Studying of Bacterial Resistance Against (Sulfur-Ligands) and Thermal Studying

Dr. Nagham Mahmood Aljamali[1] , Dalal Abdul Hussain Kadium[2] , Zainab Jawad Naki[3], Jihan Razzaq Muslim[4]*

[1,4]Chemistry Department, Faculty of Education for Girls , Iraq.*

[2,3]Biology Department, Faculty of Education for Girls , Iraq.

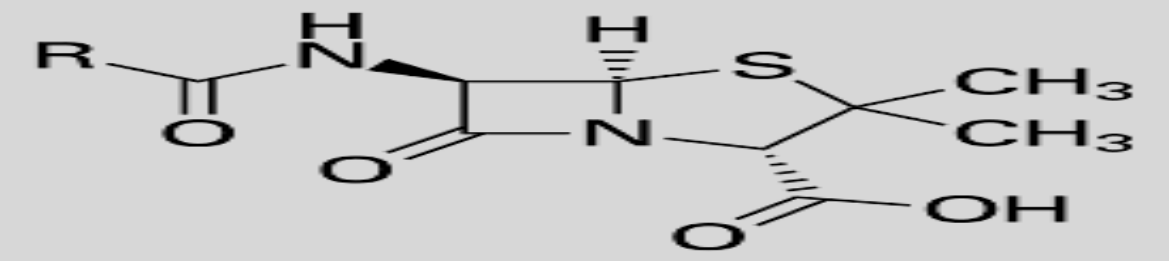
**Corresponding Author E-mail: Dr.Nagham_mj@yahoo.com*

***ABSTRACT :** Series sulfo- compounds were synthesized in previously work as a ligands ,while in present work, we will study effect of our sulfo-compounds on resistance of bacteria . Our chemical compounds in this work screened against four types of bacteria (bacteria- B. subtilis) and (bacteria - Pseudomonas .aeruginosa), (bacteria -Escherichia .Coli) , (bacteria - Lactobacillus .sp)., to test antimicrobial activity of prepared sulfo-derivatives , then studying of some chemical and physical properties with studying of thermo- analysis.*

***Keywords:** Sulfur , microbial, sulphone.*

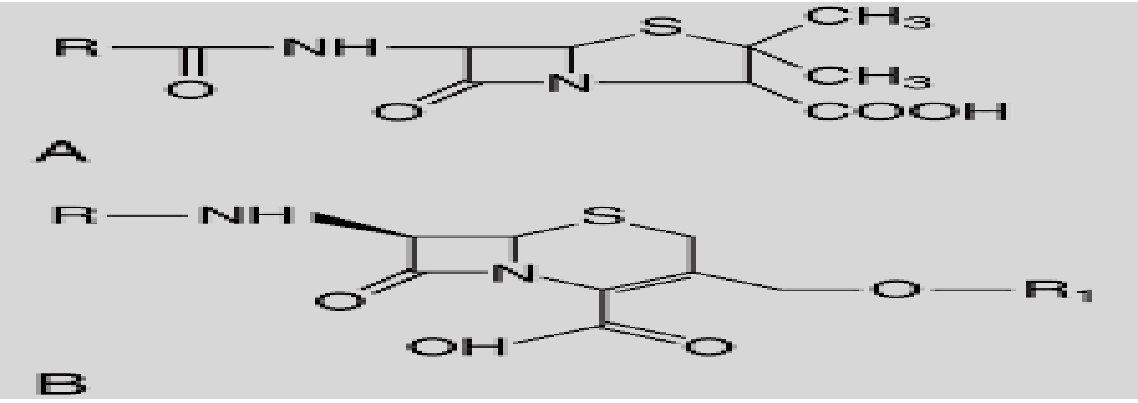
I.INTRODUCTION

Sulfur atom is importance element for bio-molecules, but almost always in the form of organo-sulfur compounds or sulfides , sulphone. The structure of three amino acids (cysteine, cystine, and methionine) with some of vitamins (biotin and thiamine) are organo-sulfur compounds. Several cofactors also include sulfur atom (glutathione and thioredoxin and sulfur proteins) . Disulfides ((S–S))bonds, confer mechanical strength and insolubility of the protein keratin, found in outer skin, hair, and feathers. Sulfur is one of the core chemical elements needed for biochemical functioning and is an elemental macro - nutrient for all organisms. The sulfur atom is used in matches, insecticides, and fungicides and in drugs[(1-7)]:



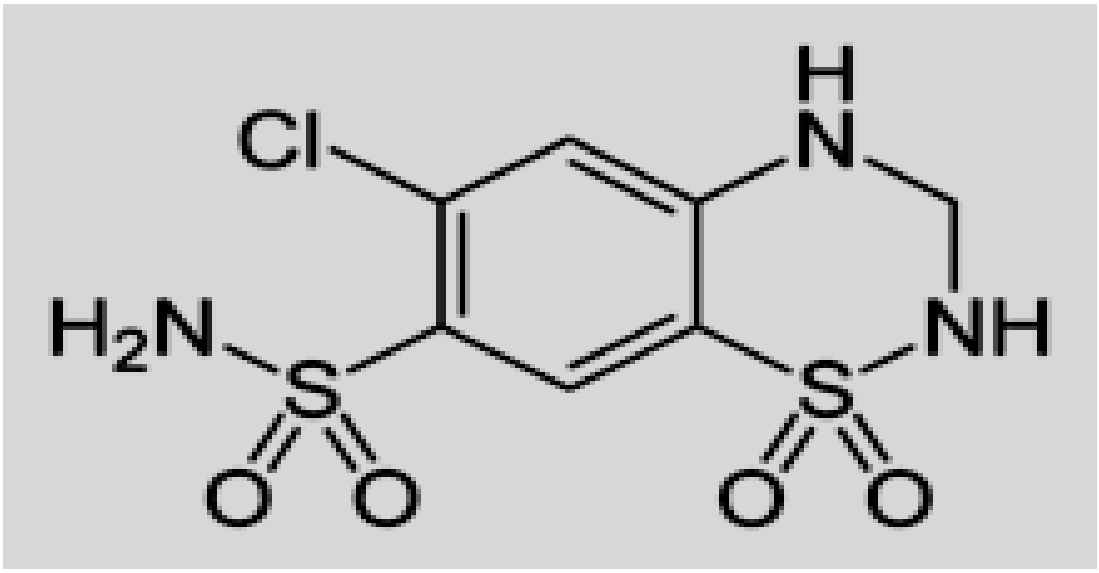
Fig(1) : Sulfur in Structure of drug

Organo-sulfur derivatives are applied in medicals, dyestuffs, and agrochemicals. Several drugs contain sulfur, early examples being antibacterial sulfonamides, known as sulfa drugs. Sulfur is a part of many microbial defense molecules[(8-13)] . Most β-lactam antibiotics, containing the penicillins, cephalosporins and mono-lactam contain sulfur

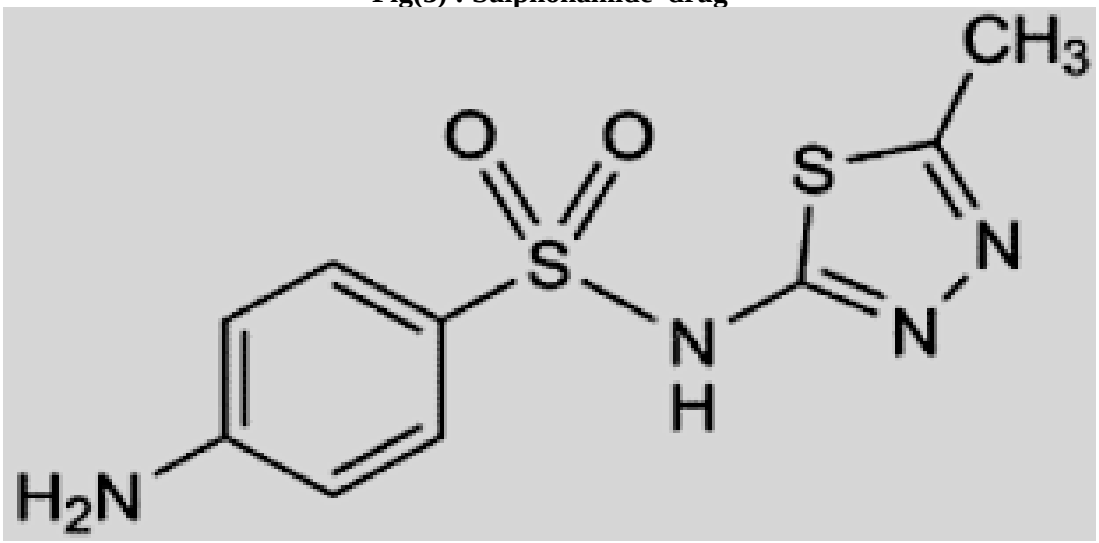


Fig(2) : Sulfur with beta-lactam drug

It used in pharmaceutical skin preparations for the treatment of acne and other conditions. It acts as a keratolytic agent and also kills microbes , fungi, scabies mites and other parasites.[67] Precipitated sulfur and colloidal sulfur are used[14-22], in form of lotions, creams, powders, soaps, and bath additives, for the treatment[23-36], of acne vulgaris, acne rosacea, and seborrhoeic dermatitis



Fig(3) : Sulphonamide drug



Fig(4) : Sulfide with Sulphone in same drugs

II.EXPERIMENTAL WORK

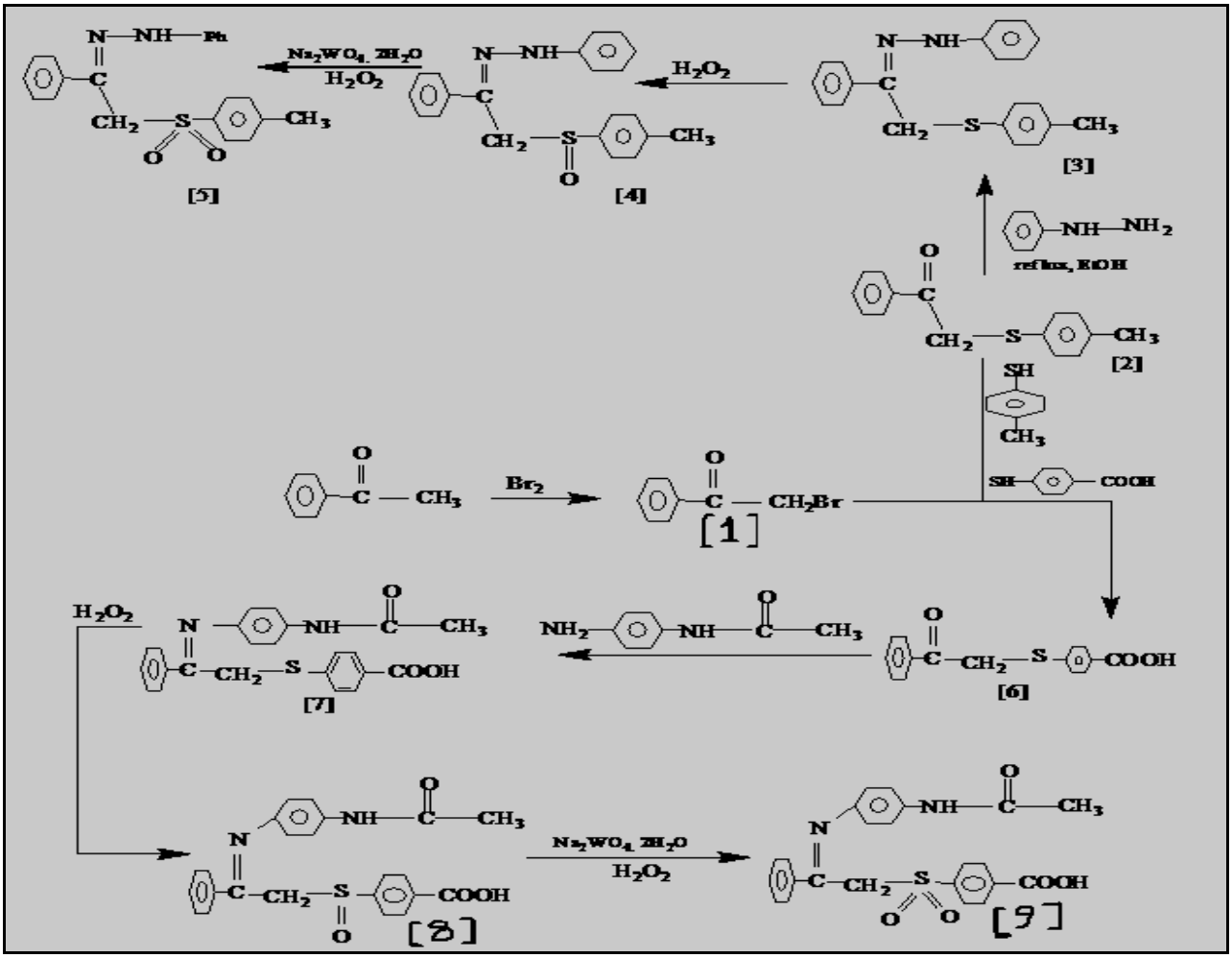
Most of the special chemicals used were of Sigma , and Aldrich grade .All bio materials and instrumentals carried out in college of education, biological studying carried out in Bio – lab in biological department , college of science ., Chemical Studying carried out in chemistry department .

STEP .1 : Formatted Sulfur – Ligands In Schemes:

In present scheme , we prepared series derivatives in previously paper , but now we will study the biological activity for them in present work (in scheme . 1).

STEP .2 : The studying of biological activities

To biological assay of prepared compounds have been tested for their antimicrobial activities through agar via biological procedures[31, 33] .The antimicrobial activities were done at three Concentrations (1 ,4 , 8 $mg.ml^{-1}$) in (DMSO) solvent by using four types of bacteria : for Positive (+) Bacteria (**bacteria- *Streptococcus faecalis***) and (**bacteria - *Bacillus sp***), and for Negative (-) Bacteria ***(bacteria - Shigella flexneri***) , (***bacteria - Salmonella typhi***). These bacterial strains were incubated for 24 hr at 37^{o}C.



Scheme (1) : Formatted Compounds (Sulfur Ligands)

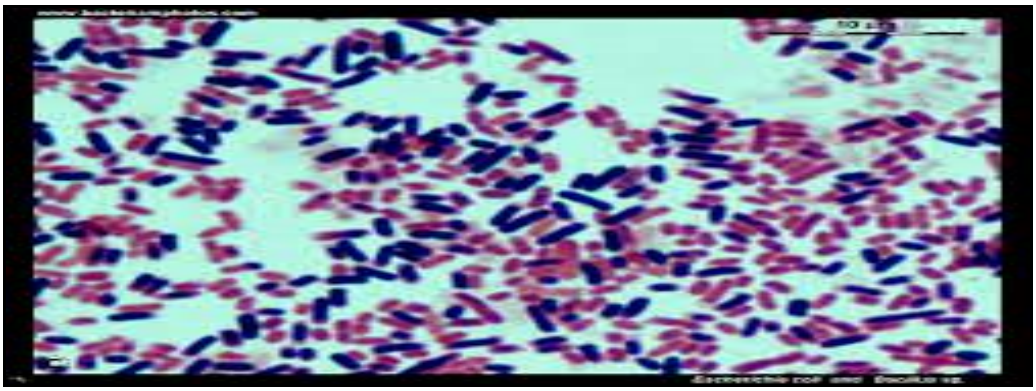
III.RESULTS AND DISCUSSION

The formatted sulfur- derivatives tested for Biological Activity against four types of bacteria .

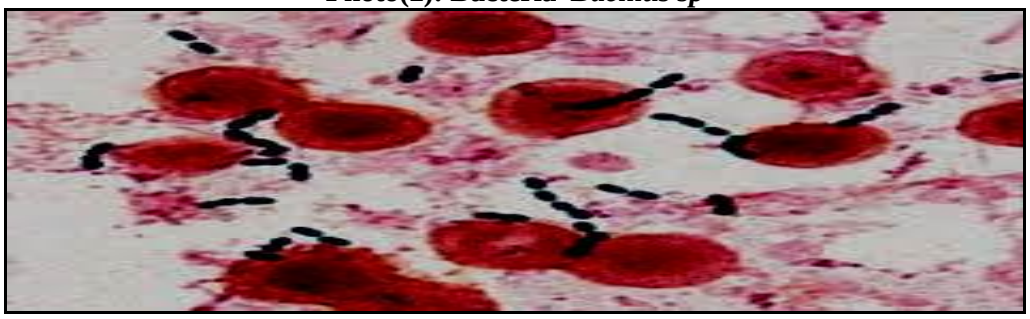
Biological Assay[31, 33] :

The studying of the sensitivity of the bacteria were included four types of bacteria to studying the biological activity of Positive (+) bacteria for (**bacteria- *Streptococcus faecalis***) and (**bacteria - *Bacillus sp***), ***and*** Negative (-) bacteria ***(bacteria - Shigella flexneri***) , (***bacteria - Salmonella typhi*)** , Table (1)and Table (2) showed the diameter of inhibition zone for vehicles chemical measured in mm towards the species bacterial.

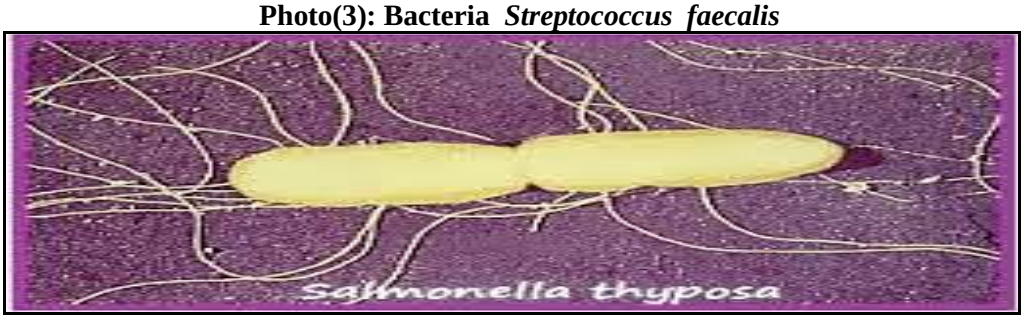
Photo(1): Bacteria *Shigella*



Photo(2): Bacteria *Bacillus sp*



Photo(3): Bacteria *Streptococcus faecalis*



Photo(4): Bacteria *Salmonella typhi*

The antimicrobial results are listed at table (1) and table (2). From results of antibacterial studies it was found to be potentially activity against towards four types of bacteria ,which gave good indicators from the results that the biological activity of all compounds have high biological activity[31-38] which inhibit the growth of bacteria .

The formatted compounds [9, 8, 7, 6] have higher activity than other compounds [5, 4, 3] for the two types of bacteria which due to presence of (sulphone and sulfide) groups in their structures[31-33] ,the mechanism of action for our compounds involved formation of hydrogen bonding with the active positions of the cell constituents resulting in the interference with the normal cell process.

Table(1):Antibacterial Activity of Compounds (Inhibition Zone in (mm))as average of three Concentrations (1 ,4 , 8mg.ml^{-1})for Positive (+) Bacteria

Compounds	(average of three Measurements) *Streptococcus faecalis*	(average of three Measurements) *Bacillus sp*
[1]	4	4
[2]	4	6
[3]	6	6
[4]	10	10
[5]	14	14
[6]	14	14
[7]	12	14
[8]	16	16
[9]	16	18

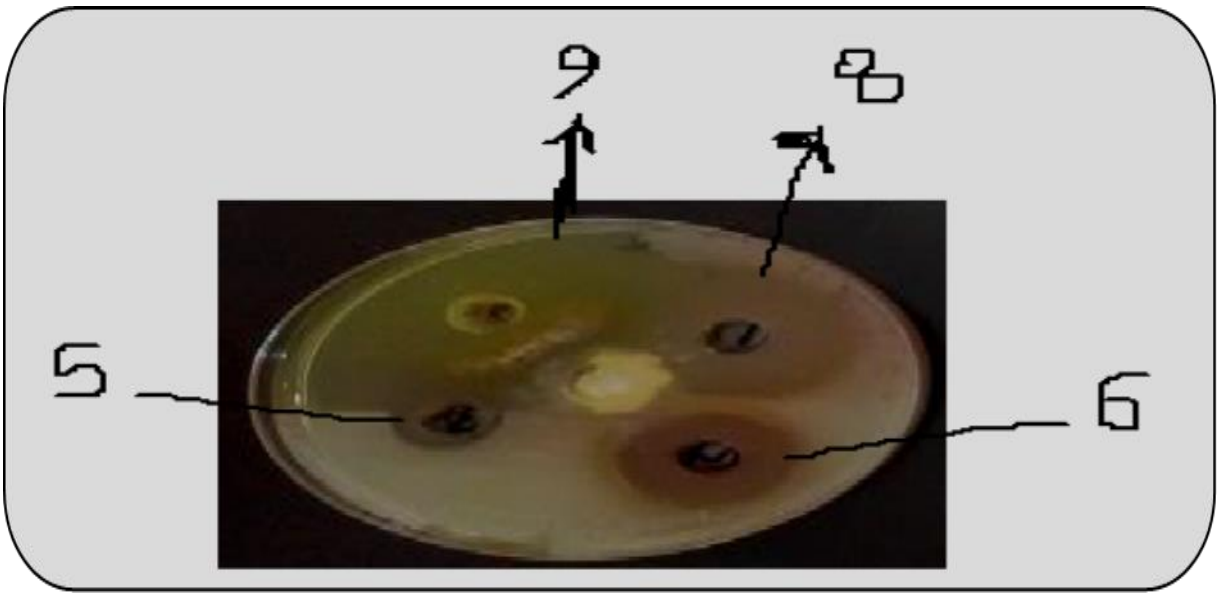


Photo (5) : Inhibition zone on *Bacillus sp*

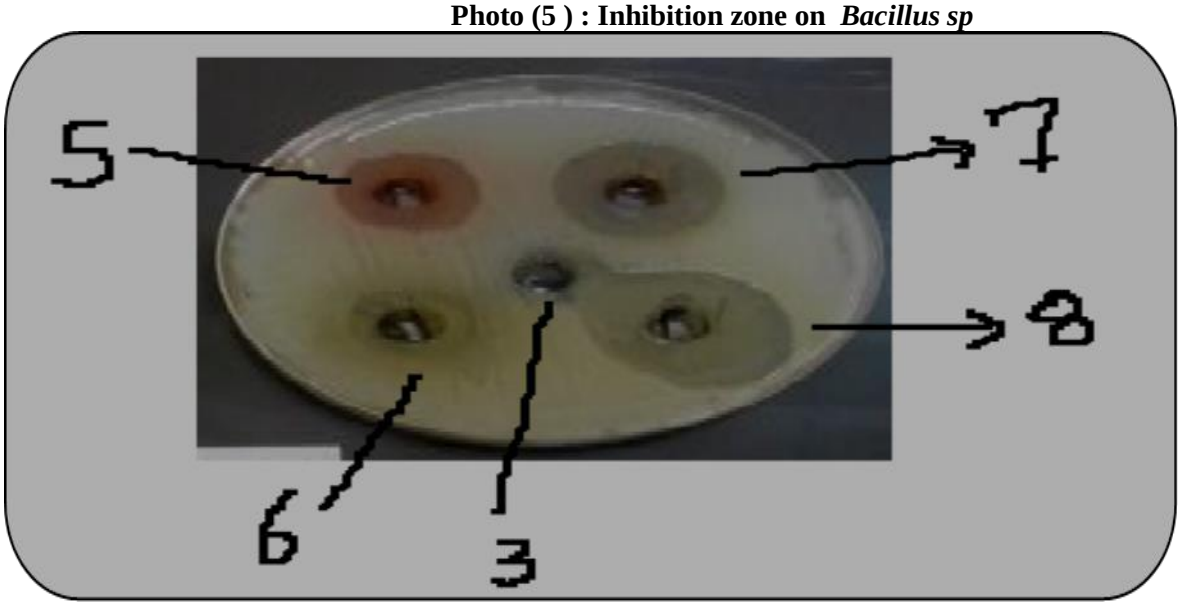


Photo (6) : Inhibition zone on *Streptococcus faecalis*

Table(2):Antibacterial Activity of Compounds (Inhibition Zone in (mm))as average of three Concentrations (1 ,4 , 8mg.ml^{-1})for Negative (-) Bacteria

Compounds	(average of three Measurements) *Shigella flexneri*	(average of three Measurements) *Salmonella typhi.*
[1]	4>	4>
[2]	4	4>
[3]	4	4
[4]	4	6
[5]	6	6
[6]	6	8
[7]	8	8
[8]	10	10
[9]	14	12

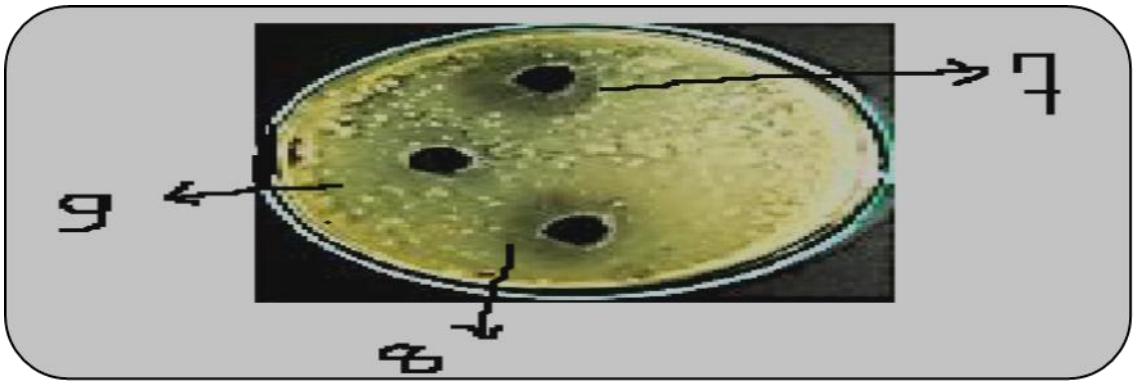


Photo. (7) : Inhibition zone on *Shigella flexneri*

Biological activities of compounds were evaluated according to their action against bacteria are described tables (1 , 2). The presence of (sulphone and sulfide) groups are reported to posses antibacterial and antifungal effect may enhance or increase the biological activity of the sulfur derivatives.The results showed the Biological Activity for compounds [9 , 8, 7, 6] the effectiveness of anti-resistant bacteria is much higher than other vehicles in the inhibition of the positive and negative bacteria, gram growth. And also Because these compounds contain multiple episodes of sulfur , which gives vital to the effectiveness of many of the bacteria.

Physical and Chemical Properties of Compounds [1 – 9] :

In the following results , table (3) appeared many physical properties and chemical characterization represented by : [(R_f) of TLC- Technique for following the chemical reactions ,type of solvent which was used in TLC – Plate , products from reactions %], all data are summarized in Table (3):

Table(3): Some Physical and Chemical Properties for Ligands [1–9]

Compounds	Products %	R_f	Solvents of (TLC)
[1]	70	0.68	Ethanol : Hexane
[2]	72	0.66	Ethanol : Hexane
[3]	74	0.60	Ethanol : Hexane
[4]	76	0.70	Ethanol : Hexane
[5]	64	0.62	Ethanol : Hexane
[6]	70	0.70	Ethanol : Hexane
[7]	70	0.74	Ethanol : Hexane
[8]	74	0.66	Ethanol : Hexane
[9]	78	0.64	Ethanol : Hexane

Thermo Measurements Studying of Sulfur- Ligands :

DSC–Thermal scanning carried out for all compounds according to procedures of studying[33], all results in figures(5-10) ,DSC-scanning measurements of formatted compounds showed high stability toward high temperature in most of curves :

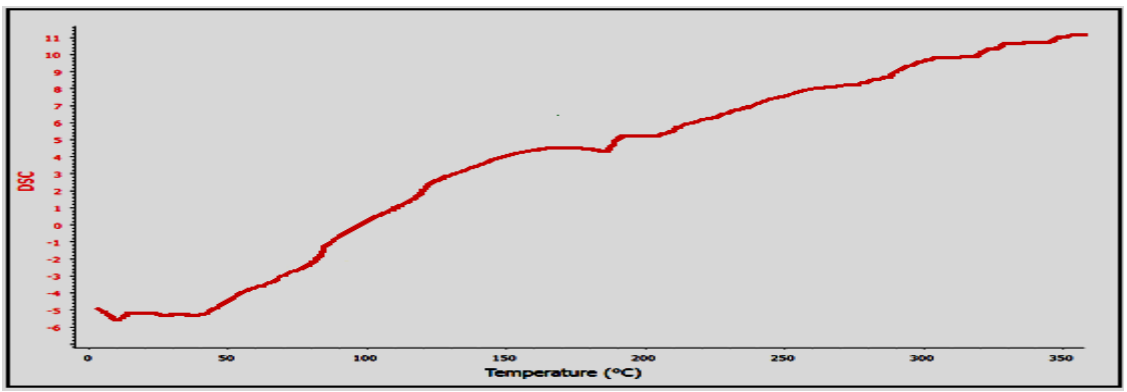


Fig (5) : DSC- Thermo Analysis of Compound [4]

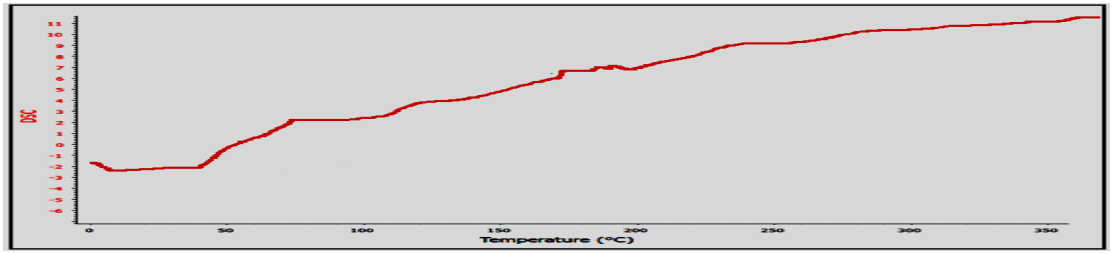


Fig (6) : DSC- Thermo Analysis of Compound [5]

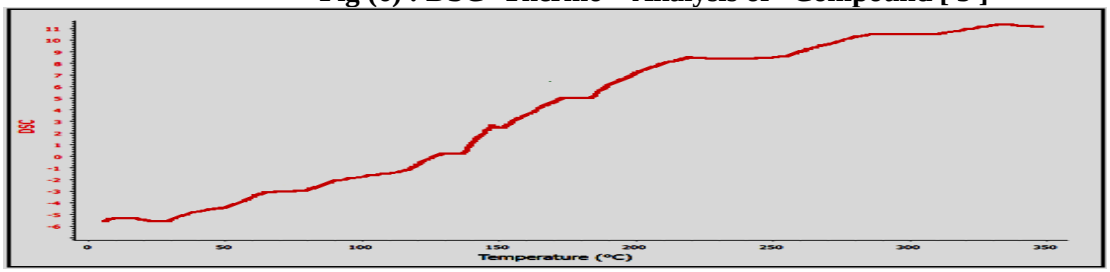


Fig (7) : DSC- Thermo Analysis of Compound [6]

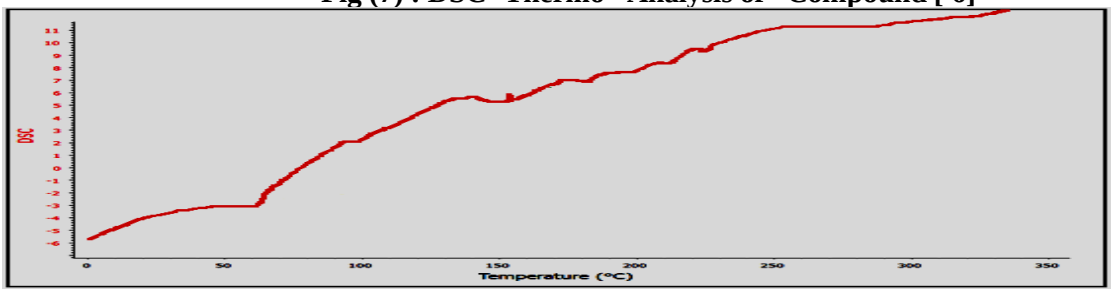


Fig (8) : DSC- Thermo Analysis of Compound [7]

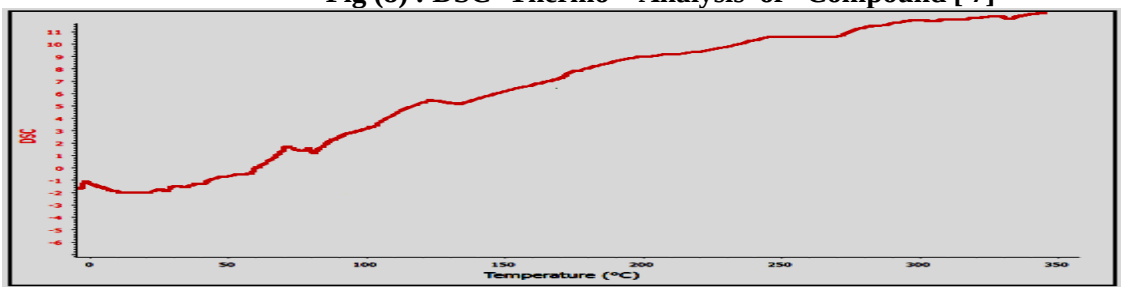


Fig (9) : DSC- Thermo Analysis of Compound [8]

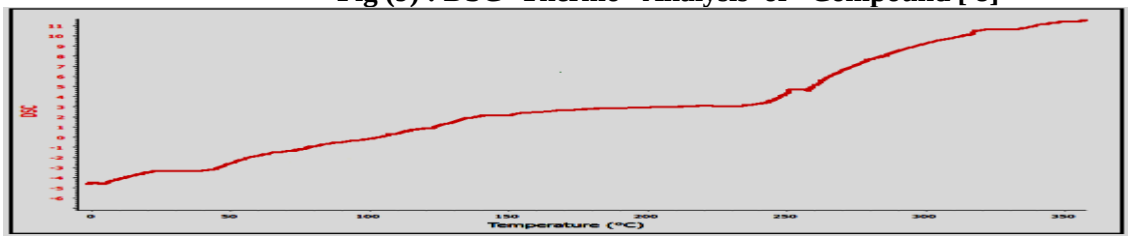


Fig (10) : DSC- Thermo Analysis of Compound [9]

REFERENCES

1. Lide, D. R., ed. ,"Magnetic susceptibility of the elements and inorganic compounds". CRC Handbook of Chemistry and Physics (PDF) (86th ed.). Boca Raton (FL): CRC Press. ,2005, ISBN 0-8493-0486-5.
2. Weast, Robert ., "CRC, Handbook of Chemistry and Physics. Boca Raton, Florida: Chemical Rubber Company Publishing. , 1984, pp. E110.
3. Rettig, S. J.; Trotter, J., "Refinement of the structure of orthorhombic sulfur, α-S8"Acta Crystallographica Section C. 43 (12): 1987, 2260–2262. doi:10.1107/S0108270187088152.
4. Greenwood, Norman N.; Earnshaw, Alan ," Chemistry of the Elements (2nd ed.). Butterworth-Heinemann., 1997, pp. 645–665.
5. Egon Wiberg; Nils Wiberg ," Inorganic Chemistry. Academic Press. , 2001, pp. 513 ., ISBN 978-0-12-352651-9.
6. Steudel, Ralf; Eckert, Bodo , "Solid Sulfur Allotropes Sulfur Allotropes". Topics in Current Chemistry. Topics in Current Chemistry. 230: 2003, 1–80. ISBN 978-3-540-40191-9. doi:10.1007/b12110.
7. Steudel, R. ,. "Homocyclic Sulfur Molecules". Topics in Current Chemistry. Topics in Current Chemistry. 102: 1982 , 149–176.

8. Tebbe, Fred N.; Wasserman, E.; Peet, William G.; Vatvars, Arturs; Hayman, Alan C.,. "Composition of Elemental Sulfur in Solution: Equilibrium of S6, S7, and S8 at Ambient Temperatures". Journal of the American Chemical Society. 104 (18): 1982 , 4971–4972.

9. Meyer, Beat , . "Solid Allotropes of Sulfur". Chemical Reviews. 64 (4):1964, 429–451. doi:10.1021/cr60230a004.

10. Karitzky, A. R.; Rees ,"Comprehensive Heterocyclic Chemistry"., (1984). , 5. p. 469–498.

11. Grimmett, M. Ross .,"Imidazole and Benzimidazole Synthesis". Academic Press., (1997).

12. Brown, E. G., " Ring Nitrogen and Key Biomolecules"., 1998, Kluwer Academic Press.

13. Pozharskii, A. F., "Heterocycles in Life and Society"., 1997, John Wiley & Sons.

14. Gilchrist, T. L. , Heterocyclic Chemistry., 1985, Bath Press. ISBN 0-582-01421-2.

15. Rosemeyer, H. , "The Chemodiversity of Purine as a Constituent of Natural Products". Chemistry & Biodiversity. 1 (3), 2004, 361.

16. Hantzsch, A. and Weber, J. H. , "Ueber Verbindungen des Thiazols (Pyridins der Thiophenreihe)" (On compounds of thiazole (pyridines of the thiophene series), Berichte der deutschen chemis chen Gesells chaft, 20 , 1887, 3118–3132,

17. Christen, Dines; Griffiths, John H.; Sheridan, John ., "The Microwave Spectrum of Imidazole; Complete Structure and the Electron Distribution from Nuclear Quadrupole Coupling Tensors and Dipole Moment Orientation". Zeitschrift für Naturforschung A. 36 (12), 1981, 1378–1385.

18. Radecka-Paryzek W., Pospieszna-Markiewicz I., Kubicki M.: "Self-assembled two-dimensional salicylaldimine lanthanum(III) nitrate coordination polymer". Inorg. Chim. Acta, 360, 2007 , 488–496.

19. Boghaei D. M., Askarizadeh E., Bezaatpour A.: Molecular and Biomolecular Spectroscopy. Spectrochim. Acta Part A, 69, 2008 , 624–628.

20. Prashanthi Y., Kiranmai K., Subhashini N. J. P., Shivaraj: Synthesis, potentiometric and antimicrobial studies on metal complexes of isoxazole Schiff bases. Spectrochim. Acta Part A, 70, 2008, 30–35.

21. Ashraf M., Wajid A., Mahmood K., Maah M., Yusoff I.: Spectral Investigation of the Activities of Amino Substituted Bases. Orient. J. Chem., 27, 2, 2011, 363–372.

22. Nagham Mahmood Aljamali ., "Synthesis and Biological Study of Hetero (Atoms and Cycles) Compounds " , Der Pharma Chemica, 8(6) , 2016, 40-48.

23. Nagham Mahmood Aljamali ., "Synthesis and Chemical Identification of Macro Compounds of (Thiazol and Imidazol) ". , Research J. Pharm. and Tech. 8(1): 2015.

24. Nagham Mahmood Aljamali ., " Synthesis of Antifungal Chemical Compounds from Fluconazole with (Pharma-Chemical) Studying" ., Research journal of Pharmaceutical, biological and chemical sciences., 8 (3)., 2017, p. 564 -573 .

25. Golcu A., Tumer M., Demirelli H., Wheatley R.: "Zn(II) and Cu(II) complexes of polydentate Schiff base ligands:" synthesis, characterization, properties and biological activity"., Inorg. Chim. Acta, , 358, 2005, 1785–1797.

26. Rice L. B.: "Unmet medical needs in antibacterial therapy" ., Biochem Pharmacol., 71, 7, 2006, 991–995.

27. Nagham Mahmood Aljamali , Nemah Sahib Muhammed., "Chemo - Spectral and Biological Studying of New Ligands" ., Research Journal of Pharmaceutical, Biological and Chemical Sciences , 8,3, 2017 ,674-684.

28. Libraries, Association, Robert Williams, and J. Silva. Bringing chemistry to life. Oxford University Press, USA, 1999.

29. Nagham Mahmood Aljamali , Saher M, Zainab M, Seena K. , "Microbial Studying of (Thiazole ,Oxadiazole, Thiadiazole)–Derivatives on Mouth and Teeth Bacteria ", International Journal of Medical Research and Pharmaceutical Sciences, 3, 8, 2016 ,30-39 , **DOI**:10.5281/zenodo.61357 .

30. Chao jun-shu, Huia ping-xin, Lia shuo, "Synthesis and Antibacterial Activities of Novel Biphenyltetrazole Derivatives Bearing 1,3,4- Oxadiazole." Journal of the Chinese Chemical Society, 52, 2005, 539-544.

31. Srinivas K, Srinivas U, Bhanuprakash K, Harakishore K. "Synthesis and antibacterial activity of various substituted s-triazines". Eur J Med Chem , 41, 2006; 1240-1246.

32. Nagham Mahmood Aljamali , Sura Essam Alesawi., "Studying of Amide Derivatives Behavior on Bacteria"., J.Bio.Innov 6(1), **2017** , pp: 100-106.

33. Saher Mahmood Jwad ., Research Journal of Pharmaceutical, Biological and Chemical Sciences ., 8, 3, 2017, 549 – 563.

34. Nabila Boujaber1, Khadija Oumaskour1, Omar Assobhei2, Samira Etahiri ., " ANTIMICROBIAL ACTIVITY OF DIFFERENT FRACTIONS OBTAINED FROM GELIDIUM SESQUIPEDALE AND LAMINARIA OCHROLEUCA"., J.Bio.Innov , 6(3), 2017, pp : 362-368