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SYNTHESIS, CHARACTERISATION, ANTIBACTERIAL AND ANTHELMINTIC ACTIVITIES OF NOVEL BENZOTHIAZOLE DERIVATIVES

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ABSTRACT

A design and synthesis of new Benzothiazole derivatives(3a-3h) containing thiazole moiety have been synthesized by conventional method by three step process by cyclization to form 2-amino benzothiazole, followed by Schiff's bases mechanism and electrophilic substitution reaction with benzyl chloride. The synthesized compounds are characterized by ^{1}H-NMR, IR and Mass spectral data. The synthesized compounds are evaluated for *invitro* antibacterial activity and anthelmintic activity against the antibacterial strains like gram-positive *Bacillus substillus*, *Staphylococcus aureus* gram-negative *Escherichia coli*, *Salmonella paratyphi* species and anthelmintic strains like Earthworms. The Streptomycin is considering as a reference standard drug for Anti-bacterial activity and Albendazole is considering as a reference standard drug for Anthelmintic activity. The compounds 3b, 3e and 3f showed good anti-bacterial activity and the compounds 3a, 3b and 3d showed good anthelmintic activity.

KEYWORDS: Benzothiazole, Antibacterial activity, anthelmintic activity.

INTRODUCTION

Microbial resistance is worldwide threat in contemporary medicine and poses a threat to mankind. As per the report of WHO, in 2016, 490 000 people developed multi-drug resistant TB globally, and drug resistance is starting to complicate the fight against HIV and malaria, as well. Resistance to first-line drugs to treat infections caused by *Staphlylococcus aureus*, a

common cause of severe infections in health facilities and the community is widespread. People with MRSA (methicillin resistant *Staphylococcus aureus*) are estimated to be 64% more likely to die than people with a non-resistant form of the infection. Designing newer antimicrobial agent to counter this resistance is need of hour and has compelled the researcher to develop a new scaffold which can be further optimized as antimicrobial agents.

Fused Heterocyclic Compounds: In several compounds, benzene is fused with the five-membered heterocyclic systems such as Indole, Benzothiazole, Benzimidazole, Benzoxazole (fig 1.1), which have been synthesized and studied extensively, because of their pharmacological activities.[1]

Benzothiazole (1, 3-benzothiazole) is one of the heterocyclic compounds, weak base and having varied biological activities. They are rarely available in nature, from the source of marine or terrestrial organisms as a natural compound. Benzothiazole analogues are present in the aroma of the tea leaves and also found in flavor component produced in fungi viz. Aspergillus clavatus, Polyporous frondosus etc.[2-3] Benzene ring is fused with thiazole at 4, 5 positions to form the basic structure of benzothiazole.

The two rings together constitute the basic nucleus of 1, 3 benzothiazole.[4] The resultant compound is a planar and the various positions of the atoms are numbered in such a way that, sulfur atom is numbered 1, followed by methylene carbon atom and then nitrogen of the ring.

During the last decade, the structure activity concept has been emerged as central concept for the new drug discovery and is a fruitful approach to understand the relationship between the structure of synthesized chemical compound and their affinity towards the biological systems. Benzothiazole is such a model structure and has wide spectrum of activity for the diverse biological receptor and hence, it became the most valuable scaffold and tailing fragment for the design and synthesizing the target based drugs.[5-6] The diversified molecular structure of the benzothiazole and remarkable biological activity makes one of the important compounds in heterocyclic chemistry and has received overwhelming response.[7]

Benzothiazole derivatives possesses versatile biological activities such as antiviral, anticancer, antimicrobial, anti-tuberculor, anti-malarial, anti-oxidant etc.

MATERIALS AND METHODS

The some benzothiazole derivatives (3a-3h) containing thiazole moiety have been synthesized by conventional method by three step process by Cyclisation to form 2-amino benzothiazole, and followed by Schiff's bases mechanism. Finally, Schiff's bases undergo electrophilic substitution reaction with Benzyl chloride to give the title of compounds.

Step: 1: Preparation of 2-aminobenzothiazole

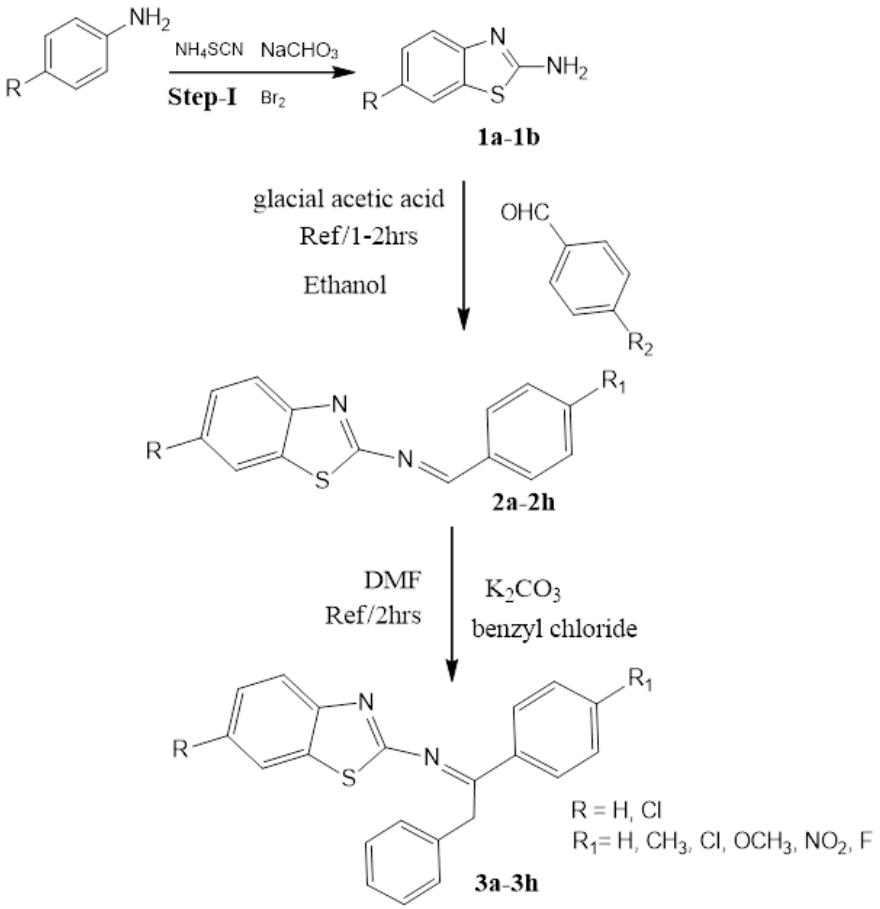
Aniline (4.6g, 0.05mol) and ammonium thiocyanate (3.8g, 0.05 mol) were dissolved in absolute ethanol containing 4 ml of con. HCl. To this mixture bromine in glacial acetic acid (6.75ml, 0.125 mol) was added and the reaction mixture was refluxed for 1 hr. Then it was cooled in ice bath. The precipitate obtained was filtered, washed with cold water and dried. The crude product was recrystallized from ethanol.

Step-II: Synthesis of N-(6-substitutedbenzo[d]thiazol-2-yl)-1-(substituted-methoxyphenyl) methanimine (2a-2h)

A mixture of 2-aminobenzothiazole (0.01mol) and Substituted aromatic aldehyde (0.01mol) dissolved in (30ml) and 5ml glacial acetic acid was added and refluxed for 1-2hrs. The progress of the reaction was monitored by TLC. After completion of the reaction mixture was cooled and kept in refrigerator for overnight. The resultant solid was filtered, dried and recrystallized from suitable solvent to afford compounds.

Step-III: Synthesis of New benzothiazole derivatives (3a-3h)

In the round bottomed flask take N-(6-substitutedbenzo[d]thiazol-2-yl)-1-(substituted-methoxyphenyl) methanimine (2a-2h, 3.37mM) and equimolar quantity of benzyl chloride i.e. 6.5ml (3.7mM), mix with 20ml of DMF and to this mixture add 2gm of K_2CO_3. After gentle mixing of this reaction mixture, reflux for 2 hr, cool and pour to 100 ml of ice cold water. Then collected wash with water and dried and recrystallized from acetonitrile.



Scheme I: synthesis of (E)-N- (benzo[d]thiazol-2-yl)-1,2-diphenylethan-1-imine derivatives.

Table 1: Different type of substitution.

S.Code	**R**	**R_1**
3a	-H	-H
3b	$-CH_3$	-H
3c	-Cl	-H
3d	$-OCH_3$	-H
3e	$-NO_2$	-H
3f	-H	-Cl
3g	$-CH_3$	-Cl
3h	- Cl	-Cl

BIOLOGICAL ACTIVITY

Antimicrobial Activity

Antibacterial activity of test compounds were detected by observing the growth response of various micro-organism to those test compounds which are placed in contact with them, many methods are available for detecting antimicrobial activity.

Antimicrobial test methods

- Diffusion methods
- Dilution methods
- Bio autographic methods

Evaluation of antibacterial activity

Method of followed: Agar diffusion method (Cup plate method)

The antibacterial activity was screened by using diffusion method. In this method the petridishes were filled with inoculated liquefied agar medium to uniform thickness the pits or bores were made using core borer which filled with test drug and a Standard drug and inoculated at 37 ± 1^0C hrs. The drug will diffuse into the agar medium are prevents the growth of microbes and produce a clear zone of inhibition.

Requirements

A. Materials

The Petri dishes, syringes, cork borers, pipettes and conical flasks etc were cleaned by a suitable cleansing agent and sterilized at 121°C & 15 lb/inch^2 for 15 min.

B. Microorganisms used

The standard cultures of gram-positive *Bacillus substillus*, *Staphylococcus aureus* gram-negative *Escherichia coli*, *Salmonella paratyphi* species were obtained from Department of Microbiology, Kakatiya University, Hanmakonda, Waranagl, and Telangana.

C. Stock solution

The stock solutions of newly synthesized compounds and standard Streptomycin were prepared in dimethylsulfoxide at a concentration of 100µg/0.1 ml.

D. Culture medium

Table 2: Composition of Culture medium.

Sl. No.	Ingredients	Weight (g)
1.	Beef extract	10
2.	Peptone	10
3.	Agar (M-173)	20
4.	Distilled water	1000 ml
5.	pH	7.0-7.5

The above mentioned quantities of different ingredients were accurately weighed, dissolved in appropriate amount of distilled water and sterilized at 121°C & 15 lb/inch^2 for 15 min.

E. Stock Culture

The hot solution of culture medium was transferred into test tubes in 10 ml portions. The tubes were plugged with cotton and sterilized at 121°C & 15 lb/inch^2 for 15 min. The tubes were cooled in a slant position and incubated at 37°C for two days. Afterwards they were observed: if the tubes were contaminated with microorganism, the tubes were rejected and the experiment was repeated until there was no contamination. The stab culture made in three tubes and incubated at 30-34°C for 18-24hrs and stored in refrigerator. One tube was set aside as stock culture and the others were used for inoculation.

F. Inoculums

A volume of 3 ml sterile water was added aseptically into stab culture, shaken for 10 sec and the liquid was decanted aseptically into another sterile test tube. The resulting cell suspension was used as inoculums.

G. Method of testing

A volume of 25 ml of sterile hot agar medium was poured in each plate and allowed to harden on a level surface. The agar plates were inoculated with 24 hr test cultures by spreading uniformly with sterile cotton swabs. The plates were then allowed to dry in the inverted position in an incubator for 30 min. Afterwards they were removed and bore were made on the medium using sterile borer. A volume of 0.1 ml of test solution was added to respective bores. Streptomycin at a concentration of 100 µg/ 0.1 ml was taken as standard reference. A control having only DMSO in the cup was maintained in each plate. The petriplates were kept in the refrigerator at 4°C for 15 min for diffusion to take place. Afterwards they were incubated at 37°C for 24 hr and zones of inhibition were observed and measured using a scale. Each experiment was carried out in triplicate and the mean diameter of inhibition zone was recorded. The various antibacterial results of synthesized compounds are shown in the Table. No.2.

Anthelmintic activity

The synthesized novel Benzothiazole derivatives **(Scheme-I, 3a-3h)** are screened for anthelmintic activity by using Earth worms. One Earthworm is placed in standard drug

solution and test compound's solutions at room temperature. Normal saline used as control. The standard drug and test compounds were dissolved in minimum quantity of dimethyl sulfoxide (DMSO) and adjusted the volume up to 10 ml with normal saline solution to get the concentration of 0.1% w/v, 0.2 % w/v and 0.5% w/v. Albendazole was used as a standard drug.

The compounds were evaluated by the time taken for complete paralysis and death of earthworms. The mean lethal time for each test compound was recorded and compared with standard drug. The time taken by worms to become motionless was noted as paralysis time. To certain the death of the motionless worms was frequently applied with external stimuli, which stimulate and induce movement in the worms, if alive. The mean lethal time and paralysis time of the earthworms for different test compounds and standard drug are Albendazole.

RESULT AND DISCUSSION

The chemical structure of the synthesized compounds shall be established on the basis of physical, chemical and analytical data. Melting point of new compounds shall be determined in open capillary tube they are expressed in degree Celsius.

The synthesized new Benzothiazole derivatives (3a-3h) containing thiazole moiety will be characterized by ^{1}H-NMR, IR and Mass spectral data.

Table 3: Physical characterization of new Benzothiazole derivatives (3a-3h) derivatives.

S.Code	R	R_1	Mol. For	Mol.Wt gm/mol	M.P(°C)	%Yield	Rf.V
3a	-H	-H	$C_{21}H_{15}N_2SCl$	328.10	115-117	76	0.67
3b	$-CH_3$	-H	$C_{22}H_{18}N_2S$	342.12	131-133	77	0.70
3c	-Cl	-H	$C_{21}H_{15}N_2SCl$	362.06	137-139	69	0.81
3d	$-OCH_3$	-H	$C_{22}H_{18}N_2SO$	358.11	181-183	86	0.76
3e	$-NO_2$	-H	$C_{21}H_{15}N_3SO_2$	373.09	212-214	83	0.74
3f	-H	-Cl	$C_{21}H_{15}N_2SCl$	362.06	183-185	83	0.66
3g	$-CH_3$	-Cl	$C_{22}H_{17}N_2SCl$	376.08	153-155	78	0.87
3h	- Cl	-Cl	$C_{21}H_{14}N_2SCl_2$	396.03	203-205	76	0.81

Spectral data

(E)-N-(benzo[d]thiazol-2-yl)-1,2-diphenylethan-1-imine (3a): Light brown colour solid, molecular weight 328.10 g mol^{-1}, solubility-ethanol, nethanol and DMSO, melting point 115-117^{o}C, percentage yield 76%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value

0.67cm: IR (ν cm−1); 3002(C-H *Str,* Aromatic), 2923, 2834(C-H *Str* in aliphatic), 2392(C-S-C *Str* in thiazole), 1635(-C=N, *Str in* immine group), 1540(-C=N, *Str* in rings), 1252(C=C, *Str* in Aromatic ring): ^{1}H-NMR (DMSO) δ ppm; 9.9062(s, 2H, Benzyl), 7.8978-7.8094(d, 2H, Aromatic H), 7.7979-7.7689(d, 2H, Aromatic -H), 7.5976-7.5744(t, 2H, Aromatic -H), 7.5664-7.5479(t, 3H, Aromatic -H), 7.5332-7.5229(t, 3H, Aromatic -H): Mass (ESI-MS)m/z 328.10(M), 329.21(M + 1, 100%).

(E)-N-(benzo[d]thiazol-2-yl)-2-phenyl-1-(p-tolyl)ethan-1-imine (3b): Cream colour solid, molecular weight 342.12 g mol^{-1}, solubility-ethanol, methanol and DMSO, melting point 131-133^{o}C, percentage yield 77%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.70cm: IR (ν cm−1); 3083(C-H *Str,* Aromatic), 2933, 2817(C-H *Str* in aliphatic), 2392(C-S-C *Str* in thiazole), 1639(-C=N, *Str in* immine group), 1579(-C=N, *Str* in rings), 1263(C=C, *Str* in Aromatic ring): ^{1}H-NMR (DMSO) δ ppm; 9.5974(s, 2H, Benzyl –CH_2), 7.8958-7.8428(d, 2H, Aromatic H), 7.7928-7.7868(d, 2H, Aromatic -H), 7.6986-7.6827(d, 2H, Aromatic -H), 7.6898-7.5979(d, 2H, Aromatic -H), 7.5838-7.5168(t, 2H, Aromatic -H), 7.4906-7.3738(t, 3H, Aromatic -H), 2.0130(s, 3H, -Ar-CH_3): Mass (ESI-MS); m/z 342.12(M), 443.76(M + 1, 100%).

(E)-N-(benzo[d]thiazol-2-yl)-1-(4-chlorophenyl)-2-phenylethan-1-imine (3c): Green colour solid, molecular weight 362.06g mol^{-1}, solubility-ethanol, methanol, DMSO, melting point 137-139^{o}C, percentage yield 69%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.81cm: IR (ν cm−1); 3101(C-H *Str,* Aromatic), 2974, 2856(C-H *Str* in aliphatic), 2347(C-S-C *Str* in thiazole), 1626(-C=N, *Str in* immine group), 1531(-C=N, *Str* in rings), 1266(C=C, *Str* in Aromatic ring), 809(C-Cl, *Str* in Ar-Cl): ^{1}H-NMR (DMSO) δ ppm; 9.8045(s, 2H, Benzyl –CH_2), 7.8871-7.8486(d, 2H, Aromatic H), 7.6825-7.6634(d, 2H, Aromatic -H), 7.6586-7.6368(d, 2H, Aromatic -H), 7.5858-7.5763(d, 2H, Aromatic -H), 7.5551-7.5155(t, 2H, Aromatic -H), 7.1578-7.1467(t, 3H, Aromatic -H), 2.0130(s, 3H, -Ar-CH_3): Mass (ESI-MS): m/z 362.06(M), 363.12(M + 1, 100%), 364.34(M + 2, 30%).

(E)-N-(benzo[d]thiazol-2-yl)-1-(4-methoxyphenyl)-2-phenylethan-1-imine (3d): White colour powder, molecular weight 358.11 g mol^{-1}, solubility-ethanol, methanol and DMSO, melting point 181-183^{o}C, percentage yield 86%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.76cm: IR (ν cm−1); 3097(C-H *Str,* Aromatic), 2987, 2833, 2749(C-H *Str* in aliphatic), 2379(C-S-C *Str* in thiazole), 1650(-C=N, *Str in* immine group), 1564(-C=N,

Str in rings), 1278(C=C, *Str* in Aromatic ring): ^{1}H-NMR (DMSO) δ ppm; 9.6076(s,2H, Benzyl –CH_2), 7.9636-7.9423(d, 2H, Aromatic H), 7.9330-7.9009(d, 2H, Aromatic -H), 7.8749-7.8574(d, 2H, Aromatic -H), 7.7919-7.7413(d, 2H, Aromatic -H), 7.6609-7.6420(t, 2H, Aromatic -H), 7.5719-7.4856(t, 3H, Aromatic -H), 3.6327(s, 3H, -Ar-OCH_3): Mass (ESI-MS); m/z 358.11(M), 359.09(M + 1, 100%).

(E)-N-(benzo[d]thiazol-2-yl)-1-(4-nitrophenyl)-2-phenylethan-1-imine (3e): Yellow color solid, molecular weight 373.09 g mol^{-1}, solubility-ethanol, methanol and DMSO, melting point 212-214^{o}C, percentage yield 83%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.74cm: IR (ν cm−1); 3103(C-H *Str*, Aromatic), 2954, 2887. 2783(C-H *Str* in aliphatic), 2354(C-S-C *Str* in thiazole), 1632(-C=N, *Str in* –NO_2 group), 1623(-C=N, *Str in* immine group), 1465(-C=N, *Str* in rings), 1233(C=C, *Str* in Aromatic ring): ^{1}H-NMR (DMSO) δ ppm; 9.8763(s, 2H, Benzyl –CH_2), 8.3422-8.2321(d, 2H, Aromatic H), 8.1023-8.0231(d, 2H, Aromatic -H), 7.8743-7.8002(d, 2H, Aromatic -H), 7.5632-7.4912(d, 2H, Aromatic -H), 7.3843-7.2993(t, 2H, Aromatic -H), 7.2093-7.1093(t, 3H, Aromatic -H): Mass (ESI-MS); m/z 373.16.09(M), 374.22(M + 1, 100%).

(E)-N-(5-chlorobenzo[d]thiazol-2-yl)-1,2-diphenylethan-1-imine (3f): Green colour powdered, molecular weight 362.06 g mol^{-}, solubility-ethanol, methanol and DMSO, melting point 183-185^{o}C, percentage yield 83%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.86cm.

(E)-N-(5-chlorobenzo[d]thiazol-2-yl)-2-phenyl-1-(p-tolyl)ethan-1-imine(3g): Brown colour solid, molecular weight 376.08g mol^{-1}, solubility-ethanol, methanol and DMSO, melting point 153-156^{o}C, percentage yield 78%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.87cm.

(E)-N-(5-chlorobenzo[d]thiazol-2-yl)-1-(4-chlorophenyl)-2-phenylethan-1-imine(3h): light green colour solid, molecular weight 396.03 g mol^{-1}, solubility-ethanol, methanol and DMSO, melting point 203-205^{o}C, percentage yield 76%, TLC solvent system ethyl acetate: n-hexane(2:8), R_f value 0.81cm,

Antibacterial Activity

The antibacterial activity of the synthesized novel Benzothiazole compounds (3a-3h) was studied by cup plate method. The standard drug used was Streptomycin. Antibacterial activity

among the test compounds is presented in Table3. All the test compounds **[3a-3h]** showed a varied degree of antibacterial activity with broad spectrum of activity against the entire Gram negative and Gram positive bacterial strains employed. However, among this series of compounds **3b, 3e** and **3f** showed high activity, whereas the test compounds **3c, 3e** and **3g** exhibited moderate activity.

Table 4: Antibacterial activity of novel Benzothiazole derivatives(3a-3h) by zone of inhibition (in mm).

Compound	Zone of Inhibition (in mm)			
	B. substillus	St. aureus	E. coli	Salmonella paratyphi
Streptomycin	32	32	34	33
3a	12	09	13	15
3b	29	26	27	26
3c	26	25	24	28
3d	12	09	18	12
3e	27	30	13	28
3f	24	26	13	19
3g	14	09	15	09
3h	27	15	29	28

All values are expressed as Zone of Inhibition in mm, Bore size = 6mm; *Compounds showed maximum activity against respective bacteria; Zone size 9-11 = Poor activity; Zone size 12-18 = Moderate activity, Concentration of test compounds is 100µg/ml.

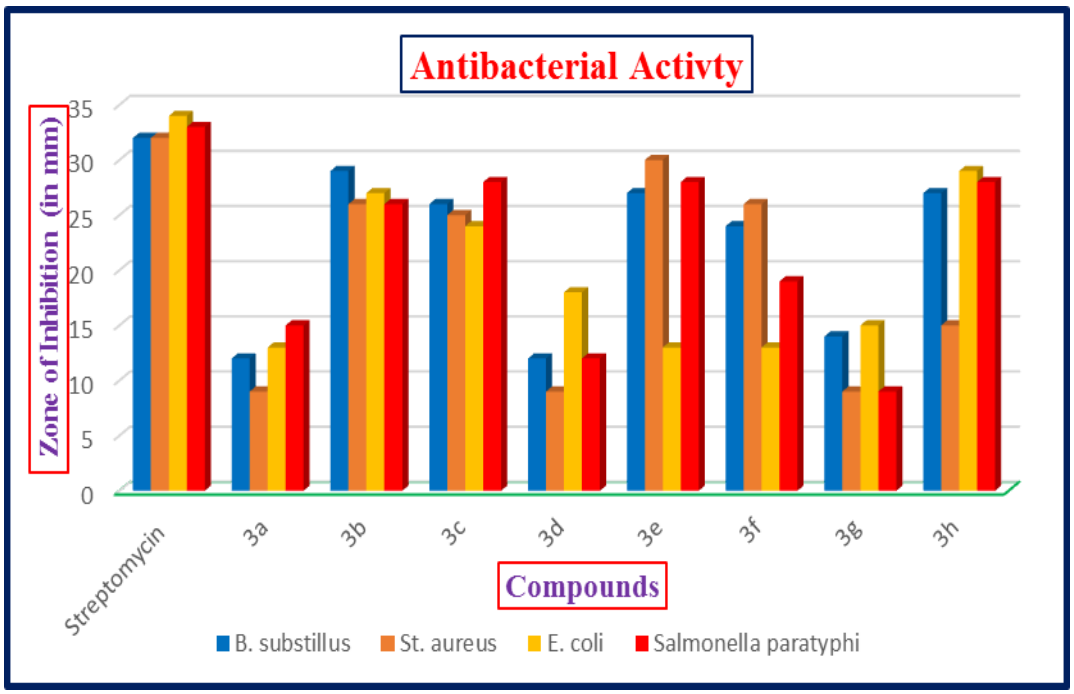


Fig. 1: Graphical representation of antibacterial activity of Novel Benzothiazole derivatives (3a-3h) – Zone of Inhibition(mm).

Anthelmintic activity

The synthesized novel Benzothiazole derivatives **(Scheme-I, 3a-3h)** are screened for anthelmintic activity by using Earth worms. One Earthworm is placed in standard drug solution and test compound's solutions at room temperature. Normal saline used as control. The standard drug and test compounds were dissolved in minimum quantity of dimethyl sulfoxide (DMSO) and adjusted the volume up to 10 ml with normal saline solution to get the concentration of 0.1% w/v, 0.2 % w/v and 0.5% w/v. Albendazole was used as a standard drug.

The compounds were evaluated by the time taken for complete paralysis and death of earthworms. The mean lethal time for each test compound was recorded and compared with standard drug. The time taken by worms to become motionless was noted as paralysis time. To certain the death of the motionless worms was frequently applied with external stimuli, which stimulate and induce movement in the worms, if alive. The mean lethal time and paralysis time of the earthworms for different test compounds and standard drug are Albendazole (Table No.**5**).

Table 5: Anthelmintic activity of Novel Benzothiazole derivatives [3a-3h].

S.No.	Compound	Time in minutes					
		For paralysis % Concentration			For death % Concentration		
	Concentration	0.1	0.2	0.5	0.1	0.2	0.5
	Control	-	-	-	-	-	-
	Albendazole	16	13	10	42	31	23
1	3a	**18**	**16**	**12**	**44**	**35**	**28**
2	3b	33	30	21	62	48	38
3	3c	**19**	**17**	**13**	**45**	**36**	**26**
4	3d	31	28	23	61	54	44
5	3e	32	26	22	57	48	37
6	3f	**20**	**19**	**15**	**46**	**39**	**29**
7	3g	**17**	**15**	**13**	**43**	**33**	**26**
8	3h	27	24	20	56	44	36

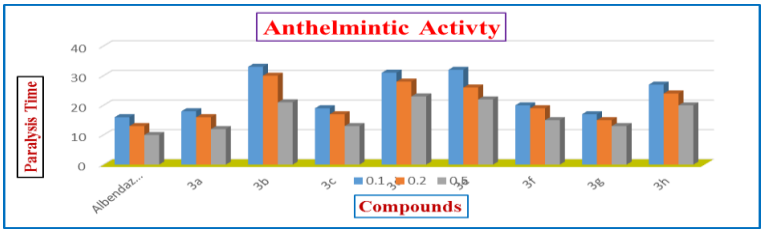


Fig.19: Graphical representation of anthelmintic activity of Novel Benzothiazole derivatives (3a-3h) –Paralysis time.

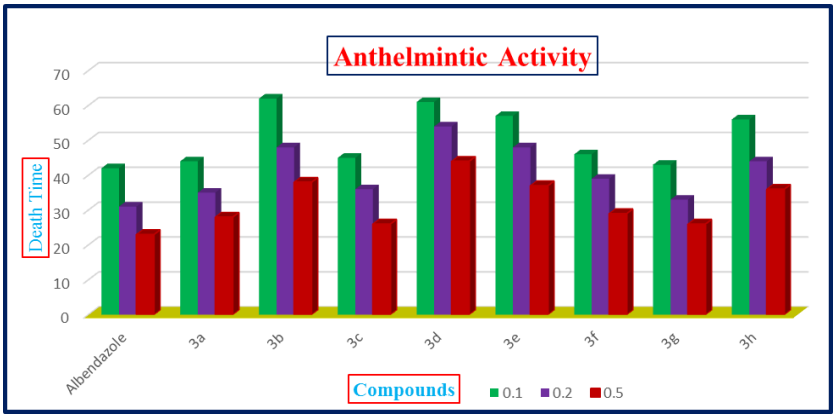


Fig. 2: Graphical representation of anthelmintic activity of Novel Benzothiazole derivatives (3a-3h) –Death time.

DISCUSSION

The characterization data of all Benzothiazole compounds **(3a-3h)** are given the experimental section and and synthesized by Cyclisation reaction to give 2-amino benzothiazole, then followed by Schiff's bases mechanism and Electrophilic substitution reaction with Benzyl chloride to form title of compounds. All the synthesized compounds gave satisfactory analysis for the proposed structures, which were confirmed on the basis of their elemental analysis by FT-IR, LC-MASS, ^{1}H-NMR data. The present work which involve reaction between substituted benzaldehyde, 2-amino Benzothiazole and Benzyl chloride in ethanol to get title of the compounds (3a-3h). The structures of all the newly synthesized compounds were characterized as **3a-3h** on the basis of satisfactory analytical and spectral data including IR, LC-MASS and ^{1}H-NMR data.

Among the all synthesized Novel Benzothiazole (3a-3h) molecules were screened for their Antibacterial and Anthelmintic activities by using slandered protocol against various gram positive and gram negative bacterial *Bacillus substillus*, *Staphylococcus aureus* gram-negative *Escherichia coli*, *Salmonella paratyphi* strains by measuring zone of inhibition by agar diffusion method. Streptomycin was used as a standard drug. Most of the synthesized compounds like **3b, 3c, 3e,3f** and **3g** have shown highest activity compare with Streptomycin as standard drug.

The synthesized compounds (**3a–3h, Scheme-I**) are screened for anthelminthic activity by using earth worms. Six earth worms of nearly equal size were placed in standard drug solution and test compound solutions at room temperature. Normal saline used as control. The standard drug and test compounds were dissolved in minimum quantity of dimethyl

sulfoxide (DMSO) and adjusted the volume up to 10 ml with normal saline solution to get the concentration of 0.1% w/v, 0.2 % w/v and 0.5% w/v. Albendazole was used as a standard drug. The compounds were evaluated by the time taken for complete paralysis and death of earthworms. The mean lethal time for each test compound was recorded and compared with standard drug. The time taken by worms to become motionless was noted as paralysis time. To ascertain the death of the motionless worms they were frequently applied with external stimuli, which stimulate and induce movement in the worms, if alive. The mean lethal time and paralysis time of the earthworms for different test compounds and standard drug was given in table. Among the synthesized (3a–3h, Scheme-I) compounds 3a, 3c, 3f and 3g showed good anthelmintic activities whereas others showed significant activities. The synthesized compounds in overall estimation confirm the better activity against peritima posthuma.

CONCLUSION

Benzothiazole is one of the heterocyclic compounds. These compounds possess versatile type of biological activities; they have anti-bacterial, anthelmintics, anticancer, antiviral activities.

A series of, (E)-N-(benzo[d]thiazol-2-yl)-1-(4-methoxyphenyl)-2-phenylethan-1-imine with benzyl chloride as cycling agent in the presence of DMF.

The yield of all synthesized compound was found to be in the range of 75-86%

The structure of newly synthesized compound were confirmed and characterized by physical data like color, Molecular weight, solubility, melting point, TLC, Rf value and analytical data such as IR,^{1}H NMR and mass spectra.

From the antimicrobial studies, the data revealed that all the synthesized compounds proved to have antibacterial activity against Gram (+ve) organisms like *bacillus substillus, staphylococcus aureus* and gram (-ve) organism like *Escherichia coli, salmonella paratyphi* .and also screened for anthelmintic activity against Indian earthworm *Peritima posthuma.*

After comparing results of compound from 3a-3h.It was concluded that compounds like **3b,3e,3f,&3g** have shown good antibacterial activity compared with streptomycin (standard drug) and Compounds **3a,3c,3f&3g** showed good anthelmintic activity compared with Albendazole (standard drug).

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