

Anticancer Evaluation of Innovated Macrocyclic Sulfazan and Triazan Compounds as anticancer- Breast Drugs

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Abstract

Triazan with Macro cyclic Sulfazan as a novel class of compounds were attended and developed for the primary stage in organic chemistry in 2019 internationally by (Professor Dr. Nagham Aljamali), who began working on studying of these chemical compounds in the field of cancerous tumors and comparing infected cells with healthy cells by using many materials prepared from the interaction of chemical compounds that include donor atoms that can attack and treat malignant tumor cells, such as sulfur and nitrogen atoms, which are considered as a measure of the ability of drugs to treat Diseases through knowledge of the ability of triazan and formazan compounds to penetrate cellular membranes, while there are special medicinal compounds that often lose this ability, and in this case it was found that antibiotics become highly effective and their activity increases in the presence of groups of Formazan, Triazan and Sulfazan. Sulfazan compounds differ in their mode of action and activity in the life system depending on their composition. For example, inert (stable) metal complexes have good effectiveness against microbes, fungi, and viruses. They are also used to control the spread of cancerous tissues.. All spectral studies appeared good results and strong evidences for their structures and all results of anticancer studies indicated to high efficiency of these compounds on cancer cells of breast.

Keywords: *azan, Macrocyclic Sulfazan, Triazan, cancer, tumor, drug.*

1. Introduction

Macrocyclic Sulfazan Compounds: Novel conceived Triazan and Sulfazan composites were innovated by (investigator Prof. Dr. Nagham) (1-3) in April 2019 for the primary stage internationally (1-3). The basics in addition to original approaches for synthesis of these novel derivatives and steps of reaction (5-7) have been positioned by Dr. Nagham as a novel procedure in organic chemistry field.

Triazan Compounds: Also it is Novel conceived Triazan composite was innovated by (investigator Prof. Dr. Nagham) (1-3) in April 2019 for the primary stage

internationally (1-3). The lack of studies and references related to it, its composition has a periodic arrangement of (-N = N-N- in the periodic arrangement) (5-7) according to the type of derivative, It is prepared under different conditions and catalysts bestowing to the type of reactant of the amino compounds in fact(47-53) , and the researcher provided sources and research papers on the methods of its preparation(1-3), and these innovative compounds were recently applied, so the academic (Dr. Nagham) operated on serial trainings For submissions of these novel composites such as fungal assay studies(5-7), bacterial assay, and cancer and oncological

studies to provide information on the influence of these composites. The dynamic groups in these compounds have different submissions.

2. Appliances and Trials:

All mechanism of preparation with instrumental analysis carried out in Tehran Universities and some of them in center of chemical lab in pharmacy college , Also anticancer Studies for two Bio-compounds.

Designation Procedures:

Designation of Triazole [1]:

1,4-Dicarboxy benzene (0.01 mol , 1.66g) was retorted with (NH₂NH-CS-NH₂) (0.02 mol, 1.82g) in 45 ml (C₂H₅-OH) in basic medium (5% alkali solution) in alternation and condensation step for 35 hrs, then ring fused step via condensation reaction and cyclization step by cyclization of ester group with thiosemicarbazide , the product filtered, dried , recrystallized, according to procedures(1-3).

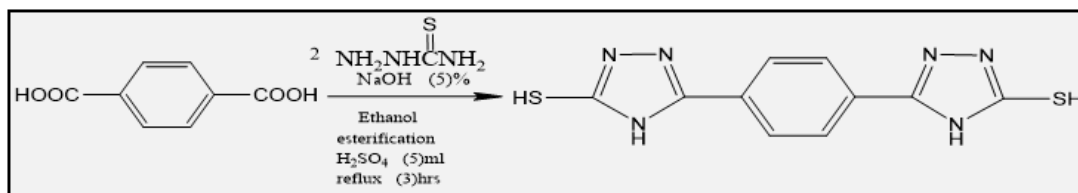
Designation of Inventive Macrocylic Sulfazan- Triazan [2]:

Starting composite [1] was (0.01 mol, 2.76g) dissolved in basic solution from (alkali solution) then responded with (0.02 mol, 5.80g) of di-azo salt of Trimethoprim by way of sundry steps in basic solution to construction invented Macrocylic Sulfazan-Triazan subsequently (60 hrs), the merchandise cleaned ,dehydrated ,eroded by refined water, recrystallized to revenue Invented Macrocylic Sulfazan-Triazan bestowing to techniques(1-3).

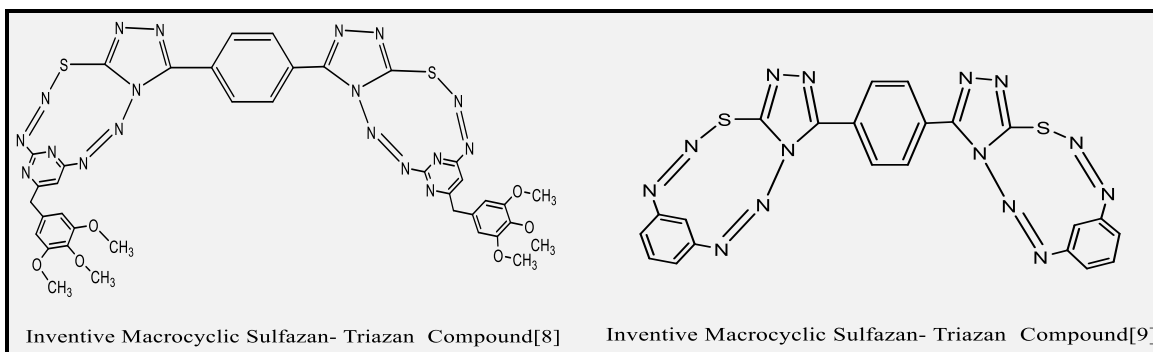
Designation of Inventive Macrocylic Sulfazan- Triazan [3]:

Starting composite [1] was (0.001 mol, 0.276g) dissolved in basic solution from (Piprydine) then reacted with (0.002 mol, 0.216g) of diazo salt of Benzene-1,4-by way of sundry steps in basic solution to construction invented Macrocylic Sulfazan-Triazan subsequently (52 hrs), the merchandise cleaned ,dehydrated ,eroded by refined water, recrystallized to revenue Invented Macrocylic Sulfazan-Triazan bestowing to techniques (1-3) .

Chaos.1: Designation of Triazole [1] as a drug



Chaos.2: Designation of Conceived Macrocylic Sulfazan-Triazan [2 , 3] as a drugs



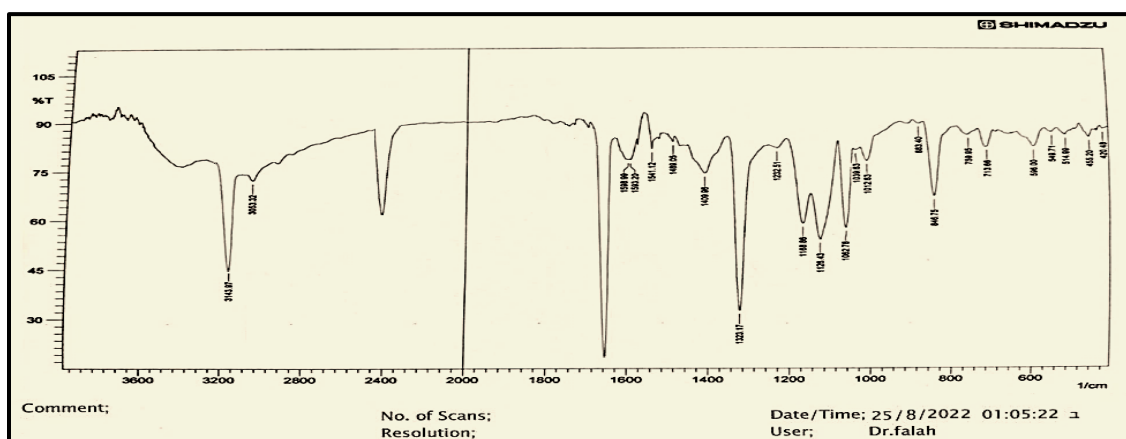
3. RESULTS AND DISCUSSION:

Invented Triazan and Macrocylic Sulfazan have been Designated in equivalent process that shadowed and conceived by the academic Dr. Nagham in year 2019 via series of studies (1-3) that got a patent for invention of Triazan and Macrocylic Sulfazan (1, 2) :

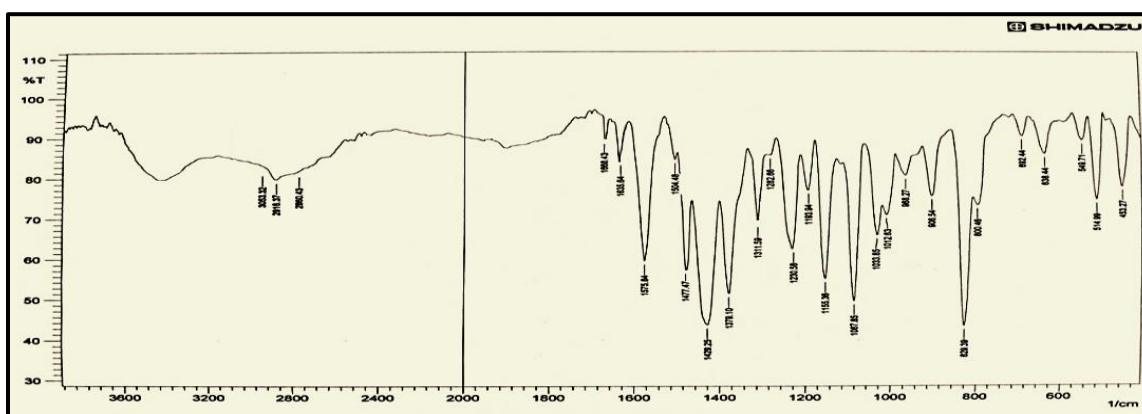
Spectral Part :

FT.IR- Supernatural Suggestion of Macrocylic Triazan and Sulfazan : It
Statistic. (1): Infrared [1]

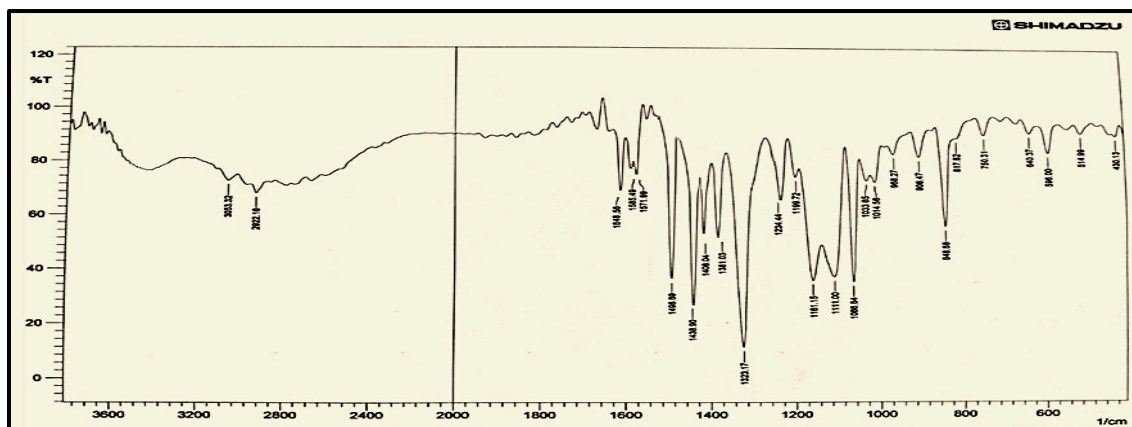
designated to foundation our Conceived Sulfazan by exterior of gang at $:(2400) \text{ cm}^{-1}$ for (SH) mercapto cluster in triazole-thiol [1] which is vanished and other bands appeared as an alternative of it characterized in (-S-N=N-) Sulfazan and (-N-N=N-) Triazan group at : $\{(1379, 1429, 1477), (1406, 1438, 1498)\} \text{ cm}^{-1}$ respectively , and band at (1311) for band (N-N-N) in Macrocylic Sulfazan and Triazan compounds [2, 3] correspondingly , statistics (1-3) :



Statistic. (2): Infrared [2]



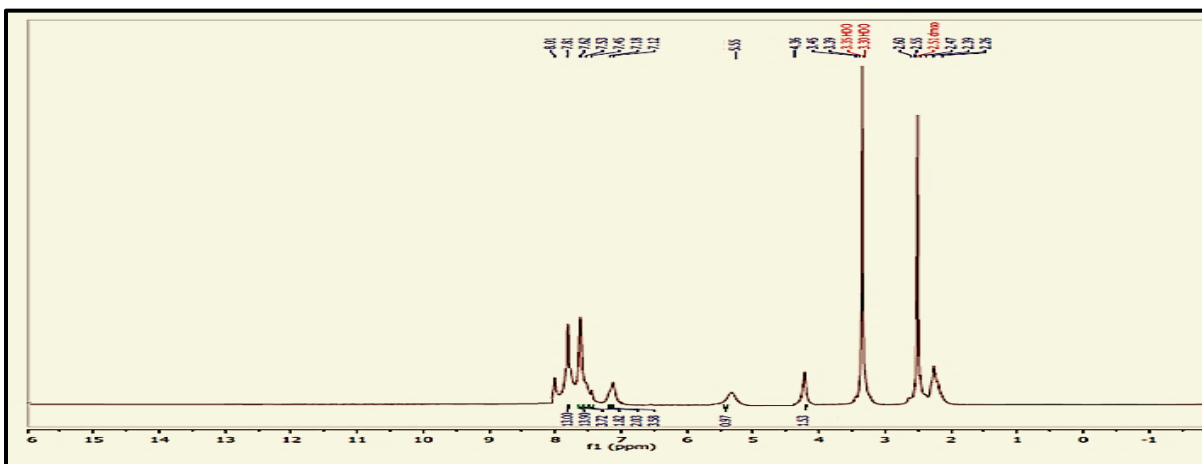
Statistic. (3): Infrared [3]



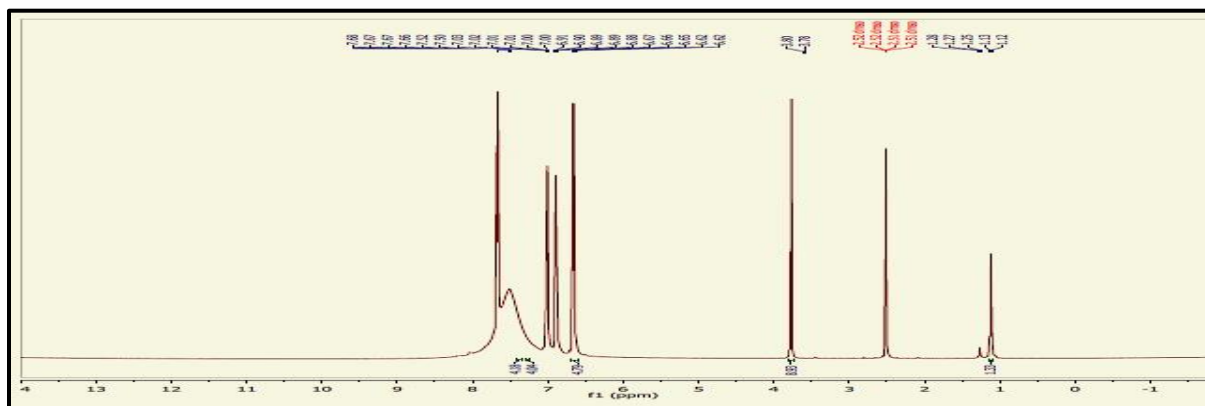
H.NMR – Rang Suggestion of Macrocyclic Sulfazan , Triazan : It designated to foundation our Conceived triazole by entrance of highest at : δ (4.36) for (SH) mercapto cluster and peak at (5.55) for (NH) of amine group of

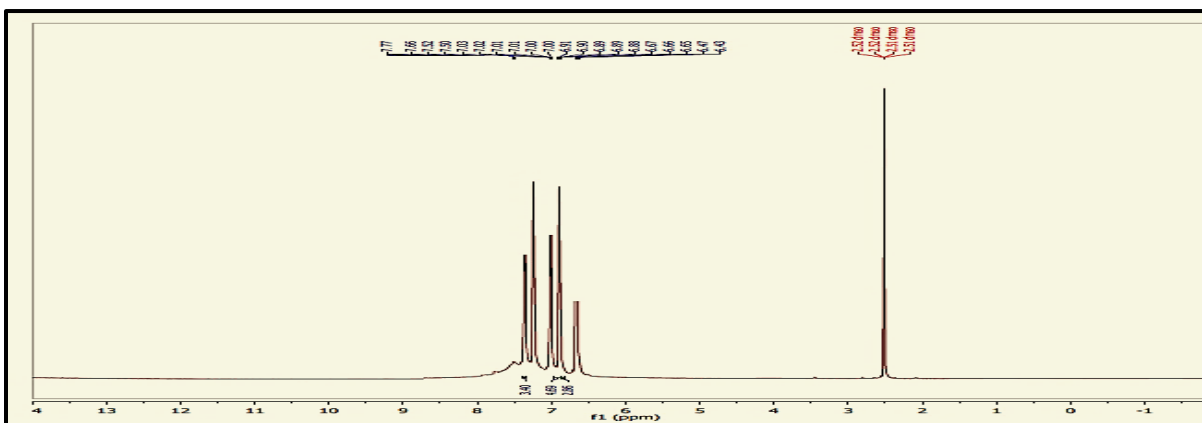
Triazole amine [1] that vanished in Triazan and Macrocyclic Sulfazan [2, 3] due to formation Triazan and Sulfazan [2, 3] Statistics (4-6) :

Statistic. (4): Resonance [1]



Statistic. (5): Resonance [2]

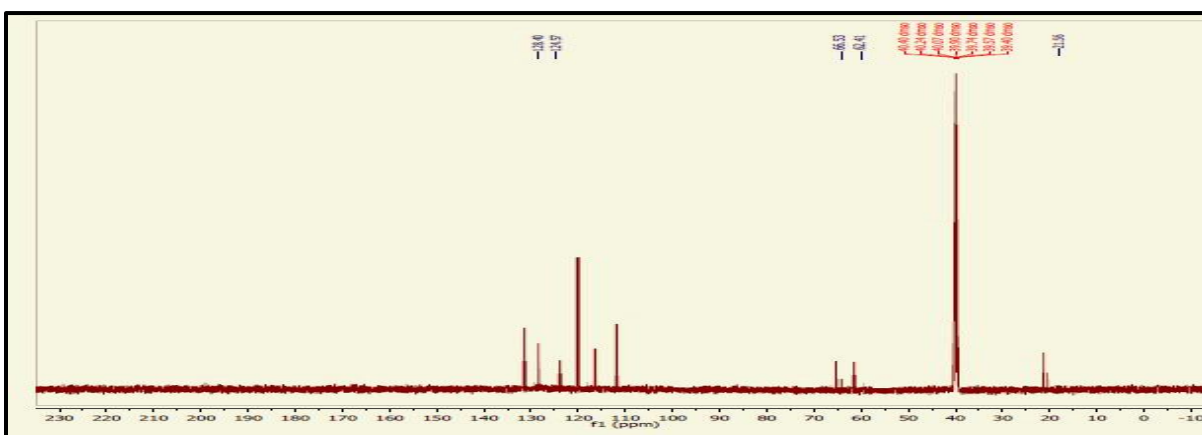


Statistic. (6): Resonance [3]

C.NMR - rang Suggestion of Triazan and Macrocylic Sulfazan : It indicated to formation our Invented Sulfazan compounds by appearance of peaks at : δ (106.0-141.9) for signals of Aromatic carbon atoms in Triazan and Sulfazan compounds [2, 3] , also peak at : δ (66.0) for signal of carbon atom of

Statistic. (7): Carbon-Resonance [2]

methoxy group (-OCH₃) in Sulfazan compound [2], other peak at : δ (21.56) for signal of carbon atom of methylene group (-CH₂) in Sulfazan compound [2], all other signals clarified according to reference(30) ,all data signals in Statistic. (7):



Anti-malignance Inspection (1-3) :

Triazan besides to Sulfazan {2 , 3} were selected for anticancer evaluation (breast cancer) by dint of MTT-Investigation of

dualistic sorts of Cells (MCF-7) as Malignancy cell besides (MCF- 10 A)as well cell affording to revisions [1-3] , all statistics (8 , 9) , Stands (1 ,2). The results gave good data indicated to high inhibition of tumor cells.

Stand. (1): Cytotoxic Commotion of Sulfazan-Triazan Composite [2] continuously Breast Malignancy Cells (MCF-7) and Well Cells (MCF-10A) at the equivalent meditation exhausting 24 hrs ., MTT trial 370c.

Dose ($\mu\text{g.mL}^{-1}$)	Proportion (%) in place of every selected cells			
	MCF-7 / IC ₅₀ = 12. 76		MCF-10A / IC ₅₀ = 196.82	
Triazan -Sulfazan {2}	Malignant cells MCF-7		Common cells MCF-10A	
	Cell Viability	Cell -Inhibition	Cell Viability	Cell- Inhibition
15. 62	90.63	9.37	85.43	14.57
31. 25	87.81	12.19	89.75	10.25
62. 5	80.92	19.08	91.64	8.36
125.0	54.78	45.22	93.32	6.68
250	47.48	52.52	94.58	5.42
500	43.02	56.98	95.76	4.24
Control	100		96.20	3.80

Stand. (2): Cytotoxic Commotion of Triazan-Sulfazan Composite [3] continuously Breast Malignancy Cells (MCF-7) and Well Cells (MCF-10A) at the equivalent meditation exhausting 24 hrs ., MTT trial 370c.

Dose ($\mu\text{g.mL}^{-1}$)	Proportion (%) in place of every selected cells			
	MCF-7 / IC ₅₀ = 14.45		MCF-10A / IC ₅₀ = 194.98	
Triazan -Sulfazan {3}	Malignant cells MCF-7		Common cells MCF-10A	
	Cell -Viability	Cell- Inhibition	Cell -Viability	Cell -Inhibition
15. 62	90.55	9.45	89.01	10.99
31. 25	86.43	13.57	90.71	9.29
62. 5	80.36	19.64	93.48	6.52
125.0	76.81	23.19	94.99	5.01
250	50.44	49.56	95.20	4.8
500	45.71	54.29	95.67	4.33
Control	100		96.45	3.55

Fig. 8: Anti-malignancy commotion of Triazan-Sulfazan {2} on (MCF-7) at 500 $\mu\text{g/ml}$

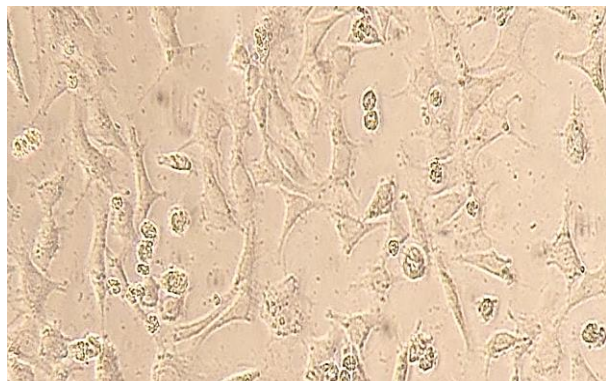
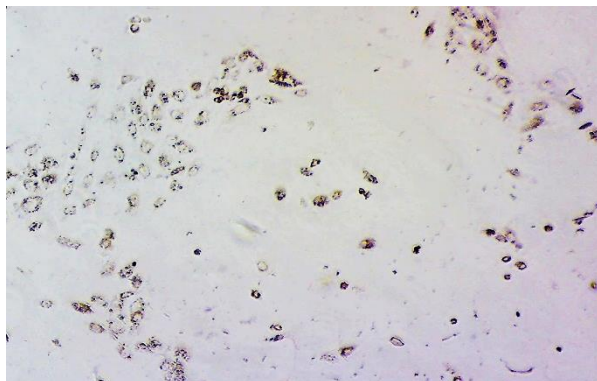


Fig. 9: Anti-malignancy commotion of Triazan-Sulfazan {2} on (MCF-A 10) at 500 $\mu\text{g/ml}$



4. Conclusions:

We distinguished that Macrocyclic Triazan-Sulfazan [2] abstains higher competence on Malignancy cells and extraordinary spontaneity than Triazan- Sulfazan [3] owing to attendance of paired sets of Triazan in addition to Sulfazan groups (-S-N=N) and (-N-N=N-) linked with trimethoprim in same compound.

Reference

- N M Aljamali. (2022). Designation of Macrocyclic Sulfazan and Triazan as Originated Compounds with Their Estimation in Nano-Activities by the Scanning Microscope ., International Journal of Convergence in Healthcare., 2022, Vol. 02, No. 01., P: 25-34 , Available at : <https://www.ijcih.com/index.php/ijcih/article/view/21>
- Mahmood N A. (2021). Creation of Originated Macrocyclic Sulfazan-Formazan Compounds and Linear Sulfazan-Formazan for the first Time Globally with their Assay as Antifungal ., Biomedical Journal of Scientific & Technical Research, 2021, Volume 40- Issue 3 , P: 32266-32272 ., DOI: 10.26717/BJSTR.2021.40.006453 .
- Nagham M A. (2021). Inventing of Macrocyclic Formazan Compounds and Studying Them Against Breast Cancer for The first Time Globally . Annals of pharma research .,9 ,7, (2021). Pp 525-533., Available at:<https://www.annalsofpharmaresearch.com/index.php?journal=apr&page=article&op=view&path%5B%5D=38>
- Francesca Milocco, Folkert de Vries, Harmke S. Siebe, Silène Engbers, Serhiy Demeshko, Franc Meyer, Edwin Otten. (2021). Widening the Window of Spin-Crossover Temperatures in (formazanate) ion Complexes via Steric and Noncovalent Interactions. Inorganic Chemistry 2021, 63 (3) , 2445-2455. 00
- Nagham M A. (2018). Experimental Methods for Preparation of Mannich Bases, Formazan, Normal and Cyclic Sulfur Compounds., 1st edition Evince pub Publishing House; 2018, ISBN: 978-93-87905-19-1.
- Nagham M A. Review on (Azo, Formazane, Sulfazane)-Compounds ., International Journal of Innovations in Scientific Engineering., 2019, Vol. No. 10, Jul-Dec ., 19-45.
- Nagham M A. Alternative Methods in Organic Synthesis .,1th-Edition, Eliva Press SRL, 2020 ., ISBN: 9798680201176.
- L Hunter and C B Roberts" The associating effect of the hydrogen atom. Part IX. The N-H-Nbond. Virtual tautomerism of the formazyl compounds" ., journal of the Chemical Society.1941, Pages 820-823.
- A A Abbas'. New synthesis of 28- and 30-crown-formazans and bis formazans" .,Tetrahedron. October 1998.Vol. 54, Issue 40, Pages 12421-12428.
- Ghyath S Mahmoud, Ameen H. Ahmed, & Bassam M. Kassim. (2022). Assessment of histopathological and hematological changes in mice treated with the aqueous extract of origanum (Driganum majorana.L)in algabal Alakhder libya. Al-Salam Journal for Biochemical and Medical Science, 1(1), 12–17. <https://doi.org/10.55145/ajbms.2022.1.1.003>
- G S. Mahmoud, Raghd 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>
- Mahmoud G S, 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>
- N Mahmood 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> .
- Matheus ME, de Almeida Violante F, Garden SJ. Isatins inhibit cyclooxygenase-2 and inducible nitric oxide synthase in a mouse macrophage cell line. *Eur J Pharmacol*. 2007; 556 :200–6.
- Nagham M A. 2016. Synthesis and Biological Study of Hetero (Atoms and Cycles) Compounds , *Der Pharma Chemica*, 8,6, 40-48.
- N M Aljamali. 2015. Synthesis and Chemical Identification of Macro Compounds of (Thiazol and Imidazol) ., *Research J. Pharm. and Tech*, 8,1, 78-84., DOI: 10.5958/0974-360X.2015.00016.5.
- 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/ij.s.2022.63.8.2>
- 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/ij.s.2022.63.8.4>
- Nagham M A. (2015). Review in Azo Compounds and its Biological Activity. *Biochem Anal Biochem*, 4, 169, doi:10.4172/2161-1009.1000169.
- N Mahmood A., S Jawad. (2022) . Preparation, Spectral Characterization, Thermal Study, and Antifungal Assay of (Formazane - Mefenamic acid)- Derivatives., *Egyptian Journal of Chemistry* ., 411, Volume 65, Issue 2, 2022, DOI: 10.21608/EJCHEM.2021.88727.4266
- 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/ij.s.2022.63.7.7>
- 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/ij.s.2022.63.6.4>
- Nagham M 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.
- Hasaneen Kudhair Abdullabass, Aseel Mahmood Jawad ,Nagham Mahmood Aljamali . Synthesis of drugs derivatives as inhibitors of cancerous cells., *Biochem. Cell. Arch*, Vol. 20 (2) – October 2020., DocID:

- <https://connectjournals.com/03896.2020.2.0.5315>.
- F. Jawad, Nagham Mahmood Aljamali . Preparation, Investigation and Study of Biological Applications of Tyrosine Derivatives against Breast Cancer Cells ., NeuroQuantology ,September 2021 ,Volume 19 , Issue 9 , Page 117-125 .,doi: 10.14704/nq.2021.19.9.NQ21144
- Nagham M A., Intisar Obaid Alfatlawi. Synthesis of Sulfur Heterocyclic Compounds and Study of Expected Biological Activity ., Research J. Pharm. and Tech., 2015, 8,9 ,1225-1242 , DOI: 10.5958/0974-360X.2015 .00224.3.
- Intisar Obaid Alfatlawi, Nuha S S, Zainab M J ,Nagham Mahmood Aljamali. Synthesis of New Organic Compounds Via Three Components Reaction with Studying of (Identification, Thermal Behavior, Bioactivity on Bacteria of Teeth)"., Journal of Global Pharma Technology. 2017;11,9, 157-164.
- Nagham M A.; Saher Mahmood Jawd.; Zainab M J.; Intisar, Obaid. Alfatlawi.; 2017. Inhibition activity of (Azo–acetyl acetone) on bacteria of mouth ., Research Journal of Pharmacy and Technology, 10(6):1683-1686, DOI: 10.5958/0974-360X.2017.00297.9
- Aseel Mahmood Jawad., Nagham Mahmood Aljamali, Saher Mahmood Jawd. 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.
- N M Aljamali. Spectral and Laboratory Diagnostics of Compounds .,1th –Edition, 2022, Eliva Press SRL., ISBN: 9781636482118.
- Shireen R. Rasool, Nagham Mahmood 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/03896.2020.2.0.3651>.
- Nagham M 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.
- Nor A., Suad S., Nagham Mahmood Aljamali. Synthesis, Characterization and Thermal Analysis for New Amoxil Ligands, Asian Journal of Chemistry; 31, 5, 1022-1026, (2019).
- Rajaa Abdul Ameer Ghafil, Nor A Alrab, 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 .
- Nagham M A. (Synthesis, Investigation, Chromatography, Thermal)- Behavior of (Five, Seven)- Membered Ring with Azo and Anil Compounds ., Pak. J. Biotechnol.; 15(1): 219-239 (2018).
- Mhammd Abdul, Abd Ali H , N Mahmood A . (2021). Synthesis, Spectral, Bio Assay, Chromatographic - Studying of New Imidazole Reagents Via Three Components Reaction . NeuroQuantology ,July 2021 , Volume 19 , Issue 7 ,Page 115-122 ., doi: 10.14704/nq.2021.19.7.NQ21092

- Amen Abd , Nagham Mahmood Aljamali .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 .
- 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>
- Imd Kam, Hsanan Kudhir Abdulabass ,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 .
- Nagham M A. Origination of Macrocyclic Formazan with Macrocyclic Sulfazan and Triazan as Originated Compounds and Compared Their efficiency Against Breast Cancer. Open Access Journal of Biomedical Science, 2022, 4(1) OAJBS.ID.000383. DOI: 10.38125/OAJBS.000383
- N M Aljamali. Synthesis Innovative Cyclic Formazan Compounds for the First Time and Evaluation of Their Biological Activity. International Journal of Polymer Science & Engineering . 2021; 7(2): 5–14p., DOI: <https://doi.org/10.37628/ijpse.v7i2.830> .; Available at : <http://materials.journalspub.info/index.php?journal=JPMSE&page=article&op=view&path%5B%5D=830>
- Nagham M A. Inventing of Macrocyclic Formazan Compounds with Their Evaluation in Nano- Behavior in the Scanning Microscope and Chromatography. Biomedical Journal of Scientific & Technical Research . 41, (3), 2022., P: 32783-32792 .; BJSTR. MS.ID.006616 .; DOI: 10.26717/BJSTR.2022.41.006616 .
- Nagham M A, Zainab Mohamed Farhan. (2023). Anticancer Study of Innovative Macrocyclic Formazan Compounds from Trimethoprim Drug ., Egyptian Journal of Chemistry ,2023 , 66, 1., DOI: 10.21608/EJCHEM.2022.132514.5852
- Zainab Mohamed Farhan, Nagham M A. Comparison of the efficiency of innovative formazan compound with innovative sulfazan against breast tumors. International Journal of Medicine Research, Volume 7, Issue 1, 2022, Pages 18-25 ., Available at : <https://www.medicinesjournal.com/archives/2022/vol7/issue1/7-1-18>
- Hussein, A. (2022). Detection of role the enzyme adenosine deaminase in leishmaniasis as biomarkers during of infection . Al-Salam Journal for Biochemical and Medical Science, 1(2), 9–18. <https://doi.org/10.55145/ajbms.2022.1.2.002>
- Sarah Mohammed Abed ., Nagham Mahmood Aljamali .(2022). Synthesis, Investigation and Anticancer Evaluation of Novel Macrocyclic Formazan and Linear Formazan, European Chemical Bulletin , 11, 11, 46-63.
- Sura Essam Mohammed Reda , Sarah Mohammed Abed .(2022). Imidazole-Cyclic Derivatives (Preparation, Spectral Studies, Microbial Studies) , European Chemical Bulletin , 11, 11, 27-35.
- Raad, M. ., Ahmed, A. H ., Ahmed, F . (2022). Identification of MRSA(methicillin resistant Staphylococcus aureus) by mecA gene. Al-Salam Journal for Biochemical and Medical Science, 1(2), 25–30.

- <https://doi.org/10.55145/ajbms.2022.1.2.004>
- S. Ahmed, F ., Ahmed, A. H. ., Raad, M. ., M. Ali, A. prof. M. (2022). 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, 1(2), 31–36. <https://doi.org/10.55145/ajbms.2022.1.2.005>
- Nagham Mahmood Aljamali, Sarah 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>
- Ghassan Nasif, Yasser El-Okda, Mouza Alzaabi, & Habiba Almohsen. (2022). Effects of the Conjugate Heat Transfer and Heat Flux Strength on the Thermal Characteristics of Impinging Jets. CFD Letters, 14(7), 18–30. <https://doi.org/10.37934/cfdl.14.7.1830>
- Suaib Al Mahmud, & Ahmad Faris Ismail. (2021). Multiphase CFD Investigation on Convective Heat Transfer Enhancement for Turbulent Flow of Water-Al₂O₃ Nanofluid. CFD Letters, 13(10), 11–24. <https://doi.org/10.37934/cfdl.13.10.1124>
- Wadhah Hussein Abdulrazzaq Al Doori. (2022). Experiments and Numerical Investigations for Heat Transfer from a Horizontal Plate via Forced Convection Using Pin Fins with Different Hole Numbers. CFD Letters, 14(9), 1–14. <https://doi.org/10.37934/cfdl.14.9.114>
- Noor H. Dhaher, Mohammed K. Khashan, Nawfel Muhammed Baqer Muhsin. (2022). One Dimensional Steady-State Heat Transfer on a Star Fin Shape. CFD Letters, 14(12), 1–10. <https://doi.org/10.37934/cfdl.14.12.110>
- Sarah Mohammed Abed, & Sura Essam Mohammed Reda. (2022). Lactam-Heterocycles Compounds (Synthesis, Organic Revealing, Bacterial and Fungal Estimation). Journal of Pharmaceutical Negative Results, 13(4), 342–350. <https://doi.org/10.47750/pnr.2022.13.04.044>
- Ghyath Salih Mahmoud, 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>
- Mkhaiber, A., & Jarallah, N. . (2022). STUDY THE RELATIONSHIP BETWEEN BREMSSTRAHLUNG DOSE RATE AND THE ENERGY OF BETA RAY FOR DIFFERENT TYPES OF SHIELD: Nuclear Physics. Malaysian Journal of Science, 41(2), 47–54. <https://doi.org/10.22452/mjs.vol41no2.4>
- Altaie, M. (2022). EFFECT TWO ZERO DISPERSION WAVELENGTHS AND RAMAN SCATTERING IN THE THIRD-ORDER SOLITON OF SOLID CORE PHOTONIC CRYSTAL FIBERS TO PRODUCE SUPERCONTINUUM GENERATION. Malaysian Journal of Science, 41(2), 55–68. <https://doi.org/10.22452/mjs.vol41no2.5>
- Deniz Ar, Alexander F. R. Kilpatrick, Beatrice Cula, Christian Herwig, Christian Limberg. Transformation of Formazanate at Nickel(II) Centers to Give a Singly Reduced Nickel Complex with Azoimate Radical Ligands and Its Reactivity toward Dioxygen. Inorganic Chemistry 2021, 60

(18) , 13844-13853.
<https://doi.org/10.1021/acs.inorgchem.0c03761>

Sahan, E. J. (2022). Evaluation of Zinc, Copper, and Lead Levels in The Blood of Breast Cancer Women in Baghdad City. Iraqi Journal of Science, 63(1), 1–8.
<https://doi.org/10.24996/ij.s.2022.63.1.1>