISCUSSION:

The multi-biological activity of these compounds prompted us to prepare new derivatives of them and encouraged us to do so because their derivatives have benign effects. All the prepared compounds have pharmacological qualities, that is, they have biological activity, and accordingly, the opinion settled on the preparation of derivative compounds, some of which are cyclic and others are noncyclic. Based on the foregoing, the organic compounds prepared in this study were diagnosed using well-known diagnostic methods, including:

Ultraviolet-Visible Spectroscopy:

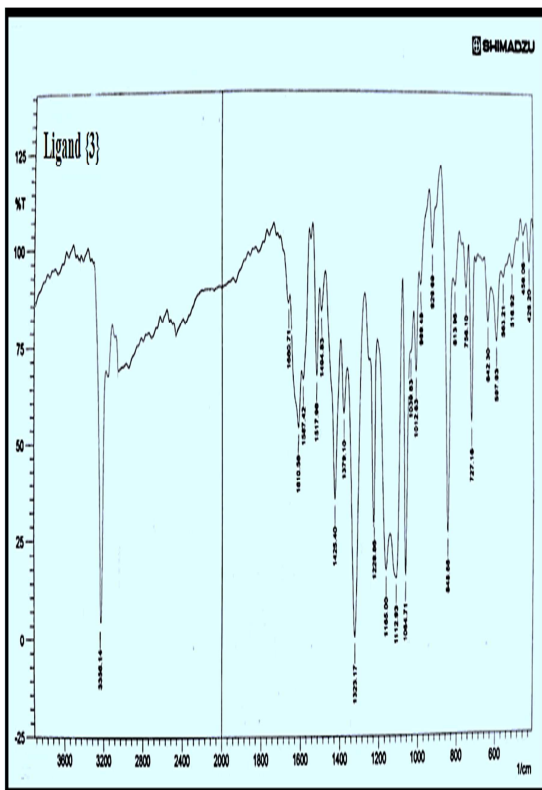
The prepared ligands were distinguished by their bright colors because they absorb light in the visible region of the spectrum, as they are accompanied by other absorptions [38-42] in the near regions of both the infrared and ultraviolet-visible region, which is a result of the magnetic and color properties of those ligands containing color-deep groups that increase the wavelength of the ligands.



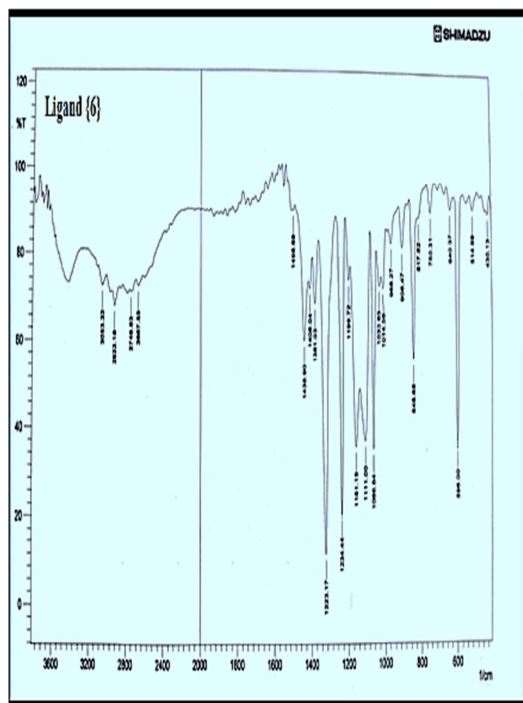
Configuration.1:U V.Vis Pyrimidine Ligands{1-6}

FT.IR- Revealing:

The bands in the spectra of the ligands suffered from the difference in the intensity of the bands compared to the bands of the ligands [43-47], as well as the occurrence of varying displacements for most of these bands., We noted appearance bands at [(2410) (2398)] cm^{-1} for (SH-) thiol group in Ligands {1 ,2} respectively, while it disappeared in Ligands {3 ,4} as a result to formation (S-CO-) groups, also new bands represented by [(3289) (3241)] cm^{-1} for (NH-) amine group for endocycle –imidazole ring in Ligands {3, 4}., But in ligand {5} appeared band at (1619) cm^{-1} for (CH=N-) anile group that disappeared in ligand {6} as a result to formation Sulphone group [48-52] (-SO₂-) at (1205) cm^{-1} ,also other band at (1688) for carbonyl of amide (CO-N), new band [53-57] at (1652) for (C=N) endocycle of pyrimide ring in most of ligands, all spectral revealing approving to investigation reference [14] , some of spectra:



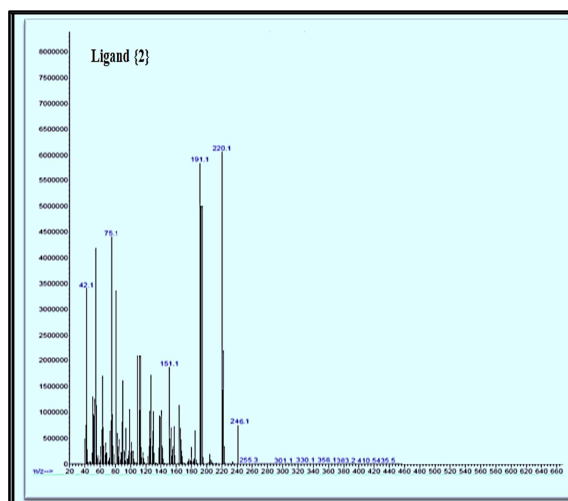
Configuration.2: I.R Pyrimidine Ligand {3}



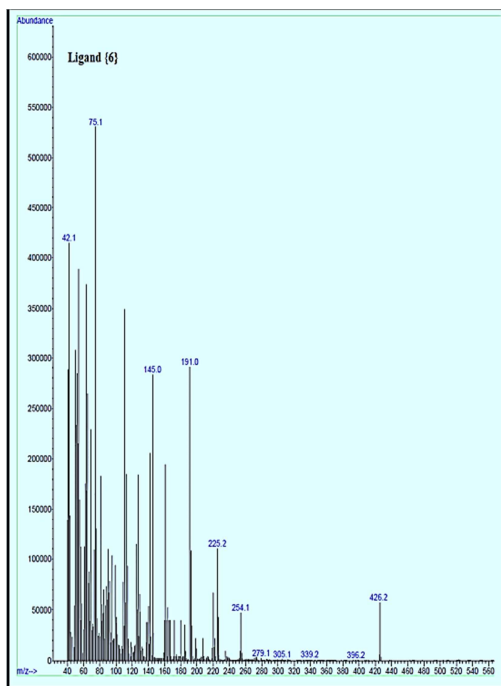
Configuration.2: I.R Pyrimidine Ligand {6}

Mass – Revealing:

The illuminating of pyrimidine Ligands subsidized another indication of prepared ligands {1-6} that acted by fractions of practical groups [58-61] in matching molecular weight that pointed to structure of measured ligands in mass- figures which indicated to improving structures of prepared ligands., all spectral revealing approving to investigation reference [14] , some figures(4, 5):



Configuration.4 : Mass –Spect. of Pyrimidine Ligand{2}



Configuration.5: Mass-Spect. of Pyrimidine Ligand {6}

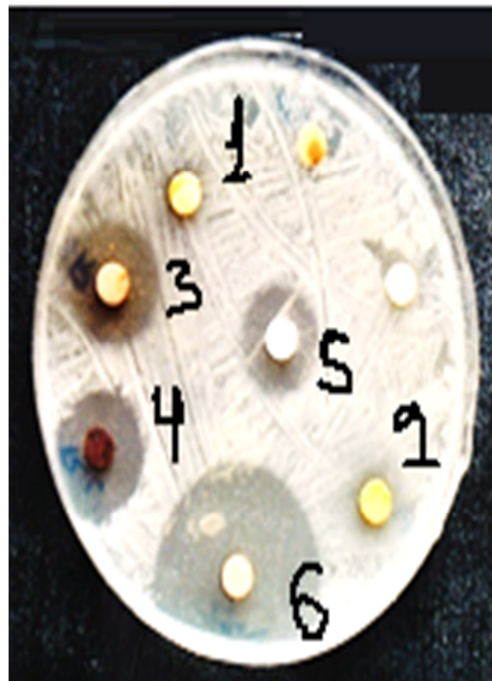


Photo.1: Inhibition of Ligands on Streptococcus Pneumonia

Bio- Studies [3, 5]

In previous studies, some researchers have used several biological studies in the treatment of types of cancer (leukemia, lung, colon, skin, ovary, kidney and central nervous system cancer), as well as the use of pyrimidine derivatives as anti-bacterial and anti-fungal agents, so we completed this study with tests for the efficiency of prepared derivatives against microbes [4, 5]. These germs were chosen because of their importance in the medical field, as they cause many different diseases, as well as differ in the nature of their resistance to antibiotics and therapeutic chemicals [62-66]. The results in the table indicate that all the tested compounds have the ability to inhibit the bacteria used, and it was noted that with the increase in the concentration of the substance, the diameter of the area free of bacterial growth increased., we noted that Ligand [6 ,4] have high activity towards resistance of bacteria due to their ability to inhibition wall of bacterial cell then kill it for this reason these ligands have more activity, also these ligands involved sulphone group in its structure.

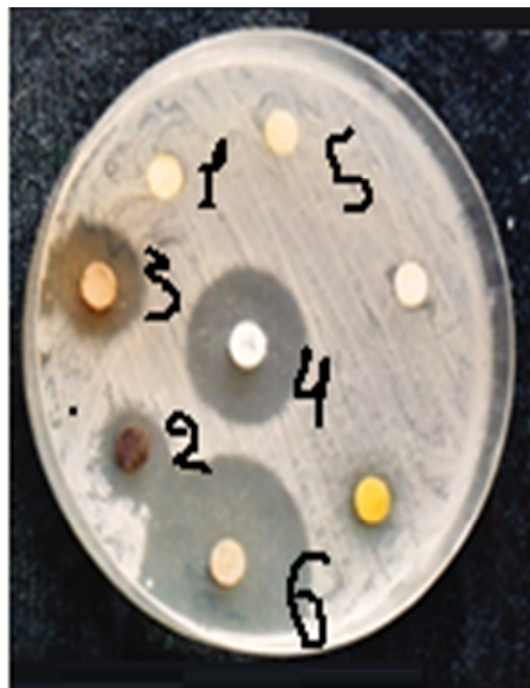


Photo. 2: Inhibition of Ligands on Escherichia. Coli

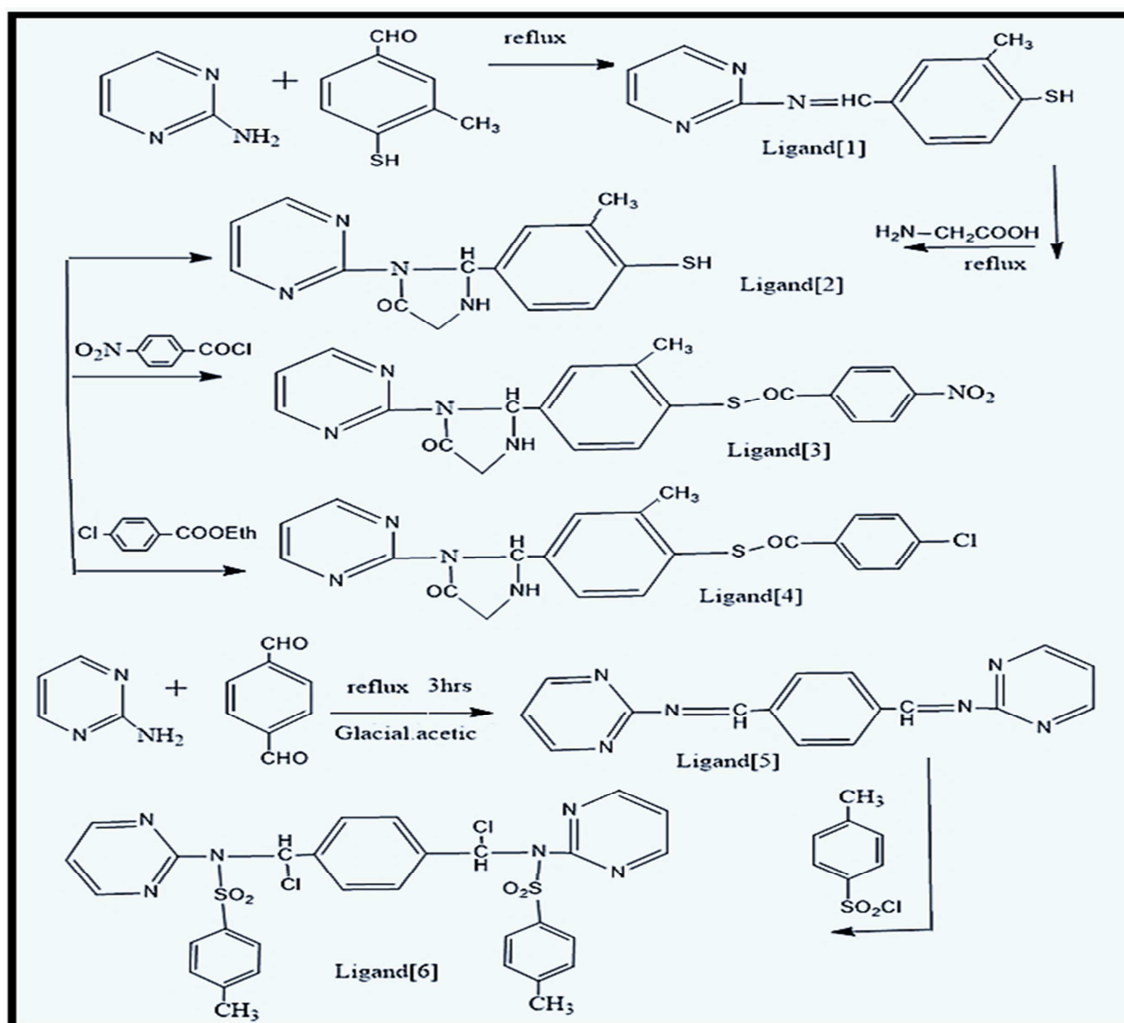
Table 1
Influence of resistance of Pyrimidine Ligands against Bacteria in Conc. (60 micro gram)

Pyrimidine Ligands	<i>Staphylococcus aureus</i>	<i>Streptococcus pneumonia</i>	<i>Escherichia. Coli</i>
Pyrimidine {1}	+	++	+
Pyrimidine {2}	++	++	++
Pyrimidine {3}	++	++	++
Pyrimidine {4}	+++	+++	+++
Pyrimidine {5}	++	+	++
Pyrimidine {6}	+++	+++	+++

(+) : inhibition (2-6) mm

(++) : inhibition (7-10) mm

(+++): inhibition (11-16) mm



Configuration.6: Production of Pyrimidine Ligands {1-6}

Conclusions:

The bands in the spectra of the ligands suffered from the difference in the intensity of the bands compared to the bands of the ligands, as well as the occurrence of varying displacements for most of these bands. Also the results indicated that Ligand [6, 4] have high activity towards resistance of bacteria due to their ability to inhibition wall of bacterial cell then kill it for this reason these ligands have more activity, also these ligands involved sulphone group in its structure

Conflict of interest: The authors declare that there is no conflict of interest.

Funding source: None

REFERENCES

1. Stockert, J.C.; Blázquez-Castro, A.; Cañete, M.; Horobin, R.W.; Villanueva, A. MTT assay for cell viability: Intracellular localization of the formazan product is in lipid droplets. *Acta Histochemica*. 2012, 114, 785-796. doi:10.1016/j.acthis.2012.01.006
2. Mosmann, T.M. "Rapid colorimetric assay for cellular growth and survival: application to proliferation and cytotoxicity assays". *Journal of Immunological Methods*. 1993, 65, 2, 55-63. doi:10.1016/0022-1759(83)90303-4. ISSN 0022-1759. PMID 6606682
3. Aljamali N M.; Sabreen, J. F. Preparation, Spectral Characterization, Thermal Study, and Antifungal Assay of (Formazane -Mefenamic acid)-Derivatives., *Egyptian Journal of Chemistry*. 2022, 411, 65, 2, DOI: 10.21608/EJCHEM.2021.88727.4266.
4. Nagham M A .Effect of Conditions and Catalysis on Products .,1th -Edition, 2021, Eliva Press SRL., ISBN: 9781636482286
5. Mahmood N A. Synthesis of Antifungal Chemical Compounds from Fluconazole with (Pharma-Chemical) Studying., *Research journal of Pharmaceutical, biological and chemical sciences*. 2017, 8 (3), 564 -573 .
6. Nagham, M. A. *Alternative Methods in Organic Synthesis* .,1th-Edition, Eliva Press SRL, 2020 ., ISBN: 9798680201176.
7. Bernas, T. .; J. Dobrucki. Reduction of a tetrazolium salt, CTC, by intact HepG2 human hepatoma cells: subcellular localisation of reducing systems. *Biochim Biophys Acta.*, 1999, 1451(1): p. 73-81.
8. Fadel, O.; Gomes, R.D.; Girard, L. B.; Rossignol, C. A.; Gaillard, J.C.; Diat, O. Separation and identification of polar polyphenols in oily formulation using high-performance thin-layer chromatography and mass spectroscopy techniques. *OCL*, 2018, 46., <https://doi.org/10.1051/ocl/2018039>.
9. Aljamali, N. M. *Synthesis and Biological Study of Hetero (Atoms and Cycles) Compounds.* , Der Pharma Chemica. 2016, 8,6, 40-48.
10. Sun S.Y., Jiang W.G., Zhao Y.P. Comparison of aromatic and phenolic compounds in cherry wines with different cherry cultivars by HS-SPME-GC-MS and HPLC. *Int. J. Food Sci. Technol*. 2012;47 :100-106. doi: 10.1111/j.1365-2621.2011.02812.x. [CrossRef] [Google Scholar]
11. Imd Karm, Hasaneen Kudhair Abdullabass ,Nagham Mahmood Aljamali. Invention of (Gluta.Sulfazane-Cefixime) Compounds as Inhibitors of Cancerous Tumors., *Journal of Cardiovascular Disease Research*, 2020,11, 2., 44-55 ., DOI: 10.31838/jcdr.2020.11.02.09 .
12. Aseel M Jawad, Nagham M A, Jwad S M. Development and Preparation of ciprofloxacin Drug Derivatives for Treatment of Microbial Contamination in Hospitals and Environment, *Indian Journal of Forensic Medicine & Toxicology*,2020,14, 2, p:1115-1122.
13. Agnieszka Wronka, Irena Malinowska •, Wiesła wa Ferenc , Beata Cristovao., *Chromatographic Study of Novel Heteronuclear Complexes with Schiff Base as Main Reagent.*, *Chromatographia* (2014) 77:1103-1112 ., DOI 10.1007/s10337-014-2664-2.
14. Nagham Mahmood Aljamali. *Spectral and Laboratory Diagnostics of Compounds.*, 1th - Edition, 2022, Eliva Press SRL., ISBN: 9781636482118.
15. Ren, Jun; Yao, Peng; Chen, Jingjing; Jia, Lingyun (2014). "Salt-independent hydrophobic displacement chromatography for antibody purification using cyclodextrin as supermolecular displacer" . *Journal of Chromatography A*. 1369: 98-104 . doi:10.1016/j.chroma.2014.10.009 . PMID 25441076.

16. Mahmood N A . Synthesis and Chemical Identification of Macro Compounds of (Thiazol and Imidazol) „Research J. Pharm. and Tech, 2015, 8,1, 78-84., DOI : 10.5958/0974-360X.2015.00016.5.
17. T, Manish. "How does column chromatography work?". BrightMags. Archived from the original on 21 April 2017. Retrieved 7 April 2017.
18. Shireen R. Rasool.; Nagham M Aljamali .;Ali Jassim Al-Zuhairi. Guanine substituted heterocyclic derivatives as bioactive compounds., Biochem. Cell. Arch. Vol. 20, Supplement 2, pp. 3651-3655, 2020 ., DocID: <https://connectjournals.com/03896.2020.20.3651>
19. Nagham M A, Jad F. Preparation, Diagnosis and Evaluation of Cyclic-Tryptophan Derivatives as Anti Breast Cancer Agents. Biomed Pharmacol J ., 2021; 14(4)., Available from: <https://bit.ly/3HuvlVG>
20. Nagham Mahmood Aljamali . Designation of Macrocytic Sulfazan and Triazan as Originated Compounds with Their Estimation in Nano-Activities by the Scanning Microscope ., International Journal of Convergence in Healthcare, January-June 2022, Vol. 02, No. 01., P: 25-34 , Available at : <https://www.ijcih.com/index.php/ijcih/article/view/21>
21. Rajaa Abdul Ameer Ghafil, Nor A Alrazkb, Nagham Mahmood Aljamali. Synthesis of Triazole Derivatives via Multi Components Reaction and Studying of (Organic Characterization, Chromatographic Behavior, Chem-Physical Properties)., Egyptian Journal of Chemistry. Vol. 63, No. 11, pp. 4163 - 4174 (2020). DOI: 10.21608/EJCHEM.2020.23541.2399 .
22. Nagham M Aljamali, Zainab Mohamed Farhan. Anticancer Study of Innovative Macrocytic Formazan Compounds from Trimethoprim Drug ., Egyptian Journal of Chemistry ,2023., DOI: 10.21608/EJCHEM.2022.132514.5852
23. D. Bravo-Díaz, Carlos (2010), "Diazohydroxides , Diazoethers and Related Species", in Rappoport , Zvi (ed.), PATai's Chemistry of Functional Groups, John Wiley & Sons, Ltd, doi:10. 1002/ 97804 70682531.pat05 11, ISBN 9780470682531
24. Carey, Francis A., (2007). Advanced organic chemistry. Sundberg, Richard J. (5th ed.). New York: Springer. ISBN 9780387448978 . OCL C 154040953.
25. Mahmood N A , Nemah Sahib Muhammed . Chemo - Spectral and Biological Studying of New Ligands ., Research Journal of Pharmaceutical, Biological and Chemical Sciences ., May – June, 2017 , RJPBCS ,8,(3) ,Page No. 674
26. Karmakar, R.; Mukhopadhyay, C. Synthesis of new horizons in benzothiazole scaffold and used in anticancer drug development. Phys. Sci. Rev. 2022. DOI: 10.1515/psr-2021-0044.
27. Pathak, N.; Rathi, E.; Kumar, N.; Kini, S.G.; Rao , C.M. A review on anticancer potentials of benzothiazole derivatives. Mini. Rev. Med. Chem. 2020, 20, 12-23.
28. Stockert JC, Horobin RW, Colombo LL, and Blázquez-Castro A. Tetrazolium salts and formazan products in Cell Biology: Viability assessment, fluorescence imaging, and labeling perspectives. Acta Histochemica 120: 159-167 (2018). doi:10.1016/j.acthis.2018.02.005
29. Mhand K, Saden Ab, Nour Alrazzaka, Nagham M A. 2021 . Synthesis, Characterization and Biological activity study for new hybridpolymers by grafting 1,3,4-triazole and 1,2,4-oxadiazole moieties ontopolyvinyl chloride ., Egyptian Journal of Chemistry ., Vol. 64, No. 3 pp. 1273 – 1283 ., DOI: 10.21608/EJCHEM.2021.27879.2584
30. Berridge, M.V.; Herst, P.M .; Tan, A.S. Tetrazolium dyes as tools in cell biology: new insights into their cellular reduction. Biotechnology Annual Review, 2015,11: 127-152 .
31. Elgemeie, G.E.H.; Abd Aal, F.A.E.M. Nitriles in heterocyclic synthesis: Novel synthesis of pyrido[2,1-b]benzothiazoles, pyrimido[6,1-b]benzothiazoles and pyrazolo[4,3-c]pyridazine derivatives. Heterocycles 1986, 24, 349-353.
32. S Jawad.; Nagham M Aljamali., Tetrazole Derivatives (Preparation, Organic Analysis, Biotic Evaluation, Nano-Study)., Egyptian Journal of Chemistry , 2023, 6.
33. El Rady, E.A. Efficient one pot synthesis of triazolotriazine, pyrazolotriazine, triazole, isoxazole and pyrazole derivatives. Heterocycl. Comm. 2012, 18, 215-221.
34. Pathak, A.K.; Saroj, R. Clinical Efficacy of benzothiazole in antitumor activity: A recent trends. World J. Pharm. Pharm. Sci. 2020, 9, 796-838.
35. Nagham Mahmood Aljamali. Review on (Azo, Formazane, Sulfazane)-Compounds ., International Journal of Innovations in Scientific Engineering., 2019, Vol. No. 10, Jul-Dec ., 19-45.
36. Irfan, A.; Batool, F.; Zahra Naqvi, S.A.; Islam, A.; Osman, S.M.; Nocentini, A.; Alissa, S.A.;

- Supuran, C.T. Benzothiazole derivatives as anticancer agents. *J. Enzyme Inhib. Med. Chem.* 2020, 35, 265-279.
37. Bhat, M.; Belagali; S.L. Structural activity relationship and importance of benzothiazole derivatives in medicinal chemistry: A comprehensive review. *Mini Rev. Org. Chem.* 2020, 17, 323-350.
38. Hussein, A. Detection of role the enzyme adenosine deaminase in leishmaniasis as biomarkers during of infection . *Al-Salam Journal for Biochemical and Medical Science*, 2022,1(2), 9–18. <https://doi.org/10.55145/ajbms.2022.1.2.002>
39. S. Ahmed, F. ., Ahmed, A. H. ., Raad, M. ., & M. Ali, A. prof. M.. Isolation of ferric Yersinia bactin A (fyuA) as virulence gene and biofilm forming in *Escherichia coli* was Collected from patient with UTI. *Al-Salam Journal for Biochemical and Medical Science*, 2022,1(2), 31–36. <https://doi.org/10.55145/ajbms.2022.1.2.005>
40. Ghyath Salih Mahmoud, & Dr. Wael Adil Obaid. (2022). Experimental studies on the effect of Chlorpyrifos on rats. VI. Population of intestinal mast cells and hypersensitivity reactions. *Al-Salam Journal for Biochemical and Medical Science*, 1(1), 6–11. <https://doi.org/10.55145/ajbms.2022.1.1.002>
41. Mahmood N A.; Jawd S M.; Zainab M J.; Intisar, O A.. Inhibition activity of (Azo–acetyl acetone) on bacteria of mouth ., *Research Journal of Pharmacy and Technology* , 2017, 10(6):1683-1686, DOI: 10.5958/0974-360X.2017.00297.9
42. S Al-Daffay, R. K. H. ., Al-Hamdani, A. A. S. (2022). Synthesis and Characterization of Some Metals Complexes with New Acidicazo Ligand 4-[(2-Amino-4-Phenylazo)-Methyl]-Cyclohexane Carboxylic Acid. *Iraqi Journal of Science*, 63(8), 3264–3275. <https://doi.org/10.24996/ijs.2022.63.8.2>
43. Kadhim, S. M. ., & Mahdi,. M. (2022). Preparation and Characterization of New (Halogenated Azo-Schiff) Ligands with Some of their Transition Metal Ions Complexes. *Iraqi Journal of Science*, 63(8), 3283–3299. <https://doi.org/10.24996/ijs.2022.63.8.4>
44. S M Abed ., N Mahmood A .(2022). Synthesis, Investigation and Anticancer Evaluation of Novel Macrocyclic Formazan and Linear Formazan, *European Chemical Bulletin* ., 11, 11, 46-63.
45. Nagham M A, Imd Kam. Development of Trimethoprim Drug and Innovation of Sulfazane-Trimethoprim Derivatives as Anticancer Agents ., *Biomedical & Pharmacology Journal*, March 2020., Vol. 13, (2), p. 613-625 ., <http://dx.doi.org/10.13005/bpj/1925>
46. Amen Abd , Nagham M A .Triazole-Anil and Triazol-Azo Reagents (Creation, Spectral Categorization, Scanning Microscopy, Thermal Analysis)., *NeuroQuantology* , 2021; 19(11):84-94 ., DOI Number: 10.14704/nq.2021.19.11.NQ21178
47. N Mahmood A., S Mohammed Abed. (2022). Bio Studies of Novel Macrocyclic Sulfazan and Linear Sulfazan (Creation, Analysis and Anticancer Assessment). *Journal of Pharmaceutical Negative Results*, 13(4), 351–363. <https://doi.org/10.47750/pnr.2022.13.04.043>
48. Jamali, Muhammad Sabaruddin Ahmad, Zuhaila Ismail, and Norsarahaida Saidina Amin. "Effect of Different Types of Stenosis on Generalized Power Law Model of Blood Flow in a Bifurcated Artery." *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences* , 87, no. 3 (2021): 172-183. <https://doi.org/10.37934/arfmts.87.3.172183>
49. Abd. Rahim Abu Talib, Sadeq Salman, Muhammad Fitri Mohd Zulkeple, & Ali Kareem Hilo. (2022). Experimental Investigation of Nanofluid Turbulent Flow Over Microscale Backward-Facing Step. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 99(2), 119–134. <https://doi.org/10.37934/arfmts.99.2.119134>
50. Salih, A. R. ., Al-Messri, Z. A. K. (2022). Synthesis, Characterization and Evaluation of Some Pyranopyrazole Derivatives as Multifunction Additives for Medium Lubricating Oils. *Iraqi Journal of Science*, 63(7), 2827–2838. <https://doi.org/10.24996/ijs.2022.63.7.7>
51. Mohamad, B. J ., Zghair, F. A ., Fadhil, Z. T. (2022). Clinical and Histopathological Features of Ovarian Cancer in Iraq, Baghdad Between 2014-2020. *Iraqi Journal of Science*, 63(6), 2354–2361. <https://doi.org/10.24996/ijs.2022.63.6.4>
52. Ghyath Salih Mahmoud, Ameen H. Ahmed, & Bassam M. Kassim. Assessment of histopathological and hematological changes in mice treated with the aqueous extract of *origanum* (*Driganum majorana.L*)in *algalab Alakhder libya*. *Al-Salam Journal for Biochemical and Medical Science*, 2022,1(1), 12–17. <https://doi.org/10.55145/ajbms.2022.1.1.003>

53. Sravya M.V.N., Sampath Kumar N.S. Dirisala Vijaya R. , Sai Kiran G.V.S.D., Simhachalam G. 2023. In vitro Assessment of Antibacterial and Antioxidant Activity of *Rhizophora apiculata* leaf extracts ., Research Journal of Biotechnology.; Vol. 18(6); 58-65; doi: <https://doi.org/10.25303/1806rjbt058065>;
54. Balasubramanian Deepika, Girigoswami Agnishwar and Girigoswami Koyeli . 2023. Antioxidant and anticancer activity of nano lycopene., Research Journal of Biotechnology.; Vol. 18(6); 98-104; doi: <https://doi.org/10.25303/1806rjbt980104>;
55. Ayu Y.S. and Kasiamdari R.S . 2023. Biological Treatment of Naphthol Yellow S and Batik Effluent using *Aspergillus tamaris* and *Aspergillus sclerotiorum*., Research Journal of Chemistry and Environment., Vol. 27(6) ,June 2023
56. Dev Athira S., Hari Neethu and Nair Ananthakrishnan Jayakumaran. Biodegradable natural and synthetic polymers for the development of electrospun nanofibrous scaffolds for various tissue engineering applications., Research Journal of Biotechnology., 2023, Vol. 18(6); 115-131; doi: <https://doi.org/10.25303/1806rjbt1150131>;
57. Rulla Sabah, Ahmed saad abbas Fatin F.Al-Kazazz, Salam A.H Al-Ameri , Investigation on Glucose and levels of Zn and Cu in Sera of Iraqi Males addicted on Methamphetamine or Tramadol , Journal of Advanced Sciences and Engineering Technologies: Vol. 3 No. 2 (2020)
58. Sabah R. Simultaneous HPLC estimation of Amphetamine and Caffeine abuse drugs in Iraqi human addicts. Journal of Advanced Sciences and Engineering Technologies .; 2021 Dec. 13 ;4(1):25-31. Available from: <https://isnra.net/ojs/index.php/jaset/article/view/13>
59. Hassan AK, Atiya MA, Luaibi IM. A Green Synthesis of Iron/Copper Nanoparticles as a Catalytic of Fenton-like Reactions for Removal of Orange G Dye. Baghdad Sci.J . 2022 Dec. 1 ;19(6):1249. Available from: <https://bsj.uobaghdad.edu.iq/index.php/BSJ/article/view/6508>
60. Mattigatti, S., & Datkhile, K. (2021). Synthesis, characterization and application of green synthesized ag nps in endodontic therapy to reduce microbial biofilm. Uttar Pradesh Journal of Zoology,42(12), 25-30.
61. V. V. Vaidya . (2023). The Effects of Heavy Metal Contamination on Antioxidant Enzyme Activity and Oxidative Stress in the Earthworm *Perionyx excavatus* . Uttar Pradesh Journal of Zoology,44(3), 59-65.
62. Mwafaq RK, Abbas AK, Abdullah LAH, Abdul Ghafour KH. The Immunohistochemically Estimation of CD63 in Iraqi Patients with Gastric Cancer . Baghdad Sci.J .,2023;19(5):0932. Available from: <https://bsj.uobaghdad.edu.iq/index.php/BSJ/article/view/6272>
63. Hussein FM. Doped ZnO Nanostructured and their application as photocatalytic: as Review. Journal of Advanced Sciences and Engineering Technologies.; 2021 May ;4(1):1-15. Available from: <https://isnra.net/ojs/index.php/jaset/article/view/1>
64. Ghyath S. Mahmoud, Raghed H. Rashed, Afrah Jabbar Lazim, & Heyam Aziz Mohammed. (2022). The Effects of Capparis Spinosa Leaves on The Histological Findings Associated With The Exposure of Mice to Trichloroacetic Acid. Al-Salam Journal for Biochemical and Medical Science, 1(1), 18–25. <https://doi.org/10.55145/ajbms.2022.1.1.004>
65. Ghyath Salih Mahmoud, Wael Adil Obaid. (2022). Cellular Elements of the Human's Bone Marrow. Al-Salam Journal for Biochemical and Medical Science, 1(1), 26–34. <https://doi.org/10.55145/ajbms.2022.1.1.005>
66. Raad, M ., Ahmed, A. H. ., & Ahmed, F.. Identification of MRSA(methicillin resistant *Staphylococcus aureus*) by *mecA* gene. Al-Salam Journal for Biochemical and Medical Science, 2022, 1(2), 25–30. <https://doi.org/10.55145/ajbms.2022.1.2.004>