Synthesis, Characterization and Biological Activity Study of New Compounds Tetrazole Derivatives Azo-Schiff Base

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Abstract:
This work included synthesis of azo dye (H1) by the reaction of diazonium salt to sulacetamide with 4-hydroxy benzaldehyde at (0-5) °C and synthesis of schiff base (H2-H6) through reaction substituted aromatic amine (aniline, 4-nitro aniline, 4-chloro aniline, 4-amino benzoic acid and phenyl hydrazine) with aldehyde group in azo compound (H1) in ethanol compounds (H2-H6) and tetrazole derivatives prepared by reaction schiff base with sodium azide in ethanol compounds (H7-H11) and characterization by using spectroscopic techniques Uv/Vis, FT-IR, C.H.N. and H1-NMR of some the prepared compounds using DMSO-d6 a solvent, in addition melting point and determination a purity of TLC, and this work consists a study of biological activity for the some prepared compounds against four types of pathogenic bacteria and know to be resistant to anti biotic.

Key words: Azo, Schiff's base, Tetrazole and Biological activity.
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Abstract:
This research includes the preparation of azo (H1) dye through diazonium salt formation with 4-aminobenzaldehyde at 0-5°C, and then preparation of Schiff bases (H2-H6) through reaction with aromatic amines and the azo dye prepared, then preparation of a mixture of five derivatives (H6-H11) from the Schiff bases prepared with sodium hydroxide in ethanol, then characterized the prepared compounds by spectral methods such as UV and IR spectra, and NMR spectra, and determined the quantities of the elements (C.H.N.) and evaluated the biological activity for some of the prepared compounds against two types of bacterial isolates, namely, Pseudomonas aeruginosa and Staphylococcus aureus.

Keywords: Azo, Schiff base, Tetrazole, Biological activity.
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Introduction:
Azo dyes are a class of compounds containing a N=N double bond and due to their ability to absorb visible light [1]. For many years, the azo compounds have been the main class of dyes used in various application such as textile fibers dyeing, coloring of different materials and advanced organic synthesis [2]. The synthesis and dyeing properties of azo compounds are assigned in many papers [3,4]. Azo compounds are widely used as dyes and pigments. Another application is analytical chemistry. On the other hand, azo compounds shown biological activities containing antibacterial [5]. Schiff bases and azo compounds are important structures in the medicinal and pharmaceutical fields [6]. The compounds carrying azomethine functional group (-C=N-) which are known as Schiff bases gain importance in medicinal [7,8] and pharmaceutical field due to the most versatile organic synthetic intermediates and also showing a broad range of biological activities [9] such as antituberculosis, anticancer, analgesic, anti-inflammatory [10], anticonvulsant, antibacterial and antifungal activities [11]. On the other hand, cyclic imides represent an important class of bioactive molecules that shows a wide range of pharmacological activities such as androgen receptor antagonistic [12]. Tetrazoles are a representative class of poly-aza-heterocyclic compounds, which consisting of a 5-membered ring of four nitrogen and one carbon atoms [13]. The first tetrazole was prepared by the Swedish chemist Bladin [14] in 1885. Katritsky et al. synthesized 1,5-disubstituted tetrazoles in high yields from imidoylbenzotriazoles includes short reaction times and mild reaction conditions [15]. Tetrazoles are unknown in the nature the ring systems of tetrazoles are very resistant to reduction [16]. Tetrazoles are a class of heterocycles with a wide range of applications including nanomaterials5 and specialty explosives [17]. The tetrazoles are representative of
active pharmacophores for several therapeutic active molecules such as antiallergic [18], anti-inflammatory, antibiotic, antihypertensive and antitubercular agents [19]. For example, the β-lactam antibiotics A of the cephalosporin class is an example of drugs containing a 1,5-disubstituted tetrazole moiety. Losartan B is sartan derivatives that was the first nonpeptide angiotensin receptor antagonist to appear on the market followed by Valsartan C which include the regulation of blood pressure and volume homeostasis [20].

**Experimental:**
**Material:** All chemicals were used through this work purchased from Alfa Aesar, Chem-Lab, HIMDIA, Oxford, Aldrich, Companies and were used without further purifications.

**Devices used:** Melting points were recorded using a measuring device melting point type: Automatic melting point\SMP40 and were uncorrected. Thin layer chromatography (T.L.C.) was carried out using sheet polygram silica- gel as stationary phase, the spots were enhanced using UV rays. UV-Vis. spectra were recorded with spectrophotometer type: SHIMADZU UV spectrometer -1800 using Ethanol as a solvent. Infrared spectra were recorded using FT-IR-600 Fourier- Transform infrared (FT-IR) Spectrophotometer by KBr disc. \(^1\)H-NMR spectra were recorded on Fourier Transform Varian spectrophotometer operating at 400 MHz with DMSO-d\(^6\)(Ibn –Al –Hatham college).

**Methods of preparation:**
**Synthesis of Azo dye (H1) [21]:**
Azo dye was prepared in two main steps:

**Step 1 / Preparation of diazonium salt:** (0.04 mol, 9.44 gm) of sulfacetamide dissolved in (50 ml) 37% HCl at a temperature of
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(0-5) °C with continuous stirring, then add a solution of sodium nitrite.

**Step 2 / Coupling reaction:** (0.04 mol, 4.88gm) of 4-hydroxy benzaldehyde dissolved in (50 ml) of the Pyridine, and cooled to (0–5) °C in an ice bath. This solution is then slowly added to the cooled diazonium salt solution to yield azo compound. Physical properties of azo is color red, M.P. (260-261) °C, yield 81% and R.f. 0.65.

Synthesis of Schiff Bases (H2-H6) [22, 23]:

A series of Schiff bases were prepared from the reaction of azo prepared (H1) (3.69 gm 0.01 mole) with (0.01 mole) from different aromatic amine (aniline, 4-nitro aniline, 4-chloro aniline, 4-amino benzoic acid and phenyl hydrazine) in (30 ml) ethanol absolute and few drops of glacial acetic acid. This mixture was refluxed for (4-9) hr. The mixture was cooled to room temperature, filtered, dry and recrystallized in absolute ethanol, physical properties, yield and R.f. are given in Table (1).

**Table (1): physical properties, yield and R.f. of schiff base (H2-H6).**

| Comp. No. | Ar | Molecular Formula/ M.Wt g/mol | Color | M.P (°C) | T. Ref. (hr.) | Yield (%) | R.f. |
|-----------|----|-------------------------------|-------|----------|--------------|-----------|------|
| H2        | ![H2 Ar](image) | C_{21}H_{16}N_{4}O_{4}SNa 444.44 | Dark Brown | 125-127 | 5 | 92 | 0.87 |
| H3        | ![H3 Ar](image) | C_{21}H_{16}N_{5}O_{6}SNa 489.44 | Orang | 159-161 | 9 | 73 | 0.50 |
| H4        | ![H4 Ar](image) | C_{21}H_{16}N_{4}O_{4}SClNa 478.88 | Brown | 147-150 | 6 | 86 | 0.69 |
| H5        | ![H5 Ar](image) | C_{22}H_{17}N_{4}O_{3}SNa 488.45 | Yellow | 136-138 | 7 | 79 | 0.43 |
| H6        | ![H6 Ar](image) | C_{21}H_{17}N_{4}O_{4}SNa 456.44 | Light Brown | -177, 177 | 9 | 91 | 0.75 |
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Synthesis of Tetrazole derivatives (H7-H11) [24]:
Compound (H2-H6) (0.02 mole) was added to solution of (0.02 mole, 1.3 gm) of sodium azide in (25ml) of ethanol. The reaction mixture was refluxed for (5-9) hrs. The mixture was cooled to room temperature, filtered, dry and rec-rystallized in absolute ethanol, physical properties, yield and R.f. are given in Table (2).

Table (2): physical properties, yield and R.f of 1,3-oxazepine derivatives (H6-H9).

| Comp. No. | Ar               | Molecular Formula/ M.Wt g/mol | Color    | M.P (°C)  | T. Ref. (hr.) | Yiel d (%) | R.f. |
|-----------|------------------|-------------------------------|----------|-----------|---------------|------------|------|
| H 7       | H2N              | C21H18N7O4SNa 487.47          | Light Yellow | 232-234   | 8             | 89         | 0.60 |
| H 8       | H2N-NO2          | C21H17N8O6SNa 532.47          | Dark Brown | 263-265   | 7             | 67         | 0.82 |
| H 9       | H2N-Cl           | C21H17N5O4SClNa 521.91       | Orang    | 167-169   | 6             | 74         | 0.93 |
| H 10      | H2N-COOH         | C22H18N7O6SNa 531.48         | Yellow   | 248-250   | 5             | 73         | 0.66 |
| H11       | H2N-NH2          | C21H17N5O4SNa 456.44         | Brown    | 216-218   | 5             | 70         | 0.85 |

The biological activity [25]:
The bacteria species used are listed in tables (7). All strains were obtained from College of Science department of Biology, Tikrit University. They were grown up to the stationary phase nutrient bath at 37 °C and a sample of 0.5 ml of each bacteria was spread over a surface of a nutrient agar plate.

Antibacterial assay [26]:
DMSO was used as a solvent for compounds (H1, H2, H4, H6, H9, H11). The same solvent was used for antibiotics
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(Aloxicillin, Ampicillin, Ciprofloxacine). Blank discs of DMSO was used as control. The inoculated plates are incubated at 37 °C for 24 hrs., and the inhibition zone (mm) were measured. In all experiments the mean of each triplicate was measured.

Results and Discussion:
In this work many compounds were synthesized azo, Schiff bases derivatives and tetrazole derivatives and as in the following Scheme:

![Scheme (1): synthesis of compounds (H1-H11).](image)

Characterization of Azo dye (H1) [27, 28]:
Azo dye has synthesized from the reaction of diazonium salt with 4-hydroxy benzaldehyde.

UV spectra show the transitions n-π* (255 nm) and π-π* (371 nm) which have confirmed the presences of the un-bonded pair electrons on nitrogen, oxygen atoms and aromatic system (double bond).
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The FT-IR spectra of azo dye general showed disappearance of (NH$_2$) absorption of sulfacetamide and appearances of (N=N) absorption band in 1468 cm$^{-1}$, besides bands in 1658 cm$^{-1}$ is due to (C=O) aldehyde and band at 3435 cm$^{-1}$ due to (OH) of salsaldehyde. IR spectra is given in fig (1).

$^1$H-NMR spectrum of compound (H2) showed singlet signal at $\delta= 2.84$ ppm due to (CH$_3$), multiple signal (6.65-7.99) ppm due to aromatic rings, singlet signal at $\delta= 9.09$ ppm due to (CH) and singlet signal (9.61) ppm due to (OH). $^1$H-NMR spectrum of compound (H2) is given in fig (11).

Characterization of Schiff Bases (H2-H6):

Schiff Bases derivatives have synthesized from the reaction of azo prepared (H1) with different aromatic amine (aniline, 4-nitro aniline, 4-chloro aniline, 4-amino benzoic acid and phenyl hydrazine). Beside UV spectra show the transions n-$\pi^*$ and $\pi$-$\pi^*$ which have confirmed the presences of the un-bonded pair electrons on nitrogen, oxygen atoms and aromatic system (double bond). UV absorbance spectra is given in table (3). The FT-IR spectra of Schiff Bases derivatives in general showed disappearance of (C=O) absorption of azo prepared (H1) and appearances of (C=N) absorption band in (1647-1684) cm$^{-1}$. IR spectra is given in table (3) see fig. (2) and fig. (3). $^1$H-NMR spectrum of compound (H$_2$) showed singlet signal at $\delta= 2.50$ ppm due to DMSO-d$^6$ solvent, multiple signal (8.20 - 9.02) ppm due to aromatic rings, singlet signal at $\delta= 10.01$ ppm due to N-H amic acid, and singlet signal (13.03) ppm due to O-H carboxylic acid. $^1$H-NMR spectrum of compound (H$_{11}$) is given in fig (12).
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Table (3): FT-IR and UV/Vis. data of Schiff Bases (H2-H6).

| Comp. No. | Ar | λ1 max (nm) | λ max (nm) | IR (KBr) cm⁻¹ | Others |
|-----------|----|------------|-----------|---------------|--------|
| H2        |  | 219 310    | 3469 3053 | 1684 1490 1599 | 1439 1135 |
| H3        | NO₂ | 269 332    | 3479 3059 | 1658 1475 1581 | 1441 1155 |
| H4        | Cl  | 261 308    | 3469 3057 | 1658 1496 1599 | 1441 1155 |
| H5        | COOH | 226 359   | 3377 3072 | 1647 1473 1576 | 1437 1169 |
| H6        |  | 248 340    | 3442 3061 | 1674 1512 1614 | 1454 1161 |

Characterization of tetrazole derivatives (H7-H11):

tetrazole derivatives (H7-H11) have synthesized from the reaction of compound (H2-H6) with sodium azide. UV spectra show the transions n-π* and π-π* which have confirmed the presences of the un-bonded pair electrons on nitrogen, oxygen atoms and aromatic system (double bond). UV absorbance spectra is given in table (4). The FT-IR spectra of tetrazole derivatives in general showed disappearance of (C=N) absorption band in (1647-1684) cm⁻¹ of schiff bases derivatives and appearances of (N-H) absorption band in (3221-3276) cm⁻¹, appearances of (C-N) absorption band of tetrazole in (1232-1290) cm⁻¹ and appearances of (N-N) absorption band of tetrazole in (1111-1157) cm⁻¹. IR spectra is given in table (4) see fig (4), (5) and (6).

¹H-NMR spectrum of compound (H11) showed singlet signal at δ= (2.89) ppm due to (CH₃), singlet signal at δ= (4.71) ppm due to (CH), singlet signal at δ= (5.02) ppm due to (NH), multiple signal (6.84-8.42) ppm due to aromatic rings, singlet signal at δ= (8.67) ppm due to (NH) and singlet signal (9.72)
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ppm due to (OH). \(^1\)H-NMR spectrum of compound (H11) is given in fig (12).

Table (4): FT-IR and UV/Vis. Characterization of tetrazole derivatives (H7-H11).

| Comp. No. | Ar | \(\lambda_{\text{max}}\) | \(\lambda_{\text{max}}\) | IR (KBr) cm\(^{-1}\) |
|-----------|----|-----------------|-----------------|-----------------|
| H7        |    | 258 377         | 3408            | 1438 1269 1123  |
| H8        |    | 245 380         | 3477            | 1442 1232 1111  |
| H9        |    | 221 339         | 3473            | 1441 1290 1157  |
| H10       |    | 208 383         | 3388            | 1421 1252 1153  |
| H11       |    | 230 367         | 3386            | 1441 1284 1144  |

Table (5): Elemental analysis of some of the prepared compounds.

| Comp. No. | Molecular Formula | Found | Calculated |
|-----------|-------------------|-------|------------|
|           |                   | C%    | H% | N% | O% | C% | H% | N% | O% |
| H1        | C\(_{15}\)H\(_{12}\)N\(_{3}\)O\(_5\)SNa | 48.67 3.20 11.40 21.64 | 48.78 3.28 11.38 21.66 |
| H2        | C\(_{21}\)H\(_{17}\)N\(_{4}\)O\(_6\)SNa | 56.81 3.82 12.70 14.43 | 56.75 3.86 12.61 14.40 |
| H5        | C\(_{22}\)H\(_{17}\)N\(_{4}\)O\(_6\)SNa | 54.11 3.59 11.34 19.67 | 54.10 3.51 11.47 19.65 |
| H7        | C\(_{21}\)H\(_{17}\)N\(_{3}\)O\(_5\)SNa | 47.42 3.17 20.95 18.08 | 47.37 3.22 21.04 18.03 |
| H8        | C\(_{21}\)H\(_{17}\)N\(_{7}\)O\(_4\)SNa | 48.26 3.27 18.83 12.30 | 48.33 3.28 18.79 12.26 |
| H11       | C\(_{21}\)H\(_{19}\)N\(_{8}\)O\(_3\)SNa | 50.10 3.74 22.39 4.55  | 50.20 3.81 22.30 4.58 |

Biological activity [32]:

The antimicrobial activity of the synthesized compounds (H1-H11) were examined by the agar diffusion method using two different bacterial species *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The results indicated that some of the assayed compounds showed antimicrobial activity against
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the used bacterial. Antibacterial activity of compounds (H1 and H9) is given in fig (13) and (14).

Table (6): Antibacterial activity of some of the prepared compounds.

| Comp. No. | Conc. mg/ml | Pseudomonas aeruginosa | Staphylococcus aurous |
|-----------|-------------|------------------------|-----------------------|
| H1        | 0.0001      | -                      | -                     |
|           | 0.001       | +                      | -                     |
|           | 0.01        | ++                     | -                     |
| H2        | 0.0001      | +                      | -                     |
|           | 0.001       | ++                     | +                     |
|           | 0.01        | +++                    | ++                    |
| H3        | 0.0001      | +                      | +                     |
|           | 0.001       | +++                    | ++                    |
|           | 0.01        | ++                     | ++                    |
| H4        | 0.0001      | +                      | +                     |
|           | 0.001       | +++                    | ++                    |
|           | 0.01        | +++                    | ++                    |
| H5        | 0.0001      | -                      | -                     |
|           | 0.001       | +                      | +                     |
|           | 0.01        | ++                     | +                     |
| H6        | 0.0001      | -                      | -                     |
|           | 0.001       | +                      | +                     |
|           | 0.01        | ++                     | +                     |
| H7        | 0.0001      | +                      | -                     |
|           | 0.001       | ++                     | +                     |
|           | 0.01        | +++                    | ++                    |
| H8        | 0.0001      | -                      | -                     |
|           | 0.001       | -                      | +                     |
|           | 0.01        | -                      | +++                   |
| H9        | 0.0001      | +                      | -                     |
|           | 0.001       | ++                     | -                     |
|           | 0.01        | ++                     | -                     |
| H10       | 0.0001      | +                      | -                     |
|           | 0.001       | ++                     | +                     |
|           | 0.01        | ++                     | +++                   |
| H11       | 0.0001      | +                      | -                     |
|           | 0.001       | ++                     | +                     |
|           | 0.01        | +++                    | +++                   |

(-) = No inhibition
(++) = Inhibition zone (15-25) mm
(++) = Inhibition zone (10-15) mm
(++) = Inhibition zone (25-30) mm
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Table (7): Antibacterial efficacy of control treatments (antibiotics) in the growth of a number of negative and positive bacteria (mm).

| No. | Name            | *Pseudomonas aeruginosa* | *Staphylococcus aureus* |
|-----|-----------------|-------------------------|-------------------------|
| 1   | Amoxicillin     | 17                      | \( \checkmark \)      |
| 2   | Ampicillin      | 18                      | 15                      |
| 3   | Ciprofloxacine  | 12                      | 16                      |
| 4   | Blank disk      | \( \checkmark \)      | \( \checkmark \)      |

Fig (1): FT-IR spectrum of compound [H1].

Fig (2): FT-IR spectrum of compound [H2].
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Fig (3): FT-IR spectrum of compound [H3].

Fig (4): FT-IR spectrum of compound [H4].
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Fig (5): FT-IR spectrum of compound [H5].
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Fig (6): FT-IR spectrum of compound [H6].
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Fig (7): FT-IR spectrum of compound [H8].
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Fig (8): FT-IR spectrum of compound [H9].
Fig (9): FT-IR spectrum of compound [H10].
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Fig (10): FT-IR spectrum of compound [H11].

Fig (11): $^1$H-NMR spectrum of compound [H2].
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Fig (12): $^1$H-NMR spectrum of compound [H11].

Fig (13): Antibacterial activity of compounds compounds [H1] against *Pseudomonas aeruginosa*.

Fig (14): Antibacterial activity of [H9] against *Staphylococcus aurous*. 
Refrains:
1. Yan,L; Patrick,O and Dolphin,D.J.(2009).Org.Chem.; 74(9):5237-5243.
2. Turcas,C.V and Sebe,I.(2012). U.P.B.Sci.Bull.; 74(3):109-118.
3. Karic,F; Sener,I and Deligoz,H.(2004). Dyes and Pigments.; 62(7)133-141.
4. El-Sonbati,A.Z; Belal,A.A.M; El-Wakeel,I.S and Hussien,M.A.(2004). Spectrochim.Acta; 60(5)965-970.
5. Jarraphour,A and Zare, M.(2004). ;Molbank, 377(16) 1-3 .
6. Jarraphour, A;Motamedifar, M;Pakshir, K; Hadi, N and Zarei,M.(2004).Molecules; 9 (1)815-824 .
7. Chandra, K.B and Kaushik, A.(2012).;J. Ph, ; 4(5) 1873-1878.
8. Anita, S and Manish, K.S.(2013). ; Chem. Sci. Trans; 2(3) 871-876.
9. Abdel-Salam ,F.H.(2010). ;J. S. D.; 13(7) 423-431.
10.Santosh, K;Niranjan, M.S; Chaluvaraju ,K.C; Jamakhandi C.M. and Dayanand,K.(2010).; J. C. Ph. Res.; 1(11), 39-42.
11.Kumar, P.P and Rani, B.L.(2011); Int. J. Chem. Tech. Res; 3(1) 155-160.
12.Sathe, B.S; Jayachandran, E and Jagrap, V.A.(2011).; Res. J. Pharm. Bio. And Chem. Sci.; 2(8) 510-515.
13.Butler, R. N; Katritzky, A.R.; Rees, C.W; Scriven, E. F. V.(1996).;Heterocyclic Chemistry II, p.94, Pergamon, Oxford, UK.
14.Bladin, J. A.(1885).; Berichte der deutschen chemischen Gesellschaft; 18(1) 1544-1551.
15.Katritzky, A. R.; Cai, C; Meher, N. K.(2007).; Synthesis, 8(4) 1204-1208.
16.Joule, J. A;Mills, K.(2010).;Heterocyclic Chemistry, 5th Et., John Wiley & Sons Ltd, United Kingdom , 561(2010).
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17. Xue, H; Gao, Y; Twamley, B; Shreeve, J. N. M.(2005); Adv. Mater.; 17(17) 2142–2146.
18. Sabatini, J. J; Raab, J. M; Hann Jr, R. K.; Damavarapu, R.; Klapçtke, T.M.(2012); Chem. Asian. J;7(8) 1657-1663.
19. Ford, R. E; Knowles, P; Lunt, E; Marshall, S. M; Penrose, A. J; Ramsden, C. A; Summers, J. H; Walker, J. L.; Wright, D. E.(1986); J. Med. Chem., 29(3) 538-549.
20. Rajasekaran, A; Thampi, P.P.(2004); Eu. J.O. M. Ch; 39(9) 273–279.
21. Uchida, M; Komatsu, M; Morita, S; Kanbe, T; Yamasaki, K; Nakagawa, K.(1989) Chemical & Pharmaceutical Bulletin; 37(4) 958-961.
22. Al-Hassani, M.A.(2016); B.Sc. J; 13(4) 793-805
23. Faraj, F.L; Ali, W.B; Jassim, A.S and Ali, R.T.(2017); D. J. P. Sc.; 2(1) 262-277.
24. Chenjie, B.(2017); C. O. Sy; 14(4) 582-589.
25. Mahmood, W.A.R..(2017); B. Sc. J; 14(3) 564-574.
26. Garrol, L; Lambert, H; Grady, D and Water Worth, P. (1981); Antibiotic and Chemotherapy 5th Ed., Churchill Livingstone New York.
27. Mahendra, K.R.(2017); J. O. Ch. Bio .Ph. Sc; 7(2) 334.
28. Roa, C.R.N.(1961); Ultra Violet and Visible Spectroscopy Chemical Application, Butter – Woths Ltd, 52.
29. Sorates, G.(1980); Infrared Characteristic group Frequencies, John Wiely and Sons. Ltd.
30. Vogle, I.(1972); Text-book for practical organic chemistry Third addition Longman.
31. Silverstein, M.R.(1998); Spectrometric Identification of Organic Compounds, 7th ed., John Wiley and Sons, New York.
32. Parikh, M.V.(1973); Absorption spectroscopy of organic molecules, Weslely Publ. Co., London.