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SYNTHESIS AND FUNGICIDAL ACTIVITY OF NEW THIAZOLE DERIVATIVES WERE PREPARED FROM 2-BROMO-1-(3,4-DIMETHYLPHENYL)ETHANONE

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Abstract

2-bromo-1-(3,4-dimethylphenyl)ethanone **(2)** was prepared and converted to thiazole derivatives **(6-11a-c, 14-20)** through reactions with different reagents. Compounds **(3, 5, 12, 13, 21)** were prepared from reaction of compound **(2)** with 2-mercapto-4,6-dimethylnicotinonitrile1H-benzo[d]imidazole-2-thiol, *p*-chloroaniline, potassium cyanide and 2-aminobenzenethiol respectively. The synthesized compounds were confirmed by elemental analysis, IR, ^{1}H-NMR and mass spectral analysis.

Keywords: 2-bromo-1-phenylethanone, thiazole, 2-aminothiazole, 2-methylthiazole, 2H-chromen-2-one, benzo[b][1,4]thiazine.

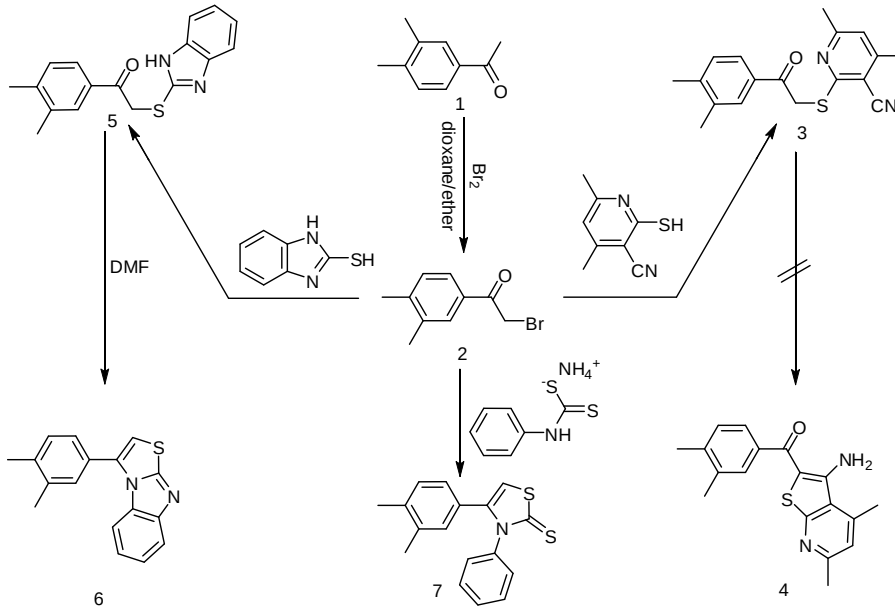
Introduction:

Thiazole derivatives have attracted a great deal of interest owing to their antibacterial,[1] antifungal,[2] antiinflammatory[3] and antiviral[4-6] activities. They are also useful as antiallergic,[7] anthelmintic[8] agents and as sedative hypnotics.[9] In addition to being used in the pharmaceutical industry, thiazoles also find a wide application in the dye[10] and photographic industry.[10] Thus, the present investigation deals with the synthesis of some new thiazole derivatives using 2-bromo-1-(3,4-dimethylphenyl)ethanone **(2)** as starting material.

Results and Discussion:

In continuation of previous work[11,12] on the utility of 2-bromo-1-phenylethanone derivatives and synthesis of some new heteroaromatic derivatives incorporating

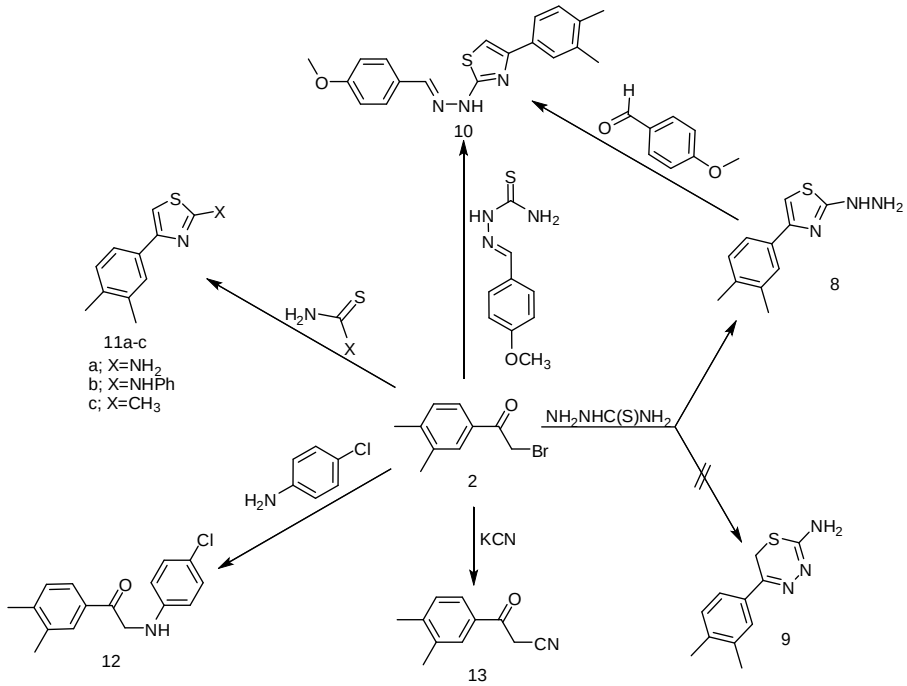
thiazole nucleus, we report here a novel synthesis of thiazole derivatives to evaluate the antimicrobial activity. 2-bromo-1-(3,4-dimethylphenyl)ethanone **(2)** was used as starting material, which prepared from bromination of 1-(3,4-dimethylphenyl)ethanone **(1)** in dioxane/ether mixture. Compound **(2)** was allowed to react with 2-mercapto-4,6-dimethylnicotinonitrile[13] in ethanol at reflux temperature to give acyclic structure **(3)**, efforts to cyclize the latter structure to produce compound **(4)** was unsuccessful, but when compound **(2)** was reacted with 1H-benzo[d]imidazole-2-thiol afforded acyclic structure **(5)**, which cyclize by boiling in dimethylformamide to produce compound **(6)**. Interaction of compound **(2)** with ammonium phenylcarbamodithioate[14] in dimethylformamide afforded 4-(3,4-dimethylphenyl)-3-phenylthiazole-2(3H)-thione **(7), (Scheme 1).**



(Scheme 1)

Compound **(2)** was subjected to react with thiosemicarbazide to afford a single product for which two isomeric structures **(8 or 9)** seemed possible. Structure **(9)** was ruled out on the basis of elemental analysis and spectral data, and structure **(8)** was firmly established by the reaction with *p*-anisaldehyde to produce a compound which identical in all respects (m.p., mixed m.p., and spectral data) with compound **(10)**, which prepared from reaction of 2-bromo-1-(3,4-dimethylphenyl)-ethanone **(2)**

with 2-(4-methoxybenzylidene)hydrazinecarbothioamide. Moreover, compound **(2)** reacts with thiocarbamide derivative namely (thiourea, phenylthiourea and thioacetamide) in boiling ethanol to give thiazole derivatives **(11a-c)** respectively. Compound **(2)** was reacted with *p*-chloroaniline and potassium cyanide in boiling ethanol to give compounds **(12, 13)** respectively, **(Scheme 2).**



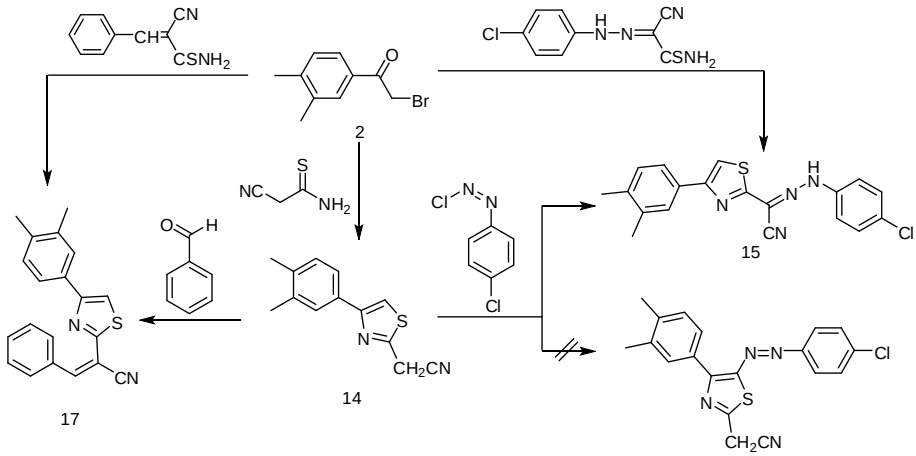
(Scheme 2)

Treatment of 2-bromo-1-(3,4-dimethylphenyl)ethanone **(2)** with cyanothioacetamide in refluxing ethanol, afforded a single product which was identified as 2-(4-(3,4-dimethylphenyl)thiazol-2-yl)acetonitrile **(14)**, The methylene group in thiazolylacetonitrile derivative **(14)** proved to be highly reactive. Thus, compound **(14)** underwent coupling with equimolar amount of 1-chloro-2-(4-chlorophenyl)diazene in ethanol solution containing sodium acetate, at (0~5 ^{o}C), to afford a colored product for which two isomeric structures **(15 or 16)** seemed possible, however the appearance of (NH) absorption band at 3100 cm^{-1}, in IR spectrum and the lack of the signal due to methylene protons, and the appearance of the singlet signals due to the H-thiazole and (NH) at 12.81 ppm., in ^{1}H-NMR

spectrum provided a firm support for structure **(15)** and ruled out the other possible isomer **(16)**.

Further conformation of the structure **(15)** was also obtained through its synthesis *via* direct reaction of **(2)** with 2-((4-chlorophenyl)diazenyl)-2-cyanoethanethioamide.

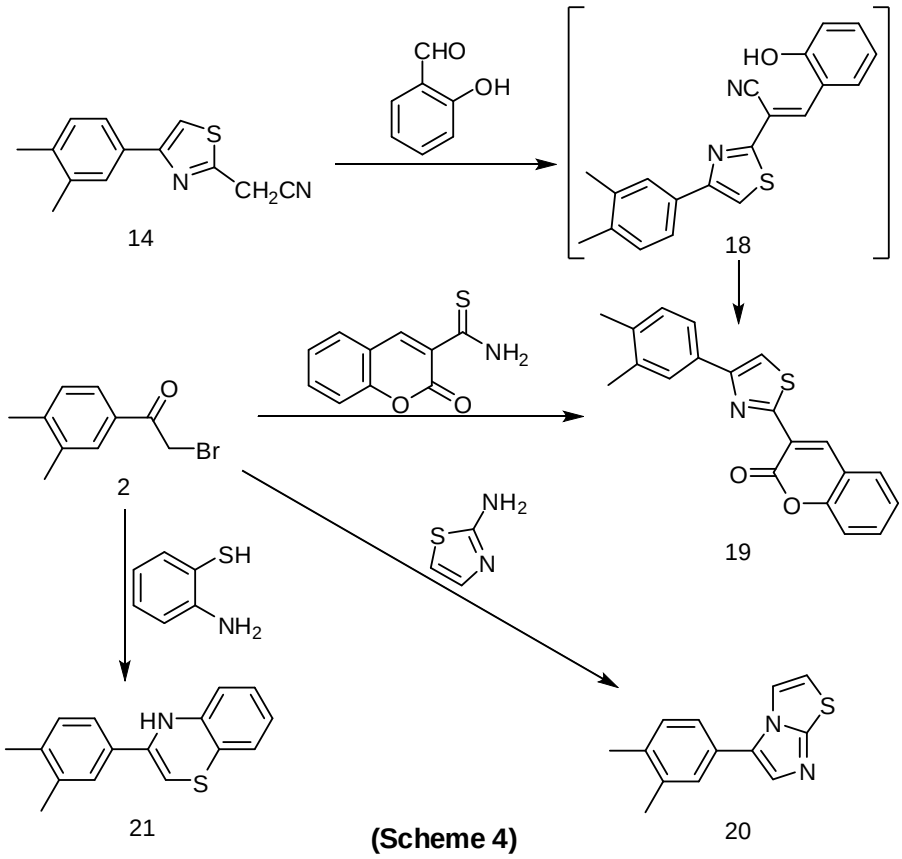
Condensation of 2-(4-(3,4-dimethylphenyl)thiazol-2-yl)acetonitrile **(14)** with benzaldehyde give the corresponding cyanobenzylvinylthiazolyl derivative **(17)**, which confirmed by spectral data and by interaction of 2-bromo-1-(3,4-dimethylphenyl)ethanone **(2)** with 2-cyano-3-phenylprop-2-enethioamide in refluxed ethanol, **(Scheme 3)**.



(Scheme 3)

Cyclocondensation of **(14)** with an equimolar amount of salicyldehyde in boiling ethanol solution containing piperidine as a catalyst, give the corresponding 3-(4-(3,4-dimethylphenyl)thiazol-2-yl)-2H-chromen-2-one **(19)**, the formation of final product was assumed to occur *via* the intermediacy of the knovenagel condensed intermediate **(18)**, intramolecular cyclization *via* an anticipated Michael-type addition of the acidic (OH) group to the (CN) function, and spontaneous hydrolysis of the imino function into a carbonyl group under the experimental reaction conditions employed,[15] a final evidence for the proposed structure comes by boiling 2-oxo-2H-chromene-3-carbothioamide[16] with compound (2) in ethanol.

Finally Interaction of compound **(2)** with 2-aminothiazole and 2-aminobenzenethiol in refluxing ethanol afforded imidazo[2,1-b]thiazole and benzo[b][1,4]thiazine derivatives **(20, 21)** respectively, **(Scheme 4).**



(Scheme 4)

Antimicrobial and Antifungal Activities:

The results of antimicrobial screening (table 3) show that compounds **(6, 7, 11a,b, 14, 19, 20)** are highly active compounds against antimicrobial activity, gram positive (B. Subtilis, S. Aureus, S. maxima), gram negative (K. Pneumonia, Salmonella, P. aeruginosa) and Antifungal activity, unicellular fungi (C. Abicans), filamentous fungi (Rhizopus, A. Fumigatus). While the compounds **(3, 10, 11c)** showed the moderate active. It seems that most activity was exhibited by derivatives with thiazole moiety, (table 3).

Experimental Section:

All melting points are uncorrected. IR spectra (KBr) were recorded on a FTIR 5300 spectrometer (ν, cm^{-1}). The NMR spectra were recorded at 300 MHz on a Varian Gemini NMR spectrometer (δ, ppm) using TMS as an internal standard. Mass spectra were obtained on GC Ms-QP 1000 EX mass spectrometer at 70 ev. Elemental analyses were carried out by the Micro analytical Research Center, Faculty of Science, Cairo University and Al-Azhar University.

2-bromo-1-(3,4-dimethylphenyl)ethanone (2)

To a stirring solution of 1-(3,4-dimethylphenyl)ethanone (**1**; 0.01 mol) in dioxane/ether mixture (30 ml) the bromine (0.01 mol) was added drop wise with constant stirring after complete addition the reaction will lefts for 1hr., then the reaction will poured in cold water (100 ml), the separated solid was filtered off and recrystallized to give **(2)**, (table 1).

2-(2-(3,4-dimethylphenyl)-2-oxoethylthio)-4,6-dimethylnicotinonitrile (3)

A solution of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) in ethanol (50 ml) and 2-mercapto-4,6-dimethylnicotinonitrile (0.01 mol) was refluxed for 3hrs., the solid product which formed on heating was collected by filtration and recrystallized to give **(3)**, (table 1).

2-(1H-benzo[d]imidazol-2-ylthio)-1-(3,4-dimethylphenyl)ethanone (5)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 1H-benzo[d]imidazole-2-thiol (0.01 mol) in ethanol (40 ml) was refluxed for 1hr., the resulting solution was collected by filtration and recrystallized to give **(5)**, (table 1).

3-(3,4-dimethylphenyl)benzo[d]thiazolo[3,2-a]imidazole (6)

Compound (5; 0.01 mol) in dimethylformamide (30 ml) was refluxed for 3hrs., the solid product was collected and washed with ethanol, dried and recrystallized to give **(6)**, (table 1).

4-(3,4-dimethylphenyl)-3-phenylthiazole-2(3H)-thione (7)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) in dimethylformamide (20 ml) and ammonium phenylcarbamodithioate (0.01 mol), was refluxed for 1hr., the solvent was removed under vacuum, and the solid obtained was recrystallized to give **(7)**, (table 1).

4-(3,4-dimethylphenyl)-2-hydrazinylthiazole (8)

A solution of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) in dioxane (30 ml) and thiosemicarbazide (0.01 mol) was refluxed fro 1hr., the solid product which obtained after cooling was collected and recrystallized to give **(8)**, (table 1).

4-(3,4-dimethylphenyl)-2-(2-(4-methoxybenzylidene)hydrazinyl)thiazole (10)

Procedure (A)

A mixture of 2-(3,4-dimethylphenyl)-4-hydrazinylthiazole (**8**; 0.01 mol) and *P*-anisaldehyde (0.01 mol) in ethanol (30 ml) was refluxed for 3hrs., the solid product was collected and recrystallized to give **(10)**.

Procedure (B)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 2-(4-methoxybenzylidene)hydrazinecarbothioamide (0.01 mol) in ethanol (40 ml) was refluxed for 2hrs., the obtained product was collected and recrystallized to give **(10),** m.p. and mixed m.p. determined with authentic which obtained in procedure **(A)** gave no depression.

General procedure for preparation of compounds (11a-c)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and thiocarbamide derivatives namely (thiourea, phenyl thiourea and thioacetamide) (0.01 mol) in ethanol (40 ml) was refluxed for 2hrs., the separated solids were filtered off and recrystallized to give 4-(3,4-dimethylphenyl)thiazol-2-amine (11a), 4-(3,4-dimethylphenyl)-N-phenylthiazol-2-amine (11b) and 4-(3,4-dimethylphenyl)-2-methylthiazole (11c), respectively (table 1).

2-(4-chlorophenylamino)-1-(3,4-dimethylphenyl)ethanone (12)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01mol) and *p*-chloroaniline (0.01 mol) in ethanol (50 ml) was refluxed for 1hr. the obtained product was collected and recrystallized to give **(12)**, (table 1).

3-(3,4-dimethylphenyl)-3-oxopropanenitrile (13)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01mol) and potassium cyanide (0.01 mol) in ethanol (20 ml) was heated under reflux for 4 hrs., during the reflux period, a crystalline solid was separated, the separated solid was filtered off, washed with ethanol and recrystallized to give **(13)**, (table 1).

2-(4-(3,4-dimethylphenyl)thiazol-2-yl)acetonitrile (14)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01mol) and cyanothioacetamide (0.01mol) in ethanol (50 ml) was heated under reflux for 4 hrs., during the reflux period, crystalline solid was separated, the separated solid was filtered off, washed with ethanol and recrystallized to give **(14)**, (table 1).

N'-(4-chlorophenyl)-4-(3,4-dimethylphenyl)thiazole-2-carbo-hydrazonoyl cyanide (15)

Procedure (A)

1-chloro-2-(4-chlorophenyl)diazene (prepared by adding sod. nitrite (0.01 mol) to p-chloroaniline (0.01 mol) in conc. HCl (6 ml) at (0~5 ^{o}C) under stirring) was added drop wise with stirring to a cold solution of thiazolyl acetonitrile derivative (14; 0.01 mol) in ethanol (20 ml) containing sodium acetate (0.08 mol), the obtained product was collected and recrystallized to give **(15)**, (table 1).

Procedure (B)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 2-((4-chlorophenyl)diazenyl)-2-cyanoethanethioamide (0.01 mol) in ethanol (50 ml) was heated under reflux for 1hr., the resulting solid was collected and recrystallized to give (15), m.p. and mixed m.p. determined with authentic which obtained in procedure (A) gave no depression.

2-(4-(3,4-dimethylphenyl)thiazol-2-yl)-3-phenylacrylonitrile (17)

Procedure (A)

A mixture of (14; 0.01 mol) and benzaldehyde (0.01 mol) in ethanol (40 ml) containing few drops of piperidine were refluxed for 2hrs., the obtained product which formed was collected by filtration and recrystallized to give **(17)**, (table 1).

Procedure (B)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (2; 0.01 mol) and 2-cyano-3-phenylprop-2-enethioamide (0.01 mol) in ethanol (40 ml) were refluxed for 2hrs., the obtained product was collected, and recrystallized to give (17), m.p. and mixed m.p. determined with authentic which obtained in procedure (A) gave no depression.

3-(4-(3,4-dimethylphenyl)thiazol-2-yl)-2H-chromen-2-one (19)

Procedure (A)

A mixture of (14; 0.01 mol) and salicyldehyde (0.01 mol) in ethanol (50 ml), few drops of piperidine was added as a catalyst, the reaction mixture was refluxed for 3hrs., the solid product was collected by filtration and recrystallized to give **(19)**, (table 1).

Procedure (B)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 2-oxo-2H-chromene-3-carbothioamide (0.01 mol) in ethanol (50 ml) was refluxed for 2hrs., the solid obtained was filtered off and recrystallized to give **(19)**, m.p. and mixed m.p. determined with authentic which obtained in procedure (A) gave no depression.

5-(3,4-dimethylphenyl)imidazo[2,1-b]thiazole (20)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 2-aminothiazole (0.01 mol) in ethanol (40 ml) was refluxed for 2hrs., the product was collected and recrystallized to give **(20)**, (table 1).

3-(3,4-dimethylphenyl)-4H-benzo[b][1,4]thiazine (21)

A mixture of 2-bromo-1-(3,4-dimethylphenyl)ethanone (**2**; 0.01 mol) and 2-aminobenzenethiol (0.01 mol) in ethanol (40 ml) was refluxed for 2hrs., the solid product which formed on heating was collected and recrystallized to give **(21)**, (table 1).

Antimicrobial and Antifungal screening

The prepared compounds were evaluated for their antimicrobial activity using the agar diffusion technique.[17,18] A mg/ml solution in DMF was used. The test organisms were gram-positive Bacillus subtilis (NCTC-1040), Staphylococcus aureus (NCTC-7447), sarcina maxima (ATCC-33910); gram-negative Klebsiella peneumonia (NCIMB-9111), Salmonella, Pseudomonas aeruginosa (ATCC-10145), and Antifungal activity, unicellular fungi Candida abicans (IMRU-3669); filamentous fungi Rhizopus, Asperigillus fumigatus. DMF showed no inhibition zones. The reference antibiotics were Ampicillin (AMD) and Calforan. The inhibition zones (IZ) of these compounds are listed in (table 3).

Table (1):- Physical and analytical data for the newly prepared compounds.

Comp. No.	m.p.°C (Solvent of recrystallization)	Colour (Yield%)	M. Formula (M.Wt.)	Calculated / Found (%)			
				C	H	N	S
2	101 (Et.)	Yellow (86)	$C_{10}H_{11}BrO$ (227.10)	52.89 52.77	4.88 4.80	------ ------	------ ------
3	140 (Et./B.)	Yellow (50)	$C_{18}H_{18}N_2OS$ (310.41)	69.65 69.61	5.84 5.81	9.02 9.01	10.33 10.31
5	160 (Et.)	White (68)	$C_{17}H_{16}N_2OS$ (296.39)	68.89 68.87	5.44 5.41	9.45 9.44	10.82 10.80
6	290 (DMF)	White (60)	$C_{17}H_{14}N_2S$ (278.37)	73.35 73.33	5.07 5.06	10.06 10.03	11.52 11.50
7	160 (Et./B.)	White (50)	$C_{17}H_{15}NS_2$ (297.44)	68.65 68.63	5.08 5.05	4.71 4.69	21.56 21.55
8	145 (Et./B.)	White (55)	$C_{11}H_{13}N_3S$ (219.31)	60.24 60.21	5.97 5.96	19.16 19.14	14.62 14.60
10	155 (Et.)	yellow (70)	$C_{19}H_{19}N_3OS$ (337.44)	67.63 67.61	5.68 5.67	12.45 12.44	9.50 9.48
11a	230 (D.)	White (77)	$C_{11}H_{12}N_2S$ (204.29)	64.67 64.66	5.92 5.90	13.71 13.70	15.70 15.68
11b	152 (Et.)	White (77)	$C_{17}H_{16}N_2S$ (280.39)	72.82 72.81	5.75 5.73	9.99 9.95	11.44 11.41
11c	151 (Et.)	White (69)	$C_{12}H_{13}NS$ (203.30)	70.89 70.88	6.45 6.41	6.89 6.87	15.77 15.75
12	110 (Et./B.)	White (80)	$C_{16}H_{16}ClNO$ (273.76)	70.20 70.19	5.89 5.88	5.12 5.10	------ ------
13	154 (Et.)	White (50)	$C_{11}H_{11}NO$ (173.21)	76.28 76.25	6.40 6.38	8.09 8.07	------ ------
14	190 (Et./B.)	White (80)	$C_{13}H_{12}N_2S$ (228.31)	68.39 68.35	5.30 5.27	12.27 12.25	14.04 14.02
15	202 (Et./B.)	Brown (85)	$C_{19}H_{15}ClN_4S$ (366.87)	62.20 62.19	4.12 4.10	15.27 15.25	8.74 8.71
17	242 (Et./B.)	yellow (88)	$C_{20}H_{16}N_2S$ (316.42)	75.92 75.90	5.10 5.08	8.85 8.82	10.13 10.11
19	260 (DMF)	yellow (65)	$C_{20}H_{15}NO_2S$ (333.40)	72.05 72.03	4.53 4.51	4.20 4.18	9.62 9.60
20	190 (Et./B.)	White (55)	$C_{13}H_{12}N_2S$ (228.31)	68.39 68.37	5.30 5.27	12.27 12.25	14.04 14.02
21	160 (Et./B.)	White (60)	$C_{16}H_{15}NS$ (253.36)	75.85 75.82	5.97 5.96	5.53 5.50	12.66 12.63

(**B.**; benzene, **D.**; dioxane, **DMF**; dimethylformamide, **Et.**; ethanol)**.**

Table (2):- Spectral data for the newly prepared compounds.

Comp. No.	IR (cm^{-1})	Spectral data (^{1}H-NMR, Mass spectra)
2	3050 (CH aromatic), 2980 (CH aliphatic), 1666 (CO).	^{1}H-NMR $CDCl_3$: 2.36 (s, 6H, $2CH_3$), 4.98 (s, 2H, CH_2), 7.30-7.71 (m, 3H, Ar-H).
3	3060 (CH aromatic), 2970 (CH aliphatic), 2225 (CN), 1660 (CO).	Mass, m/z (intensity %): M^+ 310 (2.0), 132 (100.0), 76 (27.2).
5	3240 (NH), 3051 (CH aromatic), 2970 (CH aliphatic), 1690 (CO).	Mass, m/z (intensity %): M^+ 296 (16.6), 278 (8.2), 133 (100.0).
6	3080 (CH aromatic), 2960 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.33 (s, 6H, $2CH_3$), 7.22-8.21 (m, 8H, 2Ar-H, CH-thiazole). Mass, m/z (intensity %): M^+ 278 (7.9), 160 (20.1), 133 (100.0), 105 (36.1), 77 (37.5).
7	3049 (CH aromatic), 2982 (CH aliphatic), 1340 (CS).	Mass, m/z (intensity %): M^{-1} 296 (18.1), 268 (13.8), 163 (16.1), 133 (100.0), 105 (31.4).
8	3420, 3373 (NH_2), 3140 (NH), 3070 (CH aromatic), 2975 (CH aliphatic).	Mass, m/z (intensity %): M^+ 219 (37.2), 77 (100.0).
10	3190 (NH), 3048 (CH aromatic), 2950 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.29 and 2.32 (2s, 6H, $2CH_3$), 3.86 (s, 3H, OCH_3), 6.93 and 7.66 (dd, 4H, AB-system), 7.20-7.47 (m, 4H, Ar-H, CH-thiazole), 8.17 (s, 1H, NH).
11a	3410, 3364 (NH_2), 3051 (CH aromatic), 2970 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.29 and 2.32 (2s, 6H, $2CH_3$), 8.86 (br, 2H, NH_2), 7.17-7.66 (m, 4H, Ar-H, CH-thiazole).
11b	3200 (NH), 3098 (CH aromatic), 2890 (CH aliphatic).	Mass, m/z (intensity %): M^+ 280 (63.4), 279 (100.0), 146 (18.9), 76 (36.0).
11c	3082 (CH aromatic), 2950 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.27 (s, 3H, CH_3), 2.35 (s, 6H, $2CH_3$), 7.24-7.79 (m, 4H, Ar-H, CH-thiazole).
12	3244 (NH), 3049 (CH aromatic), 2972 (CH aliphatic), 1680 (CO).	^{1}H-NMR $CDCl_3$: 2.35 (s, 6H, $2CH_3$), 4.54 (s, 2H, CH_2), 4.95 (s, 1H, NH), 6.61-7.18 (dd 4H, AB-system), 7.25-7.77 (m, 3H, Ar-H).

Table (2): con.

Comp. No.	IR (cm^{-1})	Spectral data (^{1}H-NMR, Mass spectra)
13	3051 (CH aromatic), 2852 (CH aliphatic), 2225 (CN), 1670 (CO).	^{1}H-NMR $CDCl_3$: 2.34 (s, 6H, $2CH_3$), 4.96 (s, 2H, CH_2), 7.22-7.79 (m, 3H, Ar-H).
14	2220 (CN), 3060 (CH aromatic), 2951 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.30 and 2.32 (2s, 6H, $2CH_3$), 4.17 (s, 2H, CH_2), 7.20-7.70 (m, 4H, Ar-H, CH-thiazole).
15	3100 (NH), 2222 (CN), 3054 (CH aromatic), 2955 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.33 (s, 6H, $2CH_3$), 7.21-8.32 (m, 8H, 2Ar-H, CH-thiazole), 12.81 (s, 1H, NH). Mass, m/z (intensity %): M^+ 366 (19.9), 365 (76.4), 200 (24.1), 161 (25.2), 111 (100.0), 75 (38.1).
17	2225 (CN), 3101 (CH aromatic), 2950 (CH aliphatic).	^{1}H-NMR $CDCl_3$: 2.34 (s, 6H, $2CH_3$), 7.23-7.96 (m, 9H, 2Ar-H, CH-thiazole), 8.27 (s, 1H, C=CH).
19	3190 (NH), 3050 (CH aromatic), 2950 (CH aliphatic), 1700 (CO).	^{1}H-NMR $CDCl_3$: 2.34 (s, 6H, $2CH_3$), 7.25-8.01 (m, 8H, 2Ar-H, CH-thiazole), 9.51 (s, 1H, chromine-2-one H-4).
20	3048 (CH aromatic), 2952 (CH aliphatic).	Mass, m/z (intensity %): M^+ 228 (67.1), 227 (100.0), 128 (16.7), 79 (21.4).
21	3210 (NH), 3055 (CH aromatic), 2947 (CH aliphatic).	Mass, m/z (intensity %): M^+ 253 (23.7), 252 (100.0), 77 (18.3).

Table (3):- Antimicrobial activity & Antifungal Activity; Inhibition zone diameter (mm)

Compd. No.	Gram-Positive			Gram-Negative			Unicellular Fungi	Filamentous Fungi	
	B. Subtilis (NCTC-1040)	S. Aureus (NCTC-7447)	S. maxima (ATCC-33910)	K. Pneumonia (NCIMB-9111)	Salmonella	P. aeruginosa (ATCC-10145)	C. Abicans (IMRU-3669)	Rhizopus	A. Fumigatus
3	17	16	16	12	13	15	18	19	17
6	19	20	19	18	19	20	21	22	19
7	21	19	18	20	19	20	19	20	21
10	17	18	15	13	14	15	17	18	17
11a	18	19	20	20	21	20	19	18	12
11b	19	18	18	19	17	19	18	17	17
11c	17	18	17	15	14	13	12	17	17
14	20	21	20	22	23	24	20	19	19
19	19	21	19	21	20	19	17	19	17
20	19	18	20	17	21	19	18	17	19
Ampicillin (AMD) 25mg Calforan 30 mg.	26	25	27	27	26	25	24	25	25

(24-20 mm: high active, 19-18 mm: moderate active, 17-12 mm: weak active).

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