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# Coupling Reactions Involving Aryldiazonium Salt: Part-VII. Products of Chemoselective Reaction of Aryldiazonium Chloride with Active Methylene Group containing Moiety

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**Abstract:**

**Aim:** Aryldiazonium salts, $Ar\text{-}N_2^{\oplus}Cl^{\ominus}$ were used as intermediate in different reactions. To prepare the 3-(Substituted-phenylazo)pentane-2,4-dione from Pentane-2,4-dione or Acetyl acetone (**AA**) with aryldiazonium salt. and to study their antibacterial activity.

**Method:** These reactions, either, lost nitrogen containing function or without loss of nitrogen function. First category included replacement by -H, -OH, -Br, -F, -I, -CN, $-NO_2$, aryl- etc. and the latter involved reduction and diazo coupling type reaction. In the present work we have treated aryldiazonium salt with an Active Methylene Group (**AMG**) containing moiety viz. Pentane-2,4-dione or Acetyl acetone (**AA**) and the antibacterial activity by diffusion cup method.

**Results and Conclusion:** The compounds, 3-(Substituted-phenylazo)pentane-2,4-dione, were tested for the antibacterial activity showed less activity than ciprofloxacin. These compounds will be useful as building block for organic researchers in the near future.

**Keywords:** Active methylene group, antibacterial activity, aryldiazonium salt, Azo compounds.

## INTRODUCTION:

Aryldiazonium salt, **$Ar\text{-}N_2^{\oplus}Cl$** are highly reactive class of compounds in synthetic organic chemistry. In chemistry azo dyes of phenolic compounds played a major role in synthesizing many of the commercial dyes and analytical reagent. The dyes were marketed mainly in the form of azo disperse, azo-vat, azo-acid dyes, etc. Due to the simple process of the synthesis, usually an aqueous medium and the almost unlimited choice of starting products, an extremely wide variety of azo dyes skeleton was possible. The number of combination was increased by the fact that a dye molecule can also contain several groups. The practical uses of dyes in various industrial field showed that azo compounds were the largest class of industrial synthesized organic dyes. The azo dyes were a distinct and clearly defined class, characterized by the presence of one or more azo (**-N=N-**) groups. They were all prepared by a common process involving diazotizing an aromatic primary amine and the formed diazonium salt solution is coupled with a phenol or an aromatic amine.

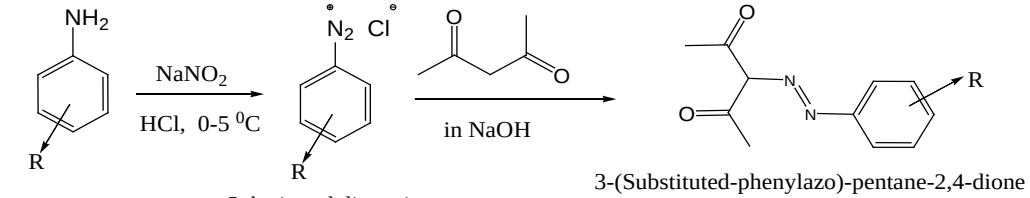
Diazo coupling reaction products were characterized by chromophoric azo group. Azo dyes were used as corrosion inhibitors for the dissolution of carbon steel in HCl acid solution[1]. Azo compounds have received much attention due to their versatile skeleton, ease of preparation and uses in many practical applications such as colouring fibre, photoelectronic applications, printing systems, optical storage technology and in various analytical techniques[2], as a polymer additive[3] used to colour waxes, oils, petrol, solvents and polishes and successful in textile processing, paper, food, cosmetic medicine, leather, plastics, varnish, automobile[4-6].

The aryldiazonium salt were synthesized and reacted upon with an **AMG** containing organic moiety viz. Pentane-2,4-dione or **AA**. Heterocyclic rings[7-8], which were the reason for the activity of Most of the drugs of natural origin lead the discovery of the many synthetic drugs possessing the heterocyclic rings. Heterocyclic nitrogenous[9-10] compounds and their fused analogues represent an important class of heterocyclic compounds exist in numerous natural products displaying a wide range of biological and pharmaceutical activities.

Similar to sitosterol[11] and cholesterol etc. cinnolines were from the class of bioactive compounds due to their remarkable biological and pharmacological property. Cinnoline and its derivatives also showed biological activities such as antihypertensive[12], bacteriocides[13] activity. In view of synthesis of newer 4-Methyl-3-acetylcinnoline or derivatives thereof were of importance, their intermediates were considered worthwhile to study their synthesis. Similar types of reactions were also reported by Mittal and Singhal[14] and recently from our laboratory[15-16].

As seen from the above discussion, azo dyes are very important for technical purposes in many types of industries and were easy to prepare. Our previous few reports[15-20] dealt with reactions involving aryldiazonium moiety. Herein we report the part-VII of this series which dealt with the synthesis of 3-(Substituted-phenylazo)-pentane-2,4-diones (**DSP-1** to **DSP-6**), also the antibacterial aspects of these compounds were determined.

**Scheme-I:**




Substituted aniline — Substituted diazonium chloride salt — 3-(Substituted-phenylazo)-pentane-2,4-dione

**R = -2-$CH_3$(DSP-1); -3-$CH_3$(DSP-2); -4-$CH_3$(DSP-3); -3Br(DSP-4); -4-Br(DSP-5); -3-$C_2H_5$(DSP-6)**

In continuation of earlier work[18-21] the present work the prepared aryldiazonium salts were reacted with an **AMG** containing moiety, pentane-2,4-dione viz. **AA** to synthesize 3-(Substituted-phenylazo)pentane-2,4-dione, (**DSP-1** to **DSP-6**) as **Scheme-l**. Review of literature indicated that such ketone derivatives were valuable synthones for the synthesis of 4-Methyl-3-acetylcinnoline or derivatives thereof.

## EXPERIMENTAL:

**Materials and Methods:** The materials used and the methods of analysis were employed were as mentioned earlier[18]. The bacterial strains, *E. coli* and *B. subtilis*, were purchased from National Centre for Cell Science(**NCCS**), Pune, India and maintained at Smt. G. G. Khadse College, to determine the antibacterial activity of synthesized compounds.

**General Method of Synthesis**

**Stage-I. General Procedure for Preparation of Diazonium Salt, (DSP-1 to DSP-6):** Charged 0.02 M aniline (or its derivative) in a beaker, the mixture of 10 ml conc. HCl and 5 ml water was added to it and stirred with the glass rod to get clear solution, cooled the solution to 0°C by keeping in an ice bath. Meanwhile (0.025 M) sodium nitrite was dissolved in 8 ml water. Cooled the solution in ice bath to 0°C, after attaining 0°C added $NaNO_2$ solution in to aniline hydrochloride solution dropwise with constant stirring (The rise in temperature above 5°C during addition was not allowed) test the diazotized solution impart dark blue colour to starch iodide paper(blue colour was obtained on the potassium-iodide starch paper). Decompose the excess of nitrous acid by adding pinch of urea filter the solution and collected the filtrate which was diazonium salt solution.

**Stage-II. General Procedure for Synthesis of (Phenylazo)-acetyl acetone, (DSP-1 to DSP-6):** Added aryldiazonium salt solution (from **Stage-I**) slowly, to the well cooled mixture of, Pentane-2,4-dione viz. **AA** (0.018 M) dissolved in 5 ml ethanol and NaOAc, 8-10 gm in 4-5 ml of water(to keep the mixture alkaline to litmus), a coloured precipitate was separated, then added 20 ml of concentrated HCl, filtered and checked the absence of ester and thus the product obtained was recrystallized by using solvent ethanol, dry it. The dried weight (in gms) and the physical constant i.e m. p. range of the compound was recorded.

The synthesized compounds were tested for the antibacterial activity against *E. coli* as per the method described in literature[19] and compared with ciprofloxacin as standard drug.

The purity of the synthesized compounds, (**DSP-1** to **DSP-6**) was ascertained by TLC method and also characterized by colour, physical constant (melting point range) and by UV-visible and FTIR-spectra.

The solubility of the synthesized compounds was tested using 0.5 gm of the compound and the selected solvent was continuously added, sonicated for 5 min to arrive at the solubility data.

**Method of Antibacterial Activity**

Synthesized azo compounds were screened for the antibacterial activity, against *E. Coli and B. Subtilis* bacterial strain by using the method reported in earlier[18]. To study the antibacterial activity of 3-(Substituted-phenylazo)-pentane-2,4-dione from diazonium chloride salt, following setup was required. The following experiment was adopted. Newly synthesized compounds were screened their antibacterial activities against strain *E. coli* and *B. subtilis* using disk diffusion method. Activity of each compound was compared with that of control.

The antimicrobial activity of compound (**DSP-1** to **DSP-6**) was studied against two bacterial strains *E-coil* and *B. Subtilis* .The bacterial suspension was spread on the surface of sterile nutrient agar medium in the petriplate and then the filter paper disc soaked with compound (**DSP-1** to **DSP-6**) solution was placed in the centre of plate. The plates were incubated at 37 °C for 24 hrs. The zone of inhibition was measured on the next day in mm.

## RESULTS AND DISCUSSION:

In the present study, diazonium intermediates of aniline and substituted anilines were synthesized, reacted with an active methylene compound (acetyl acetone) and screened for antibacterial activity. All the compounds were obtained in high purity. The progress of reactions was monitored by Silica gel-G TLC, visualized by iodine vapour. The purity of the compounds was ascertained by melting point determinations (one end sealed capillary method) and by Silica gel-G TLC. The mobile phases were 10 ml n-Hexane, 1 ml methanol, 2 ml ethylacetate(**DSP-1, DSP-3** and **DSP-6**) and 10 ml n-Hexane, 1 ml Acetic acid (**DSP-2, DSP-4** and **DSP-5**). The structural assignment of the products was based on UV-Vis and FTIR spectral data and elemental (CHN) analyses. The spectral data was in close agreement with the structures of the synthesized compounds. All compounds gave satisfactory elemental analysis. Values were in the close agreement with the values calculated for expected molecular formula assigned

to these compounds and were in 5 % in statistics. The results of analytical results and physical constants results were depicted in **Table 1**. The photographic representation and the characteristic colours of synthesized organic compounds, viz. **DSP-1** to **DSP-6** is shown in **Fig. 1**.

**Table 1:** The Analytical and Physical data for 3-(Substituted-phenylazo)-pentane-2,4-diones, (**DSP-1 to DSP-6**).

| Code | Aniline derivative | Active methylene Compound used | Colour | Molecular Formula | *m.p. range °C |
|---|---|---|---|---|---|
| **DSP-1** | 2-Methyl-aniline | Pentane-2,4-dione | Pale yellow | $C_{12}H_{14}N_2O_2$ | 70-76 |
| **DSP-2** | 3-Methyl-aniline | Pentane-2,4-dione | Dark brown | $C_{12}H_{14}N_2O_2$ | 122-128 |
| **DSP-3** | 4-Methyl-aniline | Pentane-2,4-dione | Chocolate Brown | $C_{12}H_{14}N_2O_2$ | 98-104 |
| **DSP-4** | 3-Bromo-aniline | Pentane-2,4-dione | Shiny orange | $C_{11}H_{11}N_2O_2Br$ | 84-90 |
| **DSP-5** | 4-Bromo-aniline | Pentane-2,4-dione | Brown | $C_{11}H_{11}N_2O_2Br$ | 78-84 |
| **DSP-6** | 3-Ethyl-aniline | Pentane-2,4-dione | Orange | $C_{12}H_{14}N_2O_2$ | 82-86 |

* Physical constants are uncorrected.

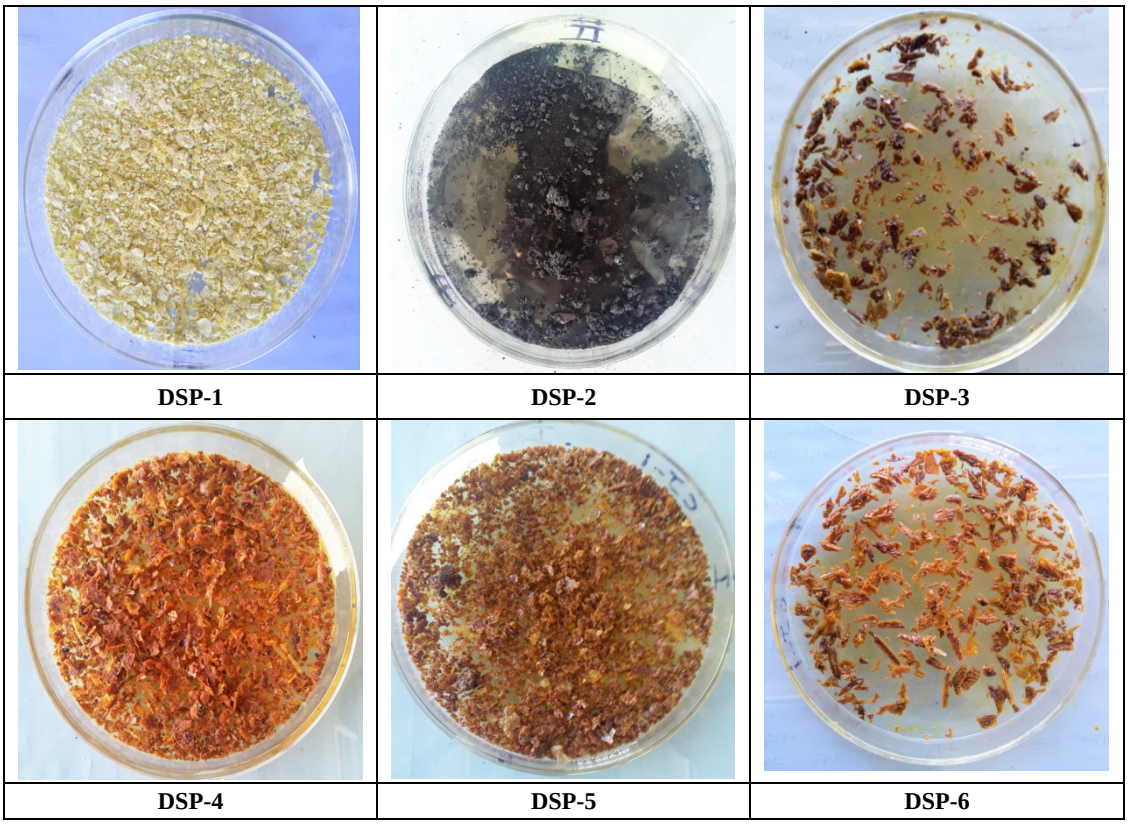



**Fig. 1:** Colour characteristics for the synthesized 3-(Substituted-phenylazo)-pentane-2,4-diones, (**DSP-1** to **DSP-6**).

**Fig. 2A:** TLC for 3-(Substituted-phenylazo)-pentane-2,4-dione, **DSP-1.**

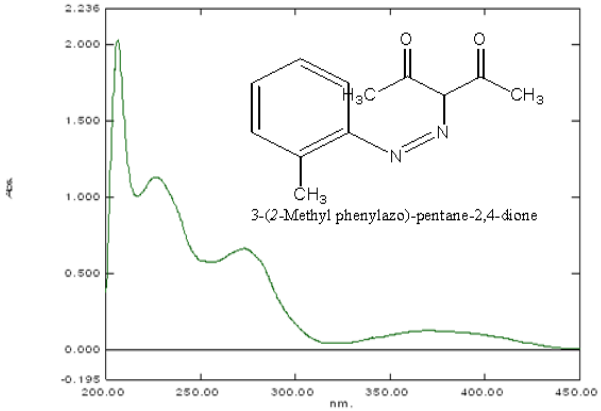



**Fig.3: The UV-Vis spectra of DSP-1.**

All the studied azo compounds showed four peaks in UV-Vis spectra in ethanol in the studied range 600 nm to 200 nm. In the UV-Vis spectral analysis of azo compound shows the three peaks in the range 397-321 nm, 270-226 nm and 220-203 nm. These were attributed to n□□* and □□□* transitions due to presence of nitro group (auxochrome) and azo group transitions and aromatic phenyl ring transition of moderate energy.

In addition to this the synthesized compounds, **DSP-1** to **DSP-6** were also characterized by spectral analysis viz. UV-Vis, and FTIR and the obtained results were reported in the **Table 2**. The **Table 2** also indicated the assigned structures from the spectral results.

The studied compounds showed absorption frequency in the range 1671-1601cm$^{-1}$, indicated presence of carbonyl group. The studied compounds showed absorption frequency in the range 1680-1613 cm$^{-1}$, indicated presence of Aromatic group >C=C<. The studied compounds showed absorption frequency in the range 3316-3000 cm$^{-1}$, indicated presence of C-H starching. The studied compounds showed absorption frequency in the range 1355-1310 cm$^{-1}$, indicated presence of C-N starching. The studied compounds showed absorption frequency in the range 1563-1513 cm$^{-1}$, indicated presence of –N=N- starching. These compounds have attracted interest because of their unique structure, in which an electrophilic oxo group is in proximity to two phenylhydrazono groups. Interaction of these groups can give rise to tautomeric phenylhydrazono-phenylazo structures, and the expected -N=N- vibration frequencies in the compound formed are of particular interest. As is known[21, 23-24], the -N=N- vibration frequencies of aromatic and aliphatic azo compounds are difficult to recognize, and therefore they had been the least studied. The presence of the azo (-N=N-) group band in 1563–1513 cm$^{-1}$ range confirmed the success of the synthesis[17].

The FITR spectra of the synthesized final products, **DSP-1** to **DSP-6** are depicted below in **Fig. 3a** to **3f**.

The related data of FTIR characteristic frequency (in cm$^{-1}$) of the groups indicated in the **Table 2**.The solubility of the synthesized compounds was decided on the basis of the experiment and the obtained data is depicted in the **Table-3**.

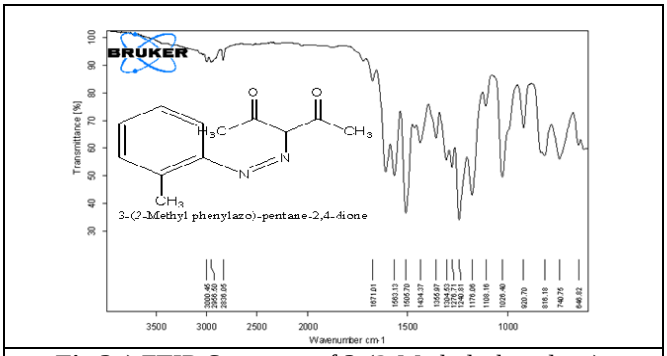



**Fig.3a)** FTIR Spectrum of 3-(2-Methyl-phenylazo)-pentane-2,4-dione, **DSP-1.**

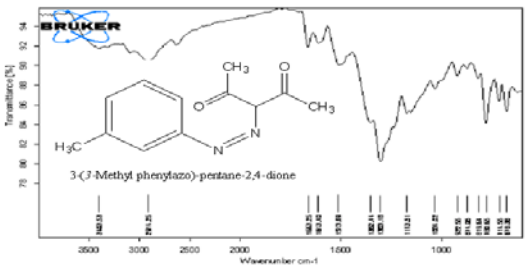



**Fig. 3b)** FTIR Spectrum of 3-(3-Methyl-phenylazo)-pentane-2,4-dione, **DSP-2.**

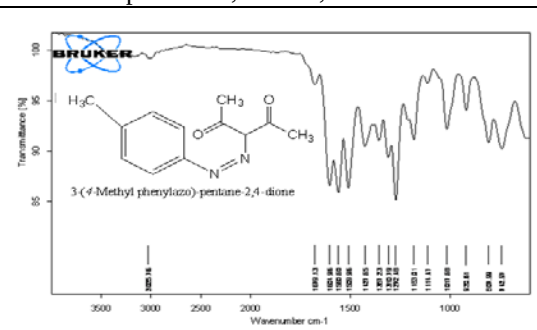



**Fig.3c)** FTIR Spectrum of 3-(4-Methyl-phenylazo)-pentane-2,4-dione, **DSP-3.**

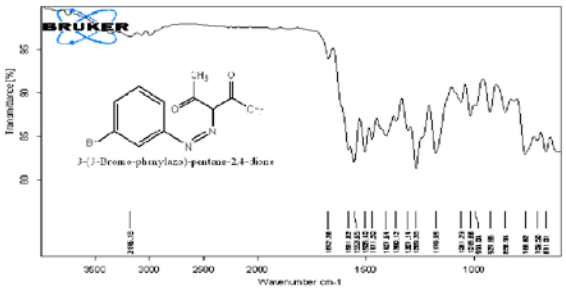



**Fig. 3d)** FTIR Spectrum of 3-(3-Bromo-phenylazo)-pentane-2,4-dione, **DSP-4.**

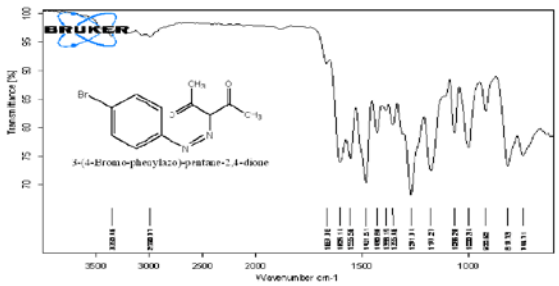



**Fig.3e)** FTIR Spectrum of 3-(4-Bromo-phenylazo)-pentane-2,4-dione, **DSP-5.**

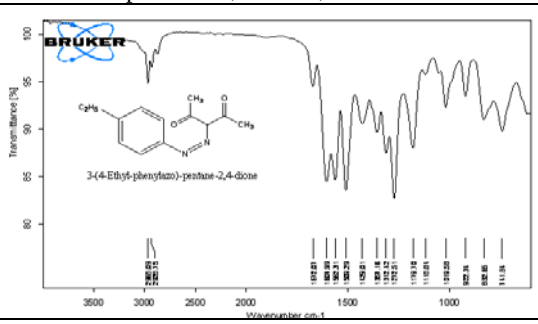



**Fig.3f)** FTIR Spectrum of 3-(4-Ethyl-phenylazo)-pentane-2,4-dione, **DSP-6.**

**Table 2:** Spectral Data for 3-(Substituted-phenylazo)-pentane-2,4-diones, (**DSP-1** to **DSP-6**).

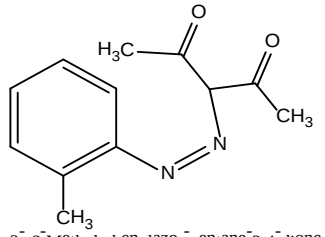
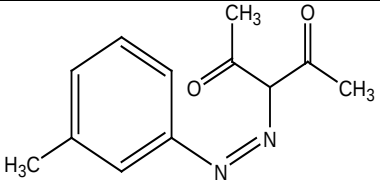
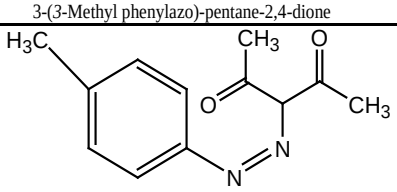
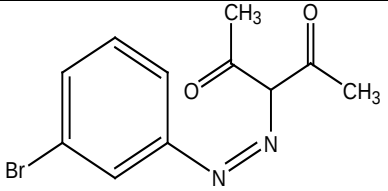
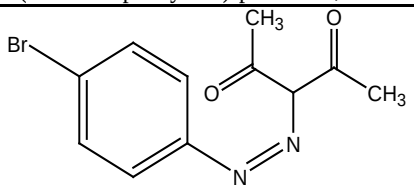
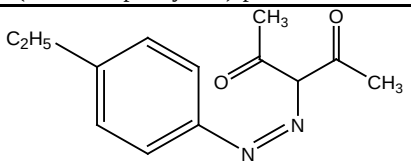
| Comp. ID | UV (nm) | IR ($cm^{-1}$) | Assigned Structure |
|---|---|---|---|
| **DSP-1** | 378.20 340.20 273.40 226.00 206.00 | $\nu_{-C=O}$ =1671<br>$\nu_{-C=C-}$ =1680<br>$\nu_{-C-H}$ =3000<br>$\nu_{-C-N-(Aryl)}$ =1355<br>$\nu_{-N=N-}$ =1563 $\nu_{-C-CH3(o)}$ =1370 |  <br>3-(2-Methyl phenylazo)-pentane-2,4-dione |
| **DSP-2** | 364.50 | $\nu_{-C=O}$ =1663<br>$\nu_{-C=C}$ =1613<br>$\nu_{-C-H}$ =2916<br>$\nu_{-C-N(Aryl)}$ =1310<br>$\nu_{-N=N-}$ =1513 $\nu_{-C-CH3(m)}$ =1380 |  <br>3-(3-Methyl phenylazo)-pentane-2,4-dione |
| **DSP-3** | 556.50 232.00 254.50 225.00 218.00 204.00 | $\nu_{-C=O}$ = 1601<br>$\nu_{-C=C-}$ = 1619<br>$\nu_{-C-H}$ = 3025<br>$\nu_{-C-N-(Aryl)}$ = 1310<br>$\nu_{-N=N-}$ = 1560<br>$\nu_{-C-CH3(p)}$ =1390 |  <br>3-(4-Methyl phenylazo)-pentane-2,4-dione |
| **DSP-4** | 331.00 261.00 224.50 205.00 | $\nu_{-C=O}$ =1612<br>$\nu_{-C=C-}$ =1675<br>$\nu_{-C-H}$ =3116<br>$\nu_{-C-N-(Aryl)}$ =1311<br>$\nu_{-N=N-}$ =1561 $\nu_{-C-Br(m)}$ =611 |  <br>3-(3-Bromo-phenylazo)-pentane-2,4-dione |
| **DSP-5** | 577.50 340.00 226.00 218.00 204.00 | $\nu_{-C=O}$ =1660<br>$\nu_{-C=C-}$ =1630<br>$\nu_{-C-H}$ =3360<br>$\nu_{-C-N-(Aryl)}$ =1355<br>$\nu_{-N=N-}$ =1555 $\nu_{-C-Br(p)}$ =711 |  <br>3-(4-Bromo-phenylazo)-pentane-2,4-dione |
| **DSP-6** | 323.00 269.00 225.00 218.00 204.00 | $\nu_{-C=O}$ =1601<br>$\nu_{-C=C-}$ =1612<br>$\nu_{-C-H}$ =2998<br>$\nu_{-C-N-(Aryl)}$ =1351<br>$\nu_{-N=N-}$ =1562 |  <br>3-(4-Ethyl-phenylazo)-pentane-2,4-dione |

**Table 3: The solubility data for the 3-(Substituted-phenylazo)-pentane-2,4-diones, (DSP-1** to **DSP-6).**

| Compound ID | Solvent used(in ml/0.1 gm of substance) | | |
|---|---|---|---|
| | **Ethyl alcohol** | **Diethyl ether** | **Acetone** |
| **DSP-1*** | 24 | 50** | - |
| **DSP-2***** | 6 | 20** | 5 |
| **DSP-3** | 12 | 7 | 2.5 |
| **DSP-4** | 5 | 2.5 | 1.5 |
| **DSP-5** | 11 | 1.5 | 4.0 |
| **DSP-6** | 14 | 1.0 | 6.5 |

*** methanol 14 ml required; ** Insoluble and coagulated and *** Benzene 2.5 ml required.**

**Table 4:** Zone of Inhibition (ZOI, in mm) indicating Antibacterial Activity of 3-(Substituted-phenylazo)-pentane-2,4-diones, (**DSP-1** to **DSP-6**).

| Name of the Compound and Controls | ZOI(in mm) of the Compound and Controls | | | |
|---|---|---|---|---|
| | 500 □g/ml | | 1000 □g/ml | |
| | *E. coli* | *B. subtilis* | *E. coli* | *B. subtilis* |
| **DSP-1** | 08 | 12 | 10 | 15 |
| **DSP-2** | 07 | 07 | 08 | 09 |
| **DSP-3** | - | - | - | - |
| **DSP-4** | - | - | - | - |
| **DSP-5** | 07 | 09 | 06 | 10 |
| **DSP-6** | 05 | 11 | 07 | 11 |
| **Std. Drug, (Ciprofloxacin)** | 21 | 24 | 22 | 25 |
| **Distilled Water (-ve control)** | 00 | | | |

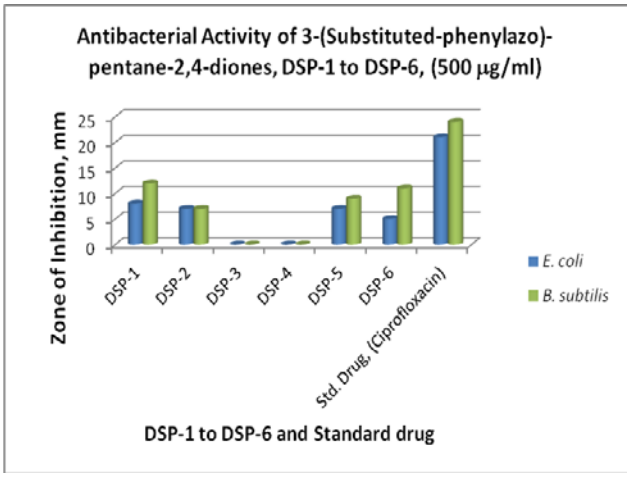



**Fig. 4A. The histographic representation of antibacterial activity of Synthesized compound, DSP-1 to DSP-6(500 µg/ml).**

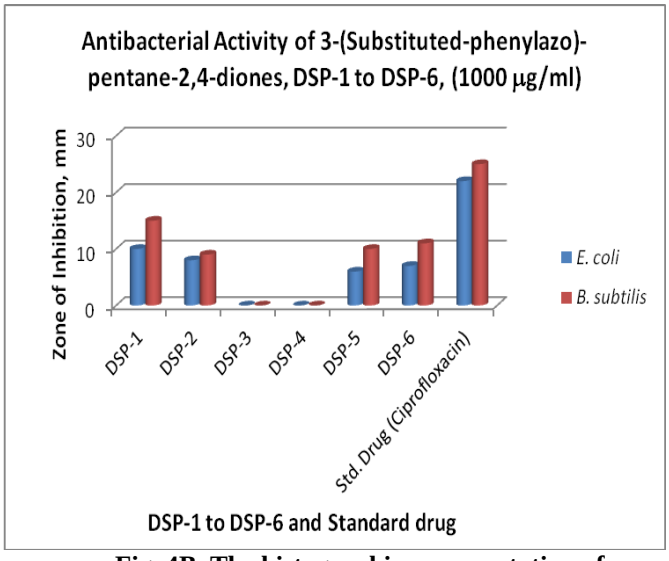



**Fig. 4B. The histographic representation of antibacterial activity of Synthesized compound, DSP-1 to DSP-6 (1000 µg/ml).**

**Antibacterial Activity:** Antibacterial activity of all the synthesized compounds were screened against gram-negative bacteria, *E. coli*(**NCCS)** and *B. subtilis*(**NCCS)** for three different concentration of 500 and 1000 µg/ml, as per the method described in[18]. The results of antimicrobial testing as zone of inhibition (in mm) are depicted in **Table 4**.

The histographical representation of the antibacterial activity is depicted in **Fig. 4A (500 µg/ml)** and **Fig. 4B (1000 µg/ml),** respectively.

The results showed that the compounds are less active than the standard drug, Ciprofloxacin in case of the studied strains.

Glimpses drawn from the Antibacterial activities of the studied 3-(Substituted-phenylazo)-pentane-2,4-diones were as...

- ✓ All the activity for compound *E. coli* and *B. subtilis* and showed less or no activity as compare to the standard drug, Ciprofloxacin.
- ✓ Compound **DSP-1** was active against both *E. coli* and *B. subtilis* (500 and 1000 □g/ml), further it shows little higher activity for *B. subtilis.*
- ✓ Compound **DSP-2** was active against both *E. coli* and *B. subtilis* (500 and 1000 □g/ml), further it shows almost same activity for both studied strains.
- ✓ There was no antibacterial activity, shown by compound **DSP-3** and **DSP-4** for studied concentration and strains.
- ✓ Compound **DSP-5** and **DSP-6** were active against both *E. coli* and *B. subtilis* (500 and 1000 □g/ml), further it shows little higher activity for *B. subtilis* than for *E. coli*.

## CONCLUSION:

Aniline and substituted anilines were used for the preparation of diazoninium salt then they were reacted upon with an active methylene group containing moiety i.e Pentane-2, 4-dione or **AA** to give or derivatives thereof. Their antibacterial activities were also reported. These compounds will be useful as building block for organic researchers in the near future.

**Conflict of Interest Statement:** The authors declares that there is no conflict of interest

**Orcid Id:** orcid.org/0000-0002-7535-698X.

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## REFERENCES:


1) Abdullah, M., Fouda, A. S., Shama, S. A. and Afifi, E. A., Azodyes as corrosion inhibitors for dissolution of C-steel in hydrochloric acid solution, *Afri J Pure and Applied Chem*, 2008; *2(9)*: 83.
2) Yazdanbakhsh, M. R. and Moradi-E-Rufchahi, E., Synthesis, characterization and spectroscopic properties of some new azo dyes derived from 6-aminopyrimidine-2, 4-(1H, 3H)-dione, *Orient J Chem*, 2009; *25*: 41.
3) Naik, A. P., Desai, K. R. and Patel, H. S., Synthesis of azo dyes based on alpha-Naphtholformaldehyde oligomer and their application on textile, *Iran Poly J*, 2001; *10:* 1.
4) Menek, N., Turgut, G. and Odabasoglu, M., Electrochemical Behaviour of Hexa[4-(phenylazo) phenoxy]cyclotriphasphazene, *Turk J Chem*, 1999; *23*: 423.
5) https://www.sigmaaldrich.com/content/dam/sigmaaldrich/docs/Fluka/ General_Information/1 /analytix5_2011.pdf (visited on 1st Aug. 2014)
6) Zollinger, H., Colour Chemistry (VCH Weinhein, Germany), 1991.
7) a) Katritzky, A. R., Charles, W. R., *Compre Heterocyc Chem*, 1990; *3*: 22, Trend in Heterocyclic Chemistry, 248; b) Katritzky, A. R., Chairman of the Editorial Board, Charles WR, FRS Co Chairman of the Editorial Board, FRS, Comprehensive Hetrocyclic Chemistry the Structure Reaction Synthesis & Use of Hetrocyclic Compounds Vol-3 (Pergamon Press) UK p. 2.
8) Pitucha, M., Pachuta-Stec, A. and Kaczor, A. A., New five-membered ring heterocyclic compounds with antibacterial and antifungal activity, *FORMATEX*, 2013; 562-573.
9) Tisler, M. and Stanovic, B., In: Katritzky, A. R. and Boulton, AJ (Ed.), *Advance in Heterocyclic Chemistry*, (Academic Press, **1979)** 408.
10) Stanczak, A. and Pakulska, W., Pietrzak, B., Lewgowd W.**,** Comparison of pharmacophore cinnoline and quinoline systems on the basis of computer calculation and pharmacological screening of their condensed systems, *Pharmazie*, 2001; *56(6)* **:** 501.
11) Patil, M. C. and Mahajan, R. T., Ethnobotanical potential of *Eulophia* species for their possible biological activity, *Int J Pharm Sci Rev Res*, 2013; *21(2)* $n^0$ 53: 297.
12) Adwards, J. W., *A Survey of Antimalerial Drugs*, 1976; *11*: 946.
13) Eisako, H., JP 7010349, C.A. 1970; 73: 45529.
14) Mittal, A. K. and Singhal, O. P., *J Ind Chem, Soc*, 1982; *59*: 711-712.
15) Patil, C. J., Patil, P. A., Patil, P. B. and Patil, M. C., Coupling Reactions Involving Aryldiazonium Salt: Part-I. Chemoselective Synthesis of 3-Oxo-(substituted-2-phenylazo)-butyricacid ethylester derivatives and their Antibacterial Activity, *Der Chemica Sinica*, 2015; *6(5):* 108-114.
16) Patil, C. J., Patil, Manisha C., Pachpole, Nilesh R. and Waykole, Vilas S., Coupling reactions involving aryldiazonium salt: Part-II. Chemoselective condensation with acetyl acetone and antibacterial activity, *Der Chemica Sinica*, 2015; *6(5):* 115-121.
17) Patil, C. J., Talele, D. S., Talele, S. P., Pohekar, P. R. and Patil, A. S., Coupling Reactions Involving Reactions of Aryldiazonium Salt: Part-IV. Chemoselective Synthesis and Antibacterial Activity of 3-(Substituted-phenylazo)-pentane-2,4-done, *Int J Pharm Sci Rev Res*, 2017; *45(1)*: 64 – 73, and ref. therein.
18) Patil, C. J., Patil, Manisha C., Rane, Vivek, Mahajan, Kunal and Nehete, C. A., Coupling Reactions Involving Reactions of Aryldiazonium Salt: Part-III. Chemoselective Condensation with β-Naphthol to Synthesize Sudan-I, its Nitro Derivatives and Antibacterial Potential, *J Chem Biol Phy Sci*, 2015; *5(4)*: 3860.
19) Nehete, C. A. and Patil, C. J., Coupling Reactions Involving Reactions of Aryldiazonium Salt: Part-V. Synthesis of Novel Azo-Aniline with Different Substituted Anilines and study of their Biological Activity, *Int J Pharma Biol Arch*, 2017; *8(1)*: 20 – 26.
20) Patil, C. J., Waghulade, G. P. and Patil, Manisha C., Coupling Reactions Involving Reactions of Aryldiazonium Salt: Part-VI. Chemoselective Condensation with Resorcinol, *Int J Green Herbal Chem*, 2017; *6(2)*: 5-14, doi: 10.24214/IJGHC/GC/6/2/0514.
21) Patil, C. J., Waghulade, G. P., Patil, M. C. and Patil, Mrunmayee C., Coupling Reactions Involving Reactions of Aryldiazonium Salt: Part-VII. Chemoselective Synthesis of 1-(Substituted-phenyl)-azo-naphthalene-2-ol, *Int J Pharm Res Rev*, 2017; *45(2)*: 21-28.
22) Patil, C. J., Nehete, C. A. and Mahajan, H. A., Azomethines and Biological Screening Part-I: An approach towards green sustainable chemistry by environmental friendly grindstone method compared with conventional method and screening of the Benzylideneanilines, *Int J Green and Herbal Chem*, 2013; *2(2)*: 241.
23) Rao, C. N. R., *Chemical Applications of Infrared Spectroscopy*, p. 267 (Academic Press Inc., New York, N.Y., 1963).
24) Bellamy, L. J., *The Infra-red Spectra of Complex Molecules*, p. 271 (John Wiley & Sons, Inc., New York, N.Y., 1958).



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