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RESEARCH ARTICLE

SYNTHESIS AND EVALUATION OF NOVEL COUMARINYL THIAZOLE AZODYES AS ANTI-BACTERIAL AND ANALGESIC

[*]Bono. Naga sudha[1] and vedula. Girija sastry[2].

1. Department of Pharmaceutical Chemistry, CES College of Pharmacy, Kurnool 518218, Andhra Pradesh, india.
2. Department of Pharmaceutical sciences, Andhra University, Visakhapatnam 530003, Andhra Pradesh, india.

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Corresponding Author

Bono. Naga sudha.

Abstract

Coumarin ring has an easy accessibility in the biological systems and has varied useful medicinal properties. Among the wide range of 5-membered heterocycles explored to develop pharmaceutically important molecules, thiazoles have played a pivotal role in medicinal chemistry. Azo compounds play a prominent role in almost every type of application. Keeping this importance in view, in the present work, novel azo compounds of 3-(2-Amino-1,3-thiazole-4-yl)-2H-chromen-2-one and phenols & anilines (4a-4h) were synthesized by multistep procedure which involved the formation of 3-Acetyl coumarin(1) by Knoevenagel condensation, its bromination and then cyclization using thiourea and sodium acetate resulting in 3-(2-Amino-1,3-thiazole-4-yl)-2H-chromen-2-one(3). This was then diazotized and coupled with various phenols & anilines to yield the targeted diazocompounds (4a-4h). Finally they were evaluated for their analgesic and antimicrobial potency.

Introduction:-

The coumarin (benzopyran-2-one, or chromen-2-one) ring system, present in natural products (such as the anticoagulant warfarin) that display interesting pharmacological properties, has intrigued medicinal chemists for decades to explore the natural coumarins or synthetic analogs for their applicability as drugs. Coumarins have attracted interest for a long time due to their multi biological activities such as antitumor[1], anti-HIV therapy[2], and as stimulants for central nervous system, antibacterial[3], anti-inflammatory[4], anti-coagulant[5],antioxidant[6], anticonvulsant[7], antifungal[8], anti hypertensive, anti arrhythmia, anti osteoporosis, assuaging pain, preventing asthma and antisepsis[9]. Besides the wide spectrum biological applications of coumarin and its derivatives, the chemical literature also embodies some of their applications from the material view point such as cosmetics [10], fragrances[11], optical brightening agents and laser dyes[12].

2-Aminothiazole derivatives are widely used as pharmaceuticals. For example, Talipexole and Pramipexole act as anti-Parkinsonian drugs were as Tigemonam is an anti-bacterial drug and Amthamine is an antihistaminic one. It is known that heterocyclic compounds with free amino groups may exhibit teratogenic and mutagenic properties because of their ability to form noncovalent complexes with DNA[13]. So derivatives of this moiety are planned to be synthesized in which free amino group is modified.

Azo compounds play a prominent part in almost every type of application. Azo compounds are the most important class of synthetic coloring materials. The Sudan series of azo dyes, typified by Sudan I, are commonly used as microbial stains[14].

The present work describes the synthesis of some new Coumarinyl Thiazole Azodyes. Their antimicrobial and analgesic activities were recorded. Synthesized compounds were characterized on the basis of their spectral data.

Chemistry:-

Combining two or more heterocyclic nuclei may facilitate the augmentation of biological activity in comparison to their individual potential. Similarly the incorporation of other heterocyclic moiety either as substituent group or as a fused component into parent coumarin alters the property of parent coumarin and converts it into a more useful product. Thiazole, one of the most intensively investigated class of aromatic five membered heterocycles due to their wide range of applications is considered to be a good choice as a substitute on the coumarin ring as both possess analgesic and antimicrobial potency which can be further enhanced by combining them.

Materials and methods:-

Melting points were taken in open capillary tubes using arson Digital melting point apparatus and are uncorrected. ^{1}H NMR spectra were recorded using BRUKER AV III, 500MHz. FT-NMR Spectrometer, SAIF, IIT Chennai. IR spectra were recorded on Bruker Alpha FTIR Spectrometer with a universal sampling model using KBr pellets.TLC was carried out using precoated Silica gel plates. All the chemicals and solvents used were of LR grade and obtained from SD fine Chem. Limited.

Synthesis of 3-Acetyl-2H-chromen-2-one (1):-

A mixture of salicylaldehyde (10.4ml, 0.1mol) in ethylacetoacetate (12.6ml, 0.1 mol) was treated with piperidine (2ml, 0.02 mol) and stirred for 30min, at room temperature. Then it was acidified with 20% HCl to neutral. The precipitated compound was filtered, washed with small portions of cold water and dried. The product was purified by recrystallization from ethanol.

Synthesis of 3-(Bromoacetyl)-2H-chromen-2-one (2):-

To a solution of compound 1 (0.005 mol) in 20ml of alcohol free chloroform, 0.75ml of 10M bromine in chloroform solution was added with intermittent shaking. The mixture was warmed to decompose an addition product. The mixture was then heated for 15min, cooled and filtered to get a solid mass which on washing with diethyl ether gave the desired product. It was recrystallized from acetic acid to give colorless needles.

Synthesis of 3-(2-Amino-1,3-thiazol-4-yl)-2H-chromen-2-one (3):-

A suspension of compound 2 (0.004 mol) in 20ml of hot ethanol was heated with thiourea (0.004 mol), giving a clear solution that soon deposited crystals. They were filtered, washed with ethanol and then boiled with water containing sodium acetate yielding the target compound. The product obtained was recrystallized from ethanol.

Diazotization & Coupling of 3-(2-Amino-1,3-thiazol-4-yl)-2H-chromen-2-one (4a-4h):-

0.001 mol of compound 3 were dissolved in suitable volume of water containing 1ml of concentrated HCl and cooled in ice to 0-5˚C. Then an aqueous solution of sodium nitrate (84mg) was added portion wise while stirring, taking care that temperature does not rise above 5˚C. To this diazotized solution, was added 0.001 mol of respective phenol (for 4a-4d,4h) in 1ml of 10% NaOH solution or 0.001 mol anilines in aq. Sodium acetate (for 4e-4g) while stirring vigorously and left in ice bath for 15min. The product formed was filtered and recrystallized from suitable solvent.

4a: 3-{2-[(4-hydroxyphenyl)diazenyl]-1,3-thiazol-4-yl}-2H-chromen-2-one:-

IR (KBr) (cm-^{1}): 3319.20(O-H Str), 3142.89, 2917.24, 2848.89 (C-H Ar Str) 1719.12 (C=O str), 1606.25, 1563.36 (ring Stretch),1333.12 (C-N aryl str); **^{1}H NMR (DMSO), δ ppm:** 5.20-5.38 (1H, s), 7.31-7.80 (4H, m), 7.92-8.22 (4H, m), 8.28-8.39 (1H, s), 8.74-8.84 (1H, s); **GC-MS (m/z,%)** : 346 (M+); Anal. Calcd for $C_{18}H_{11}N_3O_3S$: C, 61.88; H, 3.17; N, 12.03; O, 13.74; S, 9.18. Found: C, 62.06; H, 3.20; N, 12.14; O, 13.24; S, 9.22.

4b: 3-{2-[(2,4-dihydroxyphenyl)diazenyl]-1,3-thiazol-4-yl}-2H-chromen-2-one:-

IR (KBr) (cm-^{1}): 3286.02 (O-H Str), 3064.16,2917.54,2849.03 (C-H Ar Str) , 1722.12 (C=O str), 1561.38 (ring Stretch), 858.04 (C-H def, Para), 754.44 (C-C def, Ortho), 690.31 (C-H def,Meta); **^{1}H NMR (DMSO), δ ppm:** 5.25-5.78 (1H, s), 6.20-6.76 (2H, m), 7.19-7.28 (1H, s), 7.33-7.54 (3H, m), 7.55-7.69 (1H, m), 7.77-7.90 (1H, s), 8.42-8.56 (1H, s); Anal. Calcd for $C_{18}H_{11}N_3O_4S$: C, 59.17; H, 3.03; N, 11.50; O, 17.52; S, 8.78. Found: C, 60.06; H, 3.20; N, 12.09; O, 17.24; S, 9.22.

4c: 3-{2-[(2-hydroxynaphthalen-1-yl)diazenyl]-1,3-thiazol-4-yl}- 2H-chromen-2-one:-
IR (KBr) (cm-^{1}): 3283.54 (O-H Str), 1710.72 (C=O str), 1602.04 (ring Stretch), 1511.65 (C=C), 1215.08 (C=C-O-C, C-O str), 742.76 (C-C def, Ortho); **^{1}H NMR (DMSO), δ ppm:** 4.73-5.13 (1H, s), 6.22-6.57 (2H, m), 6.94-7.19 (2H, m), 7.21-7.43 (2H, m), 7.51-7.87 (4H, m), 7.80-7.89 (1H, s), 8.49-8.82 (1H, s); Anal. Calcd for $C_{22}H_{13}N_3O_3S$: C, 66.15; H, 3.28; N, 10.52; O, 12.02; S, 8.03. Found: C, 66.06; H, 3.23; N, 10.09; O, 12.21; S, 8.14.

4d: 3-{2-[(4-hydroxynaphthalen-1-yl)diazenyl]-1,3-thiazol-4-yl}-2H-chromen-2-one:-
IR (KBr) (cm-^{1}): 3090.28 (O-H Str),1720.65 (C=O str), 1607.11(ring Stretch), 1382.98 (C-N aryl str); Anal. Calcd for $C_{22}H_{13}N_3O_3S$: C, 66.15; H, 3.28; N, 10.52; O, 12.02; S, 8.03. Found: C, 66.13; H, 3.25; N, 10.49; O, 12.12; S, 8.10.

4e: 3-{2-[morpholin-4-yldiazenyl]-1,3-thiazol-4-yl}-2H-chromen-2-one:-
IR (KBr) (cm-^{1}): 2917.45, 2848.97(C-H Ar str),1722.01 (C=O str), 1649.70 (C=N) , 1382.96 (C-N aryl str), 1119.88,1098.79 (C-N alkyl str), 754.39 (CH_2 ben); **^{1}H NMR (DMSO), δ ppm:** 3.10-3.40 (4H, t), 3.52-3.73 (4H, t), 6.61-7.21 (2H, m), 7.36-8.12 (2H, m), 8.51-8.65 (1H, s), 8.80-9.18 (1H, s); Anal. Calcd for $C_{16}H_{14}N_4O_3S$: C, 56.13; H, 4.12; N, 16.36; O, 14.02; S, 9.37. Found: C, 56.10; H, 4.12; N, 16.28; O, 14.11; S, 9.29.

4f: 3-{2-(3-phenyltriaz-1-en-1-yl)-1,3-thiazol-4-yl}-2H-chromen-2-one:-
IR (KBr) (cm-^{1}): 3372.90 (N-H Str),1720.37 (C=O str), 1452.72 (C=C Ar), 1270.47(C=C-O-C, C-O str), 1085.34(C-N), 848.86(C-H def, para); **^{1}H NMR (DMSO), δ ppm:** 4.24-4.38 (1H, s), 7.23-7.29 (1H, m), 7.35-7.54 (4H, m), 7.59-7.70 (1H, m), 7.71-7.80 (2H, m), 7.81-7.87 (1H, m) 8.08-8.12 (1H, s), 8.21-8.28 (1H, s); Anal. Calcd for $C_{18}H_{12}N_4O2S$: C, 62.06; H, 3.47; N, 16.08; O, 9.19; S, 9.20. Found: C, 61.12; H, 3.42; N, 16.20; O, 9.14; S, 9.26.

4g:3-{2-[(4-((2-aminoethyl)amino)naphthalene-1-yl)diazenyl]-1,3-thiazol-4-yl}-2H-chromen-2-one:-
IR (KBr) (cm-^{1}): 3383.50, 3317.50, 3154.16 (N-H Str),1720.54(C=O str), 1697.85 (C=N), 1605.84 (C=C Ar); **^{1}H NMR (DMSO), δ ppm:** 2.86-2.98 (2H, t), 3.04-3.10 (2H, t), 4.98-5.14 (2H, t), 6.65-6.73 (1H, m), 6.98-7.10 (1H, m), 7.22-7.29 (2H, m) 7.69-7.77 (2H, m), 7.78-7.89 (4H, m), 7.99-8.32 (1H, s), 8.33-8.41 (1H, s); Anal. Calcd for $C_{24}H_{19}N_5O_2S$: C, 65.29; H, 4.34; N, 15.86; O, 7.25; S, 7.26. Found: C, 65.25; H, 4.30; N, 15.82; O, 7.22; S, 7.18.

4h: 2-hydroxy-5-{[4-(2-oxo-2H-chromen-3-yl)-1,3-thiazol-2-yl] diazenyl}Benzaldehyde:-
IR (KBr) (cm-^{1}): 3384.99 (O-H Str), 1719.25(C=O str), 1639.01 (C=N), 1606.64 (C=C Ar). 755.21 (C-H def, meta); **^{1}H NMR (DMSO), δ ppm:** 2.83-2.94 (1H, s), 6.55-7.70 (3H, m), 7.13-7.33 (4H, m), 7.80-8.08 (1H, s), 8.10-8.24 (1H, s), 10.82-11.01 (1H, s); Anal. Calcd for $C_{19}H_{11}N_3O_4S$: C, 60.47; H, 2.94; N, 11.13; O, 16.96; S, 8.50. Found: C, 60.35; H, 2.90; N, 11.11; O, 16.82; S, 8.42.

Pharmacology:-

Antibacterial studies:-

The synthesized Coumarinyl thiazole azodyes (4a-4h) were tested for their antimicrobial activity using four types of bacteria- E. coli, P. aerugenosa, B. subtili, S. aureus (obtained from Padmachandra Hospitals, KNL). Cup plate method was employed in the present study[15]. The nutrient agar medium was used as a culture medium to provide the required nutrients and facilitate the growth of the micro-organisms. The sterilized agar medium was inoculated with the suspension of micro organism (procured from Padmachandra Hospitals) at a temperature between 40-50^{o}C and was immediately poured into the Petri plates and allowed to solidify. Then holes of 6 mm in diameter were bored with the medium with a sterile borer. The holes were then filled with a specified concentration solution of synthesized compounds and standard. Then the plates were incubated at 37^{o}C for 48hrs. Ciprofloxacin was used as a standard drug. Inhibition zones were measured and compared with the standard. The bacterial zones of inhibition values are given in Table 2.

Analgesic activity:-

Swiss albino mice (25 to 30 gm) of either sex were obtained from the Sreenivasa enterprise, Bangalore. Animal ethics committee approval was obtained from institutional ethical committee (Registration number: 1305/ac/09/CPCSEA). The animals were maintained under environmental condition and had free access to standard diet and fresh water ad libitum. They were housed in animal cages at room temperature (30±2^{o}C) and 60-65% relative humidity. The animals were allowed to acclimatize to the environment for 7 days prior to the experimental session. The animal was devoid of water and food 12 hours before the administration of treatment. The animals were divided into ten groups, each consisting of six animals was fasted overnight prior to the experiments. Eight groups

were for single dose strengths (100 mg/kg) of the test drug, while one each for standard (imipramine and diclofenac sodium 10 mg/1Kg) drug and control (Tween 80 0.1ml/10Kg) respectively.

Tail immersion method:-

The tail immersion method was used to evaluate the central mechanism of analgesic activity[16,17]. Here the painful reactions in animals were produced by a thermal stimulus that is by dipping the tip of the tail in hot water. Albino mice were divided into ten groups of six animals each. The animals were fasted for 16 hours with water adlibitum. The group-1 was serving as a solvent control which received the vehicle Tween 80 (0.1ml/10Kg) through the oral route, the group-2 was serving as a reference control which received imipramine (10mg/1Kg) and group-3 to 10 were received in a dose of 100 mg/Kg of test compounds. After administration of above drug, the basal reaction time was measured after a regular interval of 30 minutes, by immersing the tail tips of the mice (Last 2-4 cm) in hot water heated at a temperature of temperature (55 ± 1) °C. The actual flick responses of mice, i.e. time taken in second to withdraw it are from the hot water source was calculated .The results are presented in Table 3.

Acetic acid induced writhing response method:-

The compounds were selected for investigating their analgesic activity in acetic acid induced writhing response in Swiss albino mice, following the method of Collier et al.[18]. Sixty mice were divided into 10 groups (six in each group) starved for 16 h pretreated as follows, the 1st group which served as control positive orally received distilled water in appropriate volumes. The 2nd to 9th groups received the aqueous suspension of synthesized compounds orally at a dose of 100 mg/kg. The last group orally received diclofenac sodium in a dose of 10 mg/kg. After 30 min, each mouse was administrated 0.6% of an aqueous solution of acetic acid (10 mL/kg) and the mice were then placed in transparent boxes for observation. The number of writhes was counted for 20 min after acetic acid injection. The number of writhing was recorded and the percentage protection was calculated. The observations are tabulated as Table 4.

Statistical analysis:-

All the results are expressed as mean ± standard error of mean (SEM). The data were analyzed for statistical significance by one-way analysis of variance (ANOVA) followed by Dunnett's test using Graph Pad Prism, version 6.Values of $p< 0.01$ and $p<0.001$ were considered statistically significant.

Results and discussion:-

A series of coumarinyl azo dyes were synthesized by coupling of diazonium salt of 3-(2-Amino-1,3-thioazol-4-yl)-2H-Chromin-2-one with eight different phenol & anilines derivatives in presence of sodium acetate (Scheme). Diazotisation was carried out in presences of nitrosyl hydrochloric acid. 2-Amino thiazole and its derivatives were synthesized by Hanztsch reactions, in which the reaction proceeds between α-halo carbonyl compounds and thiourea or thioamides. The coupling reactions involved that initially generate strong N_2^+ electrophiles from heteroarylamine then finally react and coupled with different phenol & anilines derivatives to produce coumarinyl azo dyes. The aryl substitution at C-3 of coumarin is very essential for exhibiting broad biological activity. In sertion of aryl/heteroaryl azo in C-3 of coumarin has been reported good antimicrobial and analgesic activities[19,20].

The starting material 3-Acetocoumarin (1) was prepared by the Knoevenagel condensation of salicylaldehyde and catalyzed by piperazine was added ethylacetoacetate as previously reported[21]. Bromination of the compound 1 and cyclization of the brominated product using thiourea and sodium acetate yielded 3-(2-Amino-1,3-thioazol-4-yl)-2H-Chromin-2-one(3). Diazotization and coupling of the free amino group in compound 3 with different phenol & anilines resulted in the formation of coumarinyl thiazole azodye derivatives (4a-4h) with the yields in the range of 30-80%. The compound 4b was obtained in the highest yield (83.74%). The physical data of all prepared compounds were mentioned in Table-1. The structures of prepared compounds have been confirmed by FTIR, ^{1}HNMR and elemental analysis. The structure of diazo compounds can be confirmed from the IR and NMR spectra. All the phenolic azodyes exhibited a broad peak around 3200-3300 cm^{-1} in the IR spectrum indicating –OH group, whereas the amino group of aniline azodyes exhibited considerably sharp peaks in comparison to –OH group. The coumarin protons show the signals at δ values 6.20-6.76, 7.1-7.90, 8.26-8.40 in NMR spectra.

Antibacterial studies:-

The newly prepared compounds were screened for their antibacterial activity against Staphylococcus aureu, Bacillus subtilis, Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa bacterial strains by the cup-plate

method. Compounds 4b, 4g and 4f exhibited good antibacterial activity against all tested bacterial strains. Compounds 4a, 4e and 4c showed moderate to good activity.

Analgesic activity:-

Coumarinyl Thiazole Azodyes series were evaluated for analgesic activity by tail immersion and acetic acid induced writing methods. All compounds possess significant analgesic activity. From all compounds, 4b, 4d, 4f and 4g having a resorcinol, α-naphthol, aniline and naphthylethylene diamine were found to be more potent in both the methods which is comparable to standard. The presence of electron donating groups (-OH, $-NH_2$) in the compounds may be responsible for enhanced biological activities.

Table 1: Characterization data for synthesized azodye derivatives (4a-4h)

Compound	Molecular Formula	Molecular Weight	Yield [b](%)	Melting Point(^oC)
4a	$C_{18}H_{11}N_3O_3S$	353[a]	58.31	120-128
4b	$C_{18}H_{11}N_3O_4S$	365	83.74	210-215
4c	$C_{22}H_{13}N_3O_3S$	399	68.02	78-80
4d	$C_{22}H_{13}N_3O_3S$	399	54.42	70-72
4e	$C_{16}H_{14}N_4O_3S$	342	37.20	138-140
4f	$C_{18}H_{12}N_4O_2S$	352	51.34	194-200
4g	$C_{24}H_{19}N_5O_2S$	441	32.3	178-180
4h	$C_{19}H_{11}N_3O_4S$	377	46.82	312-315

[a] Mass Spectrum of 4a exhibited the molecular ion peak at 353.
[b] Yield of crude product.

Table 2: Antibacterial activity of Coumarinyl thiazole azodyes (4a-h) against bacterial species tested by cup plate method.

Compound code	Zone of inhibition (Mean±SD)							
	S. aureus		B. subtili		E. coli		P. aerugenosa	
	50 µl	100 µl	50 µl	100 µl	50 µl	100 µl	50 µl	100 µl
4a	15.67±1.00	16.67±1.52	–	6.667±1.52	14.00±1.00	18.33±1.15	15.00±1.00	19.00±1.00
4b	16.33±0.57	18.33±1.15	19.00±1.00	22.00±1.00	17.33±0.57	19.33±0.57	11.67±1.15	17.33±0.57
4c	–	–	14.67±1.52	19.33±0.57	12.67±1.52	13.67±1.52	12.33±0.57	14.67±1.15
4d	12.33±1.52	14.67±1.15	–	–	–	–	14.67±1.15	18.33±1.15
4e	10.33±1.52	13.33±1.52	–	–	14.33±1.00	17.33±0.57	15.67±1.00	18.33±1.15
4f	8.00±2.00	10.00±1.73	12.67±1.52	16.33±1.52	16.67±1.52	18.33±1.15	14.33±0.57	16.33±0.57
4g	16.67±1.52	17.33±0.57	19.00±1.00	20.00±1.00	16.33±0.57	19.33±0.57	16.67±0.57	19.33±0.57
4h	13.67±1.52	15.33±1.15	8.667±1.52	13.67±1.15	–	–	7.66±1.52	12.33±0.57
Control	–	–	–	–	–	–	–	–
Standard	17.67±0.57	19.33±0.57	21.67±0.57	23.67±0.57	19.00±1.00	21.67±0.57	17.67±0.57	20.67±0.57

Values are mean inhibition zone(mm)±SD of three replicates

−Indicate absence of Zone of Inhibition.

Ciprofloxacin: negative control

DMSO: Positive control

Table 3: Analgesic activity by tail immersion method in mice (4a-h)

Compoud tested	Tail Flick Latency in minutes mean ± SEM						
	0	30	60	90	120	150	180
Control	5.02±0.30	4.98±0.46	4.61±0.43	4.58±0.36	5.01±0.53	4.92±0.81	4.39±0.49
Standard	4.63±0.83	5.81±0.92	8.39±1.81	12.68±1.1*	15.31±1.53**	15.19±1.44**	14.01±1.81**
4a	4.51±0.83	4.81±0.39	7.08±0.54	9.39±0.79*	12.14±1.14*	13.09±0.93**	12.83±1.93*
4b	5.13±0.51	6.04±0.61	8.32±0.93	9.81±1.32*	13.93±1.53**	13.91±1.69**	12.36±1.68*
4c	5.11±0.52	5.45±0.41	7.62±0.63	8.32±0.74	10.68±2.01*	10.93±1.56*	11.08±1.29*
4d	4.96±0.49	5.59±0.59	8.86±0.74	10.34±1.2*	13.86±1.80**	13.93±1.39**	12.73±1.92*
4e	5.28±0.53	5.93±0.69	6.17±1.32	7.32±1.11	9.13±1.96*	9.98±1.18*	8.39±1.13
4f	4.84±0.46	5.96±0.91	6.92±0.83	7.85±0.93	8.36±0.98	9.83±0.96*	10.31±1.32*
4g	5.45±1.01	5.65±0.56	6.24±0.54	6.98±0.86	8.01±1.46	8.98±0.93*	9.01±1.19*
4h	4.79±0.39	5.01±0.73	5.92±0.95	6.84±1.01	7.68±1.13	8.43±1.57	8.98±1.83*

Results are expressed as Mean ± SEM, relative to their respective standard and data were analyzed by Oneway ANOVA followed by Dunnett's test for (n=6); *$p < 0.05$, **$p < 0.01$.

Table 4: Analgesic activity by Acetic acid induced Writhing in mice (4a-h)

Group	Treatment	No. of writhes in 30 min mean±SEM	Inhibition (%)
I	Control	30.3±5.36	0
II	Standard	10.4±3.15***	65.67
III	4a	19.3±6.32	36.3
IV	4b	10.89±2.71***	64.05
V	4c	12.3±4.13**	54.05
VI	4d	18.9±4.37	37.62
VII	4e	15.7±7.32**	48.18
VII	4f	11.5±3.89***	62.04
IX	4g	17.1±6.42*	43.56
X	4h	21.5±5.17	29.04

Results are expressed as Mean ± SEM, relative to their respective standard and data were analyzed by Oneway ANOVA followed by Dunnett's test for (n=6); *p < 0.05, **p < 0.01, ***p<0,001.

Conclusions:-

In this work, a series of Coumarinyl thiazole azodyes is prepared. The antimicrobial and analgesic activity data revealed that the compounds bearing electron donating substituent produced potent results and therefore might serve as a lead molecule to obtain more clinically useful, novel entities in the future.

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Conflict of interests:-

The authors have no conflict

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