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# Synthesis and Antimicrobial Activity of Dithiocarbamates of ω-Substituted (2-naphthyloxy)alkanes

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A series of dithiocarbamates of ω-substituted (2-naphthyloxy) alkanes was developed through condensation of 2-(2-chloro-alkoxy)-naphthalene to various kinds of aliphatic, aromatic, alicyclic, heterocyclic primary and secondary amines employing benzyl trimethyl ammonium hydroxide in catalytic quantity (Triton-B/$CS_2$ system) afforded desired products in high yields (82-98 %). The complete series of synthesized compounds (**4-48**) were evaluated for antimicrobial activity through microdilution method using various bacterial and fungal strains. The antifungal and antibacterial values were estimated as MIC values. Fluconazole and ciprofloxacin [16 to 0.03 µg/mL] were used as the standard antifungal and antibacterial drug, respectively. Out of series of evaluated compounds, some of these compounds such as compounds **28**, **29**, **30**, **31**, **32**, **33** have displayed maximum potency which is comparable to standard drugs.

**Keywords: Dithiocarbamates, Antimicrobial, Amines.**

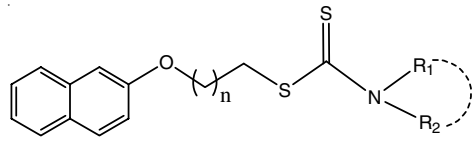
## INTRODUCTION

Dithiocarbamates have always received the attention of the researchers round the world because of its wide utility in areas such as pharmaceuticals [1-4], intermediate product in organic synthesis [5], for the sheilding of amino groups in peptide chemistry [6,7] and as linking agents in combinatorial chemistry [8-10]. Organic dithiocarbamates have been extensively used as intermediate for the synthesis of structurally diverse synthetic intermediates/molecules of biological significance like antimalarial [11], anticholinergic [12], antimicrobial [13], antimitotic [14], antitubercular [15], antifungal [16], anticancer [17], antioxidant [18], antiprotozoal [19], antileprosy [20], antifolates [21], antitubulin [22], antialzheimer [23], anti-HIV [24], antipoliferative [25] and anticontraceptives [26] active agents. As a useful synthon organic dithiocarbamates have been extensively used for the synthesis of structurally diverse biological potent synthetic intermediates/molecules like isothiocyanates [27], thiourea [28], cynamide [29], dithiobenzophene [30], glycosides [31], β-sulphonamides [32], amide [33], dicarboxylates [34], thiadizoles [35], dithiolanes [36], thiones [37], benzimidazole [38], carbamate [39], pyran [40] and flavonoids [41], *etc*. Apart from above mentioned activities, dithiocarba-mates of various imidazole [42], brassinin [43], rhodanine [44], quinoline [45], metal complexes [46], ammonium salts [47], *etc*. derivative have emerged as potent antimicrobial agents. As our group is working in drug discovery through design and synthesis of novel class of natural/semi-synthetic/synthetic molecules especially molecules like carbamates, dithiocarbamates, dithiocarbazates, *etc*. Keeping in view the importance of dithiocarbamates and its derivatives, we became interested in investigating various structurally diverse biologically potent compounds.

Considering the potency of dithiocarbamates as antimicrobial agents, we became interested to investigate the antimicrobial activity of dithiocarbamates of ω-substituted (2-naphthyloxy) alkanes (**Prototype I**).

## EXPERIMENTAL

**Procedure for ω-substituted 2-naphthyloxy haloalkanes (3):** Measured amount of β-naphthol (**1**) was taken in dry acetone



**Prototype I** (n = 1, 2 & 3; Compounds **4-48**)

and anhyd. $K_2CO_3$ (10 eqv.) was added in it. To this, 1-bromo-3-chloro propane (**2**) was added (2.5 eqv.) and then the reaction was refluxed for 12-15 h. The continuous monitoring of progress of reaction was done by TLC which indicates the appearance of less polar new spot. The filtrate of reaction mixture was concentrated, extracted thrice with ethyl acetate. After separation the organic layer was dried over anhydrous $Na_2SO_4$ afforded the corresponding compound **3**. Compound **3** was confirmed by various spectroscopic and analytical techniques.

**Procedure for synthesis of dithiocarbamates of Prototype I (4-48):** Measured amount of desired amine was dissolved in dry DMSO. To this, measured amount of $CS_2$ and Triton-B were added drop by drop and the reaction was allowed to stir for 15 min. After adding compound **3** to the reaction mixture and the reaction was stirred for about 20-40 min. Monitoring of reaction progress was done by TLC. Triple extraction of reaction mixture was done with ethyl acetate once the reaction was complete. The organic layer was separated, dried over anhydrous $Na_2SO_4$ afforded the final product that is, dithiocarbamates of prototype **I** (compounds **4-48**).

**Biological activities:** The antibacterial and antifungal activities of the ω-substituted (2-naphthyloxy) alkanes against bacterial strains (*Staphylococcus aureus* ATCC 29313, Methicillin resistant *Staphylococcus aureus*), two Gram-negative strains (*Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853), two yeast strains (*Candida albicans* ATCC 22019, *S. schencki*) and two filamentous fungi (*Aspergillus fumigatus* LSI-II, *Aspergillus niger* ATCC 16404) was performed by using microdilution method. Antibacterial tests were performed using Muller Hinton Broth which was buffered to pH 7.0. The antifungal testing was performed using RPMI 1640 with L-glutamine buffered to pH 7.0. It was supplemented with 0.165 M 3-(*N*-morpholino) propanesulfonic acid (MOPS) [Sigma-Aldrich]. The stock solution of the compounds was prepared using DMSO. The minimum inhibitory concentration (MIC) of the compounds was determined by serial 2 fold diluting the oils in the abovementioned media in 100 mL volume in a 96 well U bottom microtitre plate. The final concentrations of compound ranged from 128 to 0.25 µg/mL. Flucanazone and ciprofloxacin [16 to 0.03 µg/mL] (Sigma-Aldrich) were used as standard antifungal and antibacterial agents respectively. The bacterial and fungal suspension of the overnight grown bacterial and fungal was prepared in sterile normal saline and their density was adjusted to 0.5 McFarland. The bacterial cultures were diluted and added in 100 mL volume to a final inoculum of $1 \times 10^5$ CFU/mL. For fungal cultures $1 \times 10^3$ CFU/mL was used. The plates were incubated at 37 °C for 24 h for bacterial cultures and 48 h for fungal cultures. The plates were read visually and the minimum concentration of the compounds showing no turbidity was recorded as MIC.

All the chemicals used were obtained from Merck, Aldrich and Fluka chemical companies. Reactions were carried out in nitrogenous atmosphere. The structural analysis of compound was done as IR spectra (4000-200 $cm^{-1}$) on Bomem MB-104–FTIR spectrophotometer where as NMRs were scanned on AC-300F, NMR (300 MHz), instrument using $CDCl_3$ and some other deutrated solvents and TMS as internal standard. Elemental analysis were made by Carlo-Erba EA 1110-CNNO-S analyzer and the obtained values were in accordance with calculated values.

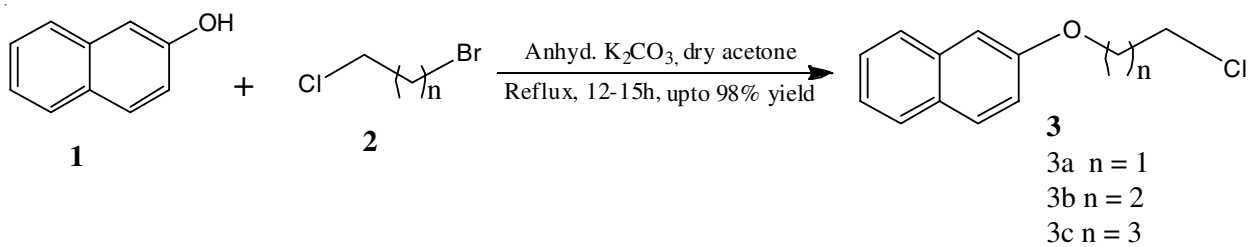
General procedure for the preparation of ω-naphthyloxy halo alkanes (**3a-c**) involves refluxing of mixture of β-naphthol (**1**) (20 g, 0.14 mol), anhydrous $K_2CO_3$ (100 g, in excess) and bromochloroalkane 2 (0.14 mol) in dry acetone (200 mL) for 12-15 h. Reaction mixture was filtered and filtrate was concentrated to get oily compound, which was crystallized with benzene-hexane to give the colourless crystals of pure desired compound (**Scheme-I**) [48].

**2-(2-Naphthyloxy)-1-chloroethane (3a):** Yield: 27.4 g (96 %); m.p.: 94 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 1455 (Ar), 1507 (Ar), 1586 (Ar), 2878 (CH), 2927 (CH); $^1$H NMR (400 MHz, $CDCl_3$): δ = 3.82 (t, 2H, $CH_2Cl$), 4.24 (t, 2H, $OCH_2$), 6.97–7.65 (m, 7H, Ar–H); $^{13}$C NMR (100 MHz, $CDCl_3$): δ = 45.2, 75.2, 105.7, 118.5, 123.7, 126.5, 129.6, 134.4, 157.6 ppm; Mass (EIMS): *m/z* = 206; Analysis: $C_{12}H_{11}OCl$, Calcd. (%): C, 69.74; H, 5.36; Obsd. (%): C, 70.04, H, 5.66.

**3-(2-Naphthyloxy)-1-chloropropane (3b):** Yield: 29.6 g (97 %); m.p.: 98 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 1462 (Ar), 1511 (Ar), 1595 (Ar), 2856 (CH), 2942 (CH); $^1$H NMR (400 MHz, $CDCl_3$): δ = 2.26–2.34 (m, 2H, $CH_2$), 3.84 (t, 2H, $CH_2Cl$), 4.24 (t, 2H, $OCH_2$), 7.12–7.75 (m, 7H, Ar–H) ppm; Mass (EIMS): *m/z* = 220; Analysis: $C_{13}H_{13}OCl$, Calcd. (%): C, 70.75; H, 5.94; Obsd. (%): C, 70.79; H, 6.21.

**4-(2-Naphthyloxy)-1-chlorobutane (3c):** Yield: 34 g (98 %); m.p.: 112 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 1463 (Ar), 1512 (Ar), 1598 (Ar), 2886 (CH), 2942 (CH); $^1$H NMR (400 MHz, $CDCl_3$): δ = 2.15–2.22 (m, 4H, $CH_2CH_2$), 3.77 (t, 2H, $CH_2Cl$), 4.25 (t, 2H, $OCH_2$), 7.13–7.76 (m, 7H, Ar– H) ppm; Mass (EIMS): *m/z* = 234; Analysis: $C_{14}H_{15}OCl$, Calcd. (%): C, 70.72; H, 5.92; Obsd. (%): C, 70.78; H, 6.20.

**Procedure for the preparation of dithiocarbamates of ω-substituted (2-naphthyloxy) alkanes:** A mixture of desired




**1** **2** **3**

3a n = 1
3b n = 2
3c n = 3

**Scheme-I**

amine (0.6 mL, 5 mmol) and carbon disulphide solution (3 mL, in excess) was taken in dry DMSO (35 mL). Triton-B (0.9 mL, 4 mmol) was added in it and the reaction mixture was stirred at room temperature for 1 h. Now 2-(2-naphthyloxy)-1-chloroalkane (0.5 g, 2 mmol) was added in it and reaction was continued till its completion (2 h) as checked by TLC. Reaction mixture was poured into distilled water (50 mL) and three-time extraction was done with ethyl acetate. After separation of organic layer, it was dried over anhydrous sodium sulphate and then concentrated to get dithiocarbamate of ω-substituted (2-naphthyloxy) alkanes. This compound was obtained as yellow solid (**Scheme-II**).

**Butyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (4):** Yield: 0.73 g (93.5 %); m.p.: 106 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 661 (C-S), 1114 (C=S), 1454 (Ar), 1511 (Ar), 1612 (Ar), 2864 (CH), 2936 (CH), 3390 (NH); $^1$H NMR ($CDCl_3$): δ = 0.92-0.96 (t, 3H, $CH_3$), 1.30-1.34 (m, 2H, $CH_2CH_3$), 1.53-1.56 (m, 2H, $CH_2.CH_2.CH_3$), 2.0 (bs, H, NH), 2.62-2.64 (m, 2H, $NHCH_2$), 3.28-3.32 (t, 2H, $CH_2$-S-C=S), 4.71-4.74 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 319; Analysis: $C_{17}H_{21}NOS_2$, Calcd. (%): C, 63.91, H 6.63, N, 4.38; Obsd. (%): C, 64.19, H, 6.49, N, 4.24.

**Butyl-dithiocarbamic acid-3-(naphthalene-2-yloxy)-propyl ester (5):** Yield: 0.73 g (93.5 %); m.p.: 106 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 661 (C-S), 1115 (C=S), 1454 (Ar), 1511 (Ar), 1610 (Ar), 2864 (CH), 2935 (CH), 3390 (NH); $^1$H NMR ($CDCl_3$): δ = 0.93-0.96 (t, 3H, $CH_3$), 1.33-1.35 (m, 2H, $CH_2CH_3$), 1.53-1.55 (m, 2H, $CH_2.CH_2.CH_3$), 2.0 (bs, H, NH), 2.62-2.65 (m, 2H, $NHCH_2$), 2.84-2.86 (t, 2H, $CH_2$-S-C=S), 2.35-2.39 (m, 2H, $CH_2CH_2CH_2$) 4.01-4.05 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 333; Analysis: $C_{18}H_{23}NOS_2$, Calcd. (%): C, 65.91, H 6.83, N, 4.38, S, 19.15, Obsd. (%): C, 65.82, H, 6.95, N, 4.20, S, 19.23 %: O, 4.80.

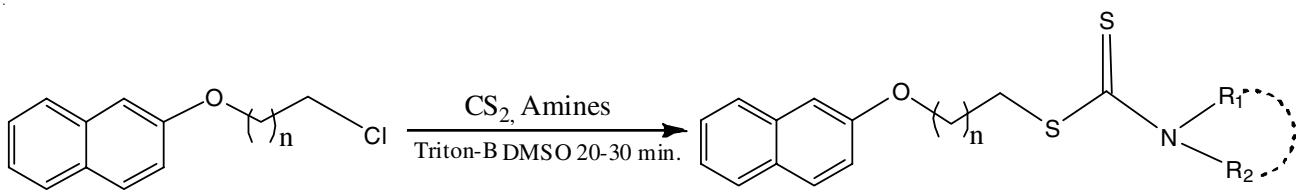
**Butyl-dithiocarbamic acid-4-(naphthalene-2-yloxy)-butyl ester (6):** Yield: 0.73 g (93.5 %); m.p.: 106 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 661 (C-S), 1114 (C=S), 1454 (Ar), 1511 (Ar), 1612 (Ar), 2864 (CH), 2936 (CH), 3390 (NH); $^1$H NMR ($CDCl_3$): δ = 0.93-0.96 (t, 3H, $CH_3$), 1.33-1.35 (m, 2H, $CH_2CH_3$), 1.53-1.55 (m, 2H, $CH_2.CH_2.CH_3$), 2.0 (bs, H, NH), 2.62-2.66 (m, 2H, $NHCH_2$), 2.85-2.87 (t, 2H, $CH_2$-S-C=S), 1.92-1.96 (m, 2H, $CH_2CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2CH_2$), 4.00-4.03 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 347.14; Analysis: $C_{19}H_{25}NOS_2$, Calcd. (%): C, 65.60, H 7.22, N, 4.58; S, 18.42 %: O, 4.58. Obsd. (%): C, 65.66, H, 7.25, N, 4.60, S, 18.45 %: O, 4.60.

**Hexyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (7):** Yield: 0.8 g (96.4 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 665 (C-S), 1116 (C=S), 1475 (Ar), 1514 (Ar), 1602 (Ar), 2875 (CH), 2936 (CH), 3394 (NH); $^1$H NMR ($CDCl_3$): δ = 0.92-0.95 (t, 3H, $CH_3$), 1.27-1.29 (m, 4H, $CH_2CH_2CH_2CH_3$ of hexyl group), 1.31-1.35 (m, 2H, $CH_2CH_3$ of hexyl group), 1.52-1.56 (m, 2H, $CH_2.CH_2.CH_3$ of hexyl group), 2.0 (bs, H, NH), 2.36-2.40 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.63-2.65 (m, 2H, $NHCH_2$), 3.24-3.29 (t, 2H, $CH_2$-S-C=S), 4.68-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 347.14; Analysis: $C_{19}H_{25}NOS_2$, Calcd. (%): C, 66.44, H 7.53, N, 3.87, 18.45 %: O, 4.60. Obsd. (%): C, 65.66, H, 7.25, N, 4.03, S, 18.45 %: O, 4.60.

**Hexyl-dithiocarbamic acid-3-(naphthalene-2-yloxy)-propyl ester (8):** Yield: 0.8 g (96.4 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1116 (C=S), 1475 (Ar), 1514 (Ar), 1602 (Ar), 2875 (CH), 2936 (CH), 3394 (NH); $^1$H NMR ($CDCl_3$): δ = 0.92-0.94 (t, 3H, $CH_3$), 1.27-1.29 (m, 4H, $CH_2CH_2CH_2CH_3$ of hexyl group), 1.31-1.35 (m, 2H, $CH_2CH_3$ of hexyl group), 1.52-1.58 (m, 2H, $CH_2.CH_2.CH_3$ of hexyl group), 2.0 (bs, H, NH), 2.34-2.42 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.63-2.66 (m, 2H, $NHCH_2$), 2.81-2.86 (t, 2H, $CH_2$-S-C=S), 4.02-4.05 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 361; Analysis: $C_{20}H_{27}NOS_2$, Calcd. (%): C, 66.44, H 7.53, N, 3.87, Obsd. (%): C, 66.75, H, 7.38, N, 3.71.

**Hexyl-dithiocarbamic acid-4-(naphthalene-2-yloxy)-butyl ester (9):** Yield: 0.72 g (98 %); m.p.: 129 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 669 (C-S), 1116 (C=S), 1475 (Ar), 1514 (Ar), 1610 (Ar), 2875 (CH), 2936 (CH), 3410 (NH); $^1$H NMR ($CDCl_3$): δ = 0.92-0.96 (t, 3H, $CH_3$), 1.25-1.29 (m, 4H, $CH_2CH_2CH_2CH_3$ of hexyl group), 1.30-1.34 (m, 2H, $CH_2CH_3$ of hexyl group), 1.53-1.56 (m, 2H, $CH_2CH_2CH_2.CH_2.CH_3$ of hexyl group), 1.71-1.73 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.94-1.96 (m, 2H, S-$CH_2CH_2$), 2.0 (bs, H, NH), 2.62-2.64 (m, 2H, $NHCH_2$), 2.82-2.86 (t, 2H, $CH_2$-S-C=S), 4.02-4.06 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 375; Analysis: $C_{21}H_{29}NOS_2$, Calcd. (%): C, 67.15, H 7.78, N, 3.73, Obsd. (%): C, 67.59, H, 7.56, N, 3.51.

**Octyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (10):** Yield: 0.85 g, (96.2 %); m.p.: 172 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 667 (C-S), 1120 (C=S), 1475 (Ar), 1521 (Ar), 1612 (Ar), 2886 (CH), 2941 (CH), 3399 (NH); $^1$H NMR ($CDCl_3$): δ = 0.92-0.94 (t, 3H, $CH_3$), 1.27-1.29 (m, 8H, $CH_2CH_2CH_2CH_2$ $CH_2CH_3$ of octyl group), 1.32-1.34 (m, 2H, $CH_2CH_3$ of octyl group), 1.53-1.56 (m, 2H, $CH_2CH_2N$ of *n*-octyl group), 2.0 (bs, H, NH), 2.62-2.64 (m, 2H, $NHCH_2$), 3.25-3.29 (t, 2H, $CH_2$-S-C=S), 4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 375.17; Analysis: $C_{21}H_{29}NOS_2$, Calcd. (%): C, 67.15, H, 7.78, N, 3.73; O, 4.22; S, 17.04.Obsd. (%): C, 67.15, H, 7.78, N, 3.73, O, 4.26; S, 17.07.




**3**

n = 1, 2 & 3

**Prototype I** (Comp. no. **4-48)**

**Scheme-II**

**Octyl-dithiocarbamic acid-3-(naphthalene-2-yloxy)-propyl ester (11):** Yield: 0.85 g, (96.2 %); m.p.: 172 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 667 (C-S), 1120 (C=S), 1472 (Ar), 1521 (Ar), 1612 (Ar), 2884 (CH), 2941 (CH), 3399 (NH); $^1H$ NMR ($CDCl_3$): δ = 0.92-0.94 (t, 3H, $CH_3$), 1.27-1.29 (m, 8H, $CH_2CH_2CH_2CH_2$ $CH_2CH_3$ of octyl group), 1.30-1.32 (m, 2H, $CH_2CH_3$ of octyl group), 1.53-1.56 (m, 2H, $CH_2CH_2N$ of *n*-octyl group), 2.0 (bs, H, NH), 2.38-2.42 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.63-2.66 (m, 2H, $NHCH_2$), 2.83-2.87 (t, 2H, $CH_2$-S-C=S), 4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.66 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 389; Analysis: $C_{22}H_{31}NOS_2$, Calcd. (%): C, 67.62, H, 8.02, N, 3.59; Obsd. (%): C, 67.89, H, 7.90, N, 3.44.

**Octyl-dithiocarbamic acid-4-(naphthalene-2-yloxy)-butyl ester (12):** Yield: 0.86 g (94 %); m.p.: 156 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 664 (C-S), 1108 (C=S), 1463 (Ar), 1514 (Ar), 1602 (Ar), 2862 (CH), 2926 (CH), 3392 (NH); $^1H$ NMR ($CDCl_3$): δ = 0.93-0.95 (t, 3H, $CH_3$), 1.27-1.29 (m, 8H, $CH_2CH_2CH_2CH_2CH_2CH_3$ of octyl group), 1.30-1.34 (m, 2H, $CH_2CH_3$ of octyl group), 1.52-1.57 (m, 2H, $CH_2.CH_2.N$), 2.0 (bs, H, NH), 2.63-2.67 (m, 2H, $NHCH_2$), 3.26-3.32 (t, 2H, $CH_2$-S-C=S), 4.71-4.74 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 375; Analysis: $C_{21}H_{29}NOS_2$, Calcd. (%): C, 67.15, H 7.78, N, 3.73, Obsd. (%): C, 67.54, H, 7.56, N, 3.56.

**Decyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (13):** Yield: 0.86 g (94 %); m.p.: 156 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 663 (C-S), 1108 (C=S), 1465 (Ar), 1511 (Ar), 1605 (Ar), 2862 (CH), 2926 (CH), 3392 (NH); $^1H$ NMR ($CDCl_3$): δ = 0.92-0.94 (t, 3H, $CH_3$), 1.27-1.29 (m, 10H, $CH_2CH_2CH_2CH_2$ $CH_2CH_2CH_2CH_3$ of decyl group), 1.31-1.35 (m, 2H, $CH_2CH_3$ of decyl group), 1.53-1.56 (m, 2H, $CH_2CH_2N$ of *n*-decyl group), 2.01 (bs, H, NH), 2.63-2.65 (m, 2H, $NHCH_2$), 3.25-3.29 (t, 2H, $CH_2$-S-C=S), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 403.25; Analysis: $C_{23}H_{33}NOS_2$, Calcd. (%): C, 68.40, H 8.20, N, 3.90, O, 3.92, S, 15.86; Obsd. (%): C, 68.44, H, 8.24, N, 3.96. O, 3.96, S, 15.89.

**Decyl-dithiocarbamic acid-3-(naphthalene-2-yloxy)-propyl ester (14):** Yield: 0.86 g (94 %); m.p.: 156 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 664 (C-S), 1109 (C=S), 1462 (Ar), 1513 (Ar), 1602 (Ar), 2863 (CH), 2925 (CH), 3392 (NH); $^1H$ NMR ($CDCl_3$): δ = 0.92-0.95 (t, 3H, $CH_3$), 1.27-1.29 (m, 10H, $CH_2CH_2CH_2CH_2$ $CH_2CH_2CH_2CH_3$ of decyl group), 1.31-1.35 (m, 2H, $CH_2CH_3$ of decyl group), 1.53-1.56 (m, 2H, $CH_2CH_2N$ of *n*-decyl group), 2.0 (bs, H, NH), 2.62-2.66 (m, 2H, $NHCH_2$), 2.84-2.87 (t, 2H, $CH_2$-S-C=S), 2.34-2.38 (m, 2H, $CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 417.67; Analysis: $C_{24}H_{35}NOS_2$, Calcd. (%): C, 69, H 8.40, N, 3.35, O, 3.80, S, 15.31. O, 3.83, S, 15.35. Obsd. (%): C, 69.02, H, 8.45, N, 3.35, O, 3.83, S, 15.35.

**Decyl-dithiocarbamic acid-4-(naphthalene-2-yloxy)-butyl ester (15):** Yield: 0.86 g (94 %); m.p.: 156 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 663 (C-S), 1107 (C=S), 1462 (Ar), 1510 (Ar), 1606 (Ar), 2865 (CH), 2926 (CH), 3392 (NH); $^1H$ NMR ($CDCl_3$): δ = 0.92-0.94 (t, 3H, $CH_3$), 1.27-1.29 (m, 10H, $CH_2CH_2CH_2CH_2$ $CH_2CH_2CH_2CH_3$ of decyl group), 1.30-1.34 (m, 2H, $CH_2CH_3$ of decyl group), 1.52-1.58 (m, 2H, $CH_2CH_2N$ of *n*-decyl group), 2.0 (bs, H, NH), 2.62-2.66 (m, 2H, $NHCH_2$), 2.84-2.87 (t, 2H, $CH_2$-S-C=S), 1.93-1.95 (m, 2H, $CH_2CH_2CH_2$), 1.67-1.71 (m, 2H, $CH_2CH_2CH_2$),4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 431.70; Analysis: $C_{25}H_{37}NOS_2$, Calcd. (%): C, 69.52, H 8.63, N, 3.21, O, 3.70, S, 14.82. Obsd. (%): C, 69.56, H, 8.64, N, 3.24, O, 3.71, S, 14.86.

**Pyrrolidine-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (16):** Yield: 0.62 g (80.8 %); m.p.: 79 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 657 (C-S), 1106 (C=S), 1454 (Ar), 1502 (Ar), 1600 (Ar), 2863 (CH), 2925 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.58-1.60 (m, 4H, $CH_2$ of pyrrolidine ring), 2.8 (t, 4H, $CH_2N$ of pyrrolidine ring (2H, $CH_2$-S-C=S), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 317; Analysis: $C_{17}H_{19}NOS_2$, Calcd. (%): C, 64.32, H, 6.03, N, 4.41, Obsd. (%): C, 63.85, H, 6.29, N, 4.64.

**Pyrrolidine-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (17):** Yield: 0.63 g (83.2 %); m.p.: 86 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 672 (C-S), 1124 (C=S), 1475 (Ar), 1524 (Ar), 1605 (Ar), 2885 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.57-1.61 (m, 4H, $CH_2$ of pyrrolidine ring), 2.35-2.38 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.8 (t, 4H, $CH_2N$ of pyrrolidine ring), 2.82-2.86 (t, 2H, $CH_2$-S-C=S), 4.02-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 331; Analysis: $C_{18}H_{21}NOS_2$, Calcd. (%): C, 65.22, H, 6.39, N, 4.23, Obsd. (%): C, 65.63, H, 6.12, N, 4.01.

**Pyrrolidine-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (18):** Yield: 0.64 g (86.5 %); m.p.: 95 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 679 (C-S), 1125 (C=S), 1484 (Ar), 1525 (Ar), 1610 (Ar), 2885 (CH), 2947 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.56-1.60 (m, 4H, $CH_2$ of pyrrolidine ring), 1.71-1.72 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.95-1.98 (m, 2H, S-$CH_2CH_2$), 2.8 (t, 4H, $CH_2N$ of pyrrolidine ring), 2.84-2.88 (t, 2H, $CH_2$-S-C=S), 4.02-4.05 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 345; Analysis: $C_{19}H_{23}NOS_2$, Calcd. (%): C, 66.09, H, 6.57, N, 4.15, Obsd. (%): C, 66.57, H, 6.32, N, 3.86.

**Piperidine-1-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (19):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1110 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.48-1.50 (m, 6H, $CH_2$ of piperidine ring), 2.7 (t, 4H, $CH_2N$ of piperidine ring), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 331; Analysis: $C_{18}H_{21}NOS_2$, Calcd. (%): C, 65.22, H 6.39, N, 4.23, Obsd. (%): C, 65.73, H, 6.13, N, 3.98.

**Piperidine-1-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (20):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1112 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2927 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.48-1.50 (m, 6H, $CH_2$ of piperidine ring), 2.7 (t, 4H, $CH_2N$ of piperidine ring), 2.82-2.86 (t, 2H, $CH_2$-S-C=S), 2.35-2.38 (m, 2H, $CH_2CH_2$), 4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 392.54; Analysis: $C_{19}H_{24}N_2O_2S_3$, Calcd. (%): C, 58.22, H 6.20, N, 7.23, Obsd. (%): C, 58.14.73, H, 6.16, N, 7.14, O, 12.23, S, 16.13.

**Piperidine-1-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (21):** Yield: 0.66 g (82.5 %); m.p.: 89 °C;

IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1110 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2925 (CH); $^1H$ NMR ($CDCl_3$): δ = 1.48-1.50 (m, 6H, $CH_2$ of piperidine ring), 2.7 (t, 4H, $CH_2N$ of piperidine ring), 2.83-2.86 (t, 2H, $CH_2$-S-C=S), 1.92-1.96 (m, 2H, $CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2$), 4.00-4.02 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.65 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 406.56; Analysis: $C_{20}H_{26}N_2O_3S_2$, Calcd. (%): C, 59.12, H 6.49, N, 6.82, O, 11.82, S, 15.75. Obsd. (%): C, 59.08, H, 6.45, N, 6.89, O, 11.89, S, 15.79.

**4-Methyl-piperazine-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (22):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1112 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 2.24-2.27 (s, 3H, $CH_3$ of methyl piperazine ring), 2.44-2.48 (t, $CH_2N$ of piperazine ring), 2.62-2.65 (t, $CH_2N$ of piperazine ring), 2.0 (bs, H, NH), 3.25-3.29 (t, 2H, $CH_2$-S-C=S), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.65 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 361; Analysis: $C_{18}H_{23}N_3OS_2$, Calcd. (%): C, 59.84, H 6.39, N, 11.60, O, 4.40, S, 17.72 % Obsd. (%): C, 59.80, H, 6.41, N, 11.62 % O, 4.43, S, 17.74.

**4-Methyl-piperazine-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (23):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1110 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 2.24-2.27 (s, 3H, $CH_3$ of methyl piperazine ring), 2.44-2.48 (t, $CH_2N$ of piperazine ring), 2.62-2.65 (t, $CH_2N$ of piperazine ring), 2.0 (bs, H, NH), 2.84-2.87 (t, 2H, $CH_2$-S-C=S), 2.34-2.38 (m, 2H, $CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.63 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 375.55; Analysis: $C_{19}H_{25}N_3OS_2$, Calcd. (%): C, 60.72, H 6.69, N, 11.23, O, 4.22, S, 17.05 % Obsd. (%): C, 60.76, H, 6.71, N, 11.19, O, 4.26, S, 17.08.

**4-Methyl-piperazine-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (24):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1112 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2925 (CH); $^1H$ NMR ($CDCl_3$): δ = 2.24-2.27 (s, 3H, $CH_3$ of methyl piperazine ring), 2.44-2.48 (t, $CH_2N$ of piperazine ring), 2.62-2.65 (t, $CH_2N$ of piperazine ring), 2.0 (bs, H, NH), 2.84-2.86 (t, 2H, $CH_2$-S-C=S), 1.94-1.96 (m, 2H, $CH_2CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 389.58; Analysis: $C_{20}H_{27}N_3OS_2$, Calcd. (%): C, 61.64, H 6.93, N, 10.73, O, 4.08, S, 16.42 % Obsd. (%): C, 61.66, H, 6.99, N, 10.79, O, 4.11, S, 16.46.

**Morpholine 4-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (25):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1110 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 3.62-3.67 (t, 2H, $CH_2$ of morphaline ring), 2.34-2.37 (t, $CH_2N$ of morphaline ring), 2.35-2.40 (s, $CH_2SCS$), 2.84-2.86 (t, 2H, $CH_2$-S-C=S), 2.34-2.38 (m, 2H, $CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 382.50; Analysis: $C_{17}H_{22}N_2O_4S_2$, Calcd. (%): C, 53.35, H 5.79, N, 7.30, O, 16.70, S, 16.72 Obsd. (%): C, 53.38, H, 5.80, N, 7.32, O, 16.73, S, 16.77.

**Morpholine 4-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (26):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1112 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 3.62-3.67 (t, 2H, $CH_2$ of morphaline ring), 2.34-2.37 (t, $CH_2N$ of morphaline ring), 2.35-2.40 (s, $CH_2$-S-C=S), 1.95-1.99 (m, 4H, $CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.65 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 396.52; Analysis: $C_{18}H_{24}N_2O_4S_2$, Calcd. (%): C, 45.50, H 6.09, N, 7.10, O, 16.10, S, 16.15. Obsd. (%): C, 45.52, H, 6.10, N, 7.06 % O, 16.14, S, 16.17.

**Morpholine 4-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (27):** Yield: 0.66 g (82.5 %); m.p.: 89 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1110 (C=S), 1461 (Ar), 1509 (Ar), 1605 (Ar), 2859 (CH), 2926 (CH); $^1H$ NMR ($CDCl_3$): δ = 3.62-3.67 (t, 2H, $CH_2$ of morphaline ring), 2.34-2.37 (t, $CH_2N$ of morphaline ring), 2.35-2.40 (s, $CH_2SCS$), 3.25-3.28 (t, 2H, $CH_2$-S-C=S), 1.94-1.96 (m, 2H, $CH_2CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.63 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 410.55; Analysis: $C_{19}H_{26}N_2O_4S_2$, Calcd. (%): C, 55.55, H 6.39, N, 6.30, O, 15.55, S, 15.60. Obsd. (%): C, 55.58, H, 6.35, N, 6.85, O, 15.59, S, 15.62.

***p*-Tolyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)-ethyl ester (28):** Yield: 0.76 g (88.4 %); m.p.: 137 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 660 (C-S), 1111 (C=S), 1454 (Ar), 1502 (Ar), 1602 (Ar), 2851 (CH), 2928 (CH), 3388 (NH); $^1H$ NMR ($CDCl_3$): δ = 2.34 (s, 3H, $CH_3$), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.0 (bs, H, NH), 4.70-4.72 (t, 2H, $CH_2$-O-naphthyl), 6.35-7.62 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 353; Analysis: $C_{20}H_{19}NOS_2$, Calcd. (%): C, 67.89, H, 5.45, N, 3.99, Obsd. (%): C, 67.63, H, 5.58, N, 4.12.

***p*-Tolyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)-propyl ester (29):** Yield: 0.76 g (88.4 %); m.p.: 137 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1111 (C=S), 1454 (Ar), 1502 (Ar), 1601 (Ar), 2851 (CH), 2928 (CH), 3388 (NH); $^1H$ NMR ($CDCl_3$): δ = 2.34 (s, 3H, $CH_3$), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.0 (bs, H, NH), 2.35-2.40 (s, $CH_2$-S-C=S), 1.95-1.99 (m, 4H, $CH_2CH_2$), 4.68-4.71 (t, 2H, $CH_2$-O-naphthyl), 6.34-7.64 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 367.53; Analysis: $C_{21}H_{21}NOS_2$, Calcd. (%): C, 68.60, H, 5.72, N, 3.80, O, 4.31, S, 17.45 % Obsd. (%): C, 68.63, H, 5.76, N, 3.81 % O, 4.35, S, 17.45.

***p*-Tolyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)-butyl ester (30):** Yield: 0.76 g (88.4 %); m.p.: 137 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1111 (C=S), 1454 (Ar), 1502 (Ar), 1601 (Ar), 2851 (CH), 2928 (CH), 3388 (NH); $^1H$ NMR ($CDCl_3$): δ = 2.34 (s, 3H, $CH_3$), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.0 (bs, H, NH), 2.35-2.40 (s, $CH_2SCS$), 3.25-3.27 (t, 2H, $CH_2$-S-C=S), 1.94-1.96 (m, 2H, $CH_2CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2CH_2$), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.35-7.63 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 381.55; Analysis: $C_{22}H_{23}NOS_2$, Calcd. (%): C, 69.20, H, 6.06, N, 3.62, O, 4.15, S, 16.79. Obsd. (%): C, 69.25, H, 6.08, N, 3.67, O, 4.19, S, 16.81.

**(4-Methoxy-4-phenyl)dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (31):** Yield: 0.8 g (89.2 %); m.p.: 117 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 659 (C-S), 1106 (C=S), 1455 (Ar), 1502 (Ar), 1600 (Ar), 2854 (CH), 2926 (CH), 3389 (NH); $^1H$ NMR ($CDCl_3$): δ = 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 3.72 (s, 3H, $OCH_3$), 4.0 (bs, H, NH), 4.70-4.72 (t, 2H, $CH_2$-O-naphthyl),

6.35-7.64 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 369; Analysis: $C_{20}H_{19}NO_2S_2$, Calcd. (%): C, 65.01, H, 5.18, N, 3.79, Obsd. (%): C, 65.47, H, 5.03, N, 3.48.

**(4-Methoxy-4-phenyl)dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (32):** Yield: 0.82 g (93.8 %); m.p.: 139 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1117 (C=S), 1472 (Ar), 1524 (Ar), 1614 (Ar), 2876 (CH), 2938 (CH), 3396 (NH); $^1$H NMR ($CDCl_3$): δ = 2.38-2.42 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.84-2.88 (t, 2H, $CH_2$-S-C=S), 3.74 (s, 3H, $OCH_3$), 4.0 (bs, H, NH), 4.02-4.05 (t, 2H, $CH_2$-O-naphthyl), 6.34-7.65 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 383; Analysis: $C_{21}H_{21}NO_2S_2$, Calcd. (%): C, 65.76, H 5.52, N, 3.65, Obsd. (%): C, 65.27, H, 5.85, N, 3.81.

**(4-Methoxy-4-phenyl)dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (33):** Yield: 0.83 g (94.5 %); m.p.: 126 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 681 (C-S), 1126 (C=S), 1484 (Ar), 1523 (Ar), 1610 (Ar), 2885 (CH), 2936 (CH), 3407 (NH); $^1$H NMR ($CDCl_3$): δ = 1.71-1.74 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.94-1.96 (m, 2H, S-$CH_2CH_2$), 2.01 (bs, H, NH), 2.82-2.86 (t, 2H, $CH_2$-S-C=S), 3.72 (s, 3H, $OCH_3$),3.92-3.94 (d, 2H, $CH_2$ of benzylic proton),4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.65-7.62 (m, 11H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 411; Analysis: $C_{23}H_{25}NO_2S_2$, Calcd. (%): C, 67.12, H, 6.12, N, 3.40, Obsd. (%): C, 67.67, H, 6.40, N, 3.67.

**Cyclohexyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (34):** Yeild: 0.714 g (85.5 %), m.p; 112 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 658 (C-S), 1103 (C=S), 1454 (Ar), 1502 (Ar), 1600 (Ar), 2851 (CH), 2926 (CH), 3373 (NH); $^1$H NMR ($CDCl_3$): δ = 1.41-1.45 (m, 6H,$CH_2$ of cyclohexyl ring), 1.62-1.64 (m, 4H, $CH_2$ of cyclohexyl ring), 2.0 (bs, H, NH), 2.54-2.58 (m, H, *tertiary* H of cyclohexyl ring), 3.26-3.29 (t, 2H, $CH_2$-S-C=S), 4.71-4.74 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 345; Analysis: $C_{19}H_{23}NOS_2$, Calcd. (%): C, 66.05, H, 6.71, N, 4.05, Obsd. (%): C, 65.65, H, 6.97, N, 4.23.

**Cyclohexyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (35):** Yield: 0.714 g (85.5 %); m.p.: 112 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 658 (C-S), 1103 (C=S), 1454 (Ar), 1502 (Ar), 1600 (Ar), 2851 (CH), 2927 (CH), 3373 (NH); $^1$H NMR ($CDCl_3$): δ = 1.44-1.48 (m, 6H,$CH_2$ of cyclohexyl ring), 1.63-1.66 (m, 4H, $CH_2$ of cyclohexyl ring), 2.0 (bs, H, NH), 2.54-2.59 (m, H, *tertiary* H of cyclohexyl ring), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 345; Analysis: $C_{19}H_{23}NOS_2$, Calcd. (%): C, 66.05, H, 6.71, N, 4.05, Obsd. (%): C, 65.65, H, 6.97, N, 4.23.

**Cyclohexyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (36):** Yield: 0.75 g (94.5 %); m.p.: 126 °C; IR (KBr, $\nu_{max}$, cm-$^1$): 668 (C-S), 1121 (C=S), 1469 (Ar), 1523 (Ar), 1617 (Ar), 2879 (CH), 2937 (CH), 3408 (NH); $^1$H NMR ($CDCl_3$): δ = 1.42-1.44 (m, 6H, $CH_2$ of cyclohexyl ring), 1.65-1.68 (m, 4H, $CH_2$ of cylohexyl ring), 1.71-1.73 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.94-1.96 (m, 2H, S-$CH_2CH_2$), 2.0 (bs, H, NH), 2.54-2.57 (m, H, *tert.* CH of cylohexyl ring), 2.84-2.88 (t, 2H, $CH_2$-S-C=S), 4.02-4.06 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.62 (m, 7H, Ar-H of naphthyloxy); Mass: *m/e* 373; Analysis: $C_{21}H_{27}NOS_2$, Calcd. (%): C, 67.52, H, 7.28, N, 3.75, Obsd. (%): C, 67.84, H, 7.12, N, 3.59.

**Benzyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)-ethyl ester (37):** Yield: 0.75 g (87.3 %); m.p.: 101 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 662 (C-S), 1112 (C=S), 1464 (Ar), 1512 (Ar), 1603 (Ar), 2865 (CH), 2926 (CH), 3385 (NH); $^1$H NMR ($CDCl_3$): δ = 2.0 (bs, H, NH), 3.26-3.32 (t, 2H, $CH_2$-S-C=S), 3.92-3.94 (d, 2H, benzylic proton), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.65 (m, 12H, Ar-H of naphthyloxy); Mass: *m/e* 353; Analysis: $C_{20}H_{19}NOS_2$, Calcd. (%): C, 67.95, H 5.42, N, 3.96, Obsd. (%): C, 67.63, H, 5.58, N, 4.12.

**Benzyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)-propyl ester (38):** Yield: 0.75 g (89.8 %); m.p.: 109 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1114 (C=S), 1474 (Ar), 1514 (Ar), 1612 (Ar), 2863 (CH), 2926 (CH), 3398 (NH); $^1$H NMR ($CDCl_3$): δ = 2.0 (bs, H, NH), 2.38-2.42 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.82-2.86 (t, 2H, $CH_2$-S-C=S), 3.91-3.93 (d, 2H, $CH_2$ of benzylic hydrogens), 4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 12H, Ar-H of naphthyloxy); Mass: *m/e* 367; Analysis: $C_{21}H_{21}NOS_2$, Calcd. (%): C, 68.63, H, 5.76, N, 3.81, Obsd. (%): C, 68.27, H, 5.94, N, 4.02.

**Benzyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)-butyl ester (39):** Yield: 0.75 g (92.8 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 673 (C-S), 1126 (C=S), 1484 (Ar), 1529 (Ar), 1612 (Ar), 2873 (CH), 2936 (CH), 3398 (NH); $^1$H NMR ($CDCl_3$): δ = 1.71-1.74 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.96-1.99 (m, 2H, S-$CH_2CH_2$), 2.0 (bs, H, NH), 2.84-2.88 (t, 2H, $CH_2$-S-C=S), 3.91-3.94 (d, 2H, $CH_2$ of benzylic proton), 4.01-4.04 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.65 (m, 12H, Ar-H of naphthyloxy); Mass: *m/e* 381; Analysis: $C_{22}H_{23}NOS_2$, Calcd. (%): C, 69.25, H 6.08, N, 3.67, Obsd. (%): C, 69.67, H, 5.87, N, 3.46.

**Phenyl ethyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (40):** Yield: 0.78 g (88.2 %); m.p.: 146 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 661 (C-S), 1112 (C=S), 1464 (Ar), 1514 (Ar), 1605 (Ar), 2865 (CH), 2923 (CH), 3376 (NH); $^1$H NMR ($CDCl_3$): δ = 2.0 (bs, H, NH), 2.80-2.82 (t, 2H, $PhCH_2$), 2.96-2.98 (m, 2H, $NHCH_2CH_2Ph$), 3.28-3.31 (t, 2H, $CH_2$-S-C=S), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.62 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 367; Analysis: $C_{21}H_{21}NOS_2$, Calcd. (%): C, 68.63, H, 5.76, N, 3.81, Obsd. (%): C, 68.19, H, 6.06, N, 3.95.

**Phenyl ethyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (41):** Yield: 0.8 g (91.4 %); m.p.: 172 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1126 (C=S), 1478 (Ar), 1519 (Ar), 1614 (Ar), 2878 (CH), 2933 (CH), 3396 (NH); $^1$H NMR ($CDCl_3$): δ = 2.0 (bs, H, NH), 2.35-2.41 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.80-2.82 (t, 2H, $PhCH_2$), 2.84-2.86 (t, 2H, $CH_2$-S-C=S), 2.96-3.02 (m, 2H, $CH_2NH$), 4.02-4.06 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 12H, Ar-H of naphthyloxy and phenyl group); Mass: *m/e* 381; Analysis: $C_{22}H_{23}NOS_2$, Calcd. (%): C, 69.25, H, 6.08, N, 3.67, Obsd. (%): C, 68.87, H, 6.29, N, 3.89.

**Phenyl ethyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (42):** Yield: 0.8 g (94.8 %); m.p.: 179 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 679 (C-S), 1149 (C=S), 1487 (Ar), 1533 (Ar), 1622 (Ar), 2884 (CH), 2944 (CH), 3438 (NH); $^1$H NMR ($CDCl_3$): δ = 1.72-1.74 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.96-1.97 (m, 2H, S-$CH_2CH_2$), 2.01 (bs, H, NH),2.80-2.82 (t, 2H, $PhCH_2$), 2.86-2.88 (t, 2H, $CH_2$-S-C=S), 2.96-3.00 (m, 2H, $CH_2NH$), 4.02-4.06 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.62 (m,

12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 395; Analysis: $C_{23}H_{25}NOS_2$, Calcd. (%): C, 69.93, H, 6.37, N, 3.54, Obsd. (%): C, 69.57, H, 6.55, N, 3.72.

**Phenyl propyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (43):** Yield: 0.84 g (90.2 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1114 (C=S), 1462 (Ar), 1514 (Ar), 1600 (Ar), 2862 (CH), 2925 (CH), 3388 (NH); $^1$H NMR ($CDCl_3$): δ = 1.86-1.88 (m, 2H, $PhCH_2CH_2CH_2NH$), 2.0 (bs, H, NH), 2.54-2.56 (t, 2H, $PhCH_2$), 2.65-2.64 (m, 2H, $NHCH_2CH_2CH_2Ph$), 3.28-3.31 (t, 2H, $CH_2$-S-C=S), 4.72-4.74 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.62 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 381; Analysis: $C_{22}H_{23}NOS_2$, Calcd. (%): C, 69.25, H 6.08, N, 3.67, Obsd. (%): C, 69.66, H, 5.99, N, 3.35.

**Phenyl propyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (44):** Yield: 0.84 g (93.2 %); m.p.: 135 °C; IR (KBr, $\nu_{max}$, cm-$^1$): 682 (C-S), 1129 (C=S), 1481 (Ar), 1533 (Ar), 1626 (Ar), 2884 (CH), 2936 (CH), 3416 (NH); $^1$H NMR ($CDCl_3$): δ = 1.86-1.89 (m, 2H, $Ph.CH_2CH_2CH_2$), 2.0 (bs, H, NH), 2.38-2.42 (m, 2H, naphthyl-O-$CH_2CH_2CH_2$-S-C=S), 2.52-2.55 (t, 2H, $PhCH_2$), 2.62-2.64 (m, 2H, $NHCH_2$), 2.84-2.88 (t, 2H, $CH_2$-S-C=S), 4.02-4.05 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.65 (m, 12H, Ar-H of naphthyloxy and phenyl group); Mass: *m/e* 395; Analysis: $C_{23}H_{25}NOS_2$, Calcd. (%): C, 69.83, H 6.37, N, 3.54, Obsd. (%): C, 69.34, H, 6.66, N, 3.74.

**Phenyl propyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (45):** Yield: 0.85 g (97.6 %); m.p.: 154 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 692 (C-S), 1139 (C=S), 1486 (Ar), 1539 (Ar), 1628 (Ar), 2882 (CH), 2948 (CH), 3427 (NH); $^1$H NMR ($CDCl_3$): δ = 1.71-1.73 (m, 2H, naphthyl-O-$CH_2CH_2$), 1.86-1.88 (m, 2H, $PhCH_2CH_2$ $CH_2NH$), 1.96-1.99 (m, 2H, S-$CH_2CH_2$), 2.02 (bs, H, NH), 2.54-2.56 (t, 2H, $PhCH_2$), 2.64-2.68 (m,2H,$PhCH_2CH_2CH_2$-N), 2.84-2.86 (t, 2H, $CH_2$-S-C=S), 2.98-3.01 (m, 2H, $CH_2NH$), 4.02-4.06 (t, 2H, $CH_2$-O-naphthyl), 6.98-7.62 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 409; Analysis: $C_{24}H_{27}NOS_2$, Calcd. (%): C, 70.37, H, 6.64, N, 3.42, Obsd. (%): C, 69.95, H, 6.86, N, 3.62.

**Di-*sec*-butyl-dithiocarbamic acid-2-(naphthalen-2-yloxy)ethyl ester (46):** Yield: 0.84 g (90.2 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1115 (C=S), 1462 (Ar), 1514 (Ar), 1601 (Ar), 2865 (CH), 2926 (CH), 3388 (NH); $^1$H NMR ($CDCl_3$): δ = 1.08-1.10 (d, $CH_3$), 2.75-2.79 (m, 8H, $CH_3CH_2CH_3$), 1.38-1.41 (M, 6H, $CH_3CHCH_3$), 0.94-0.96 (t, 2H,$CH_3CHCH_2$), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.95-7.63 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 375.59; Analysis: $C_{21}H_{29}NOS_2$, Calcd. (%): C, 67.10, H 7.75, N, 3.70, O, 4.22, S, 17.05. Obsd. (%): C, 67.15, H, 7.78, N, 3.73, O, 4.26, S, 17.07.

**Di-*sec*-butyl-dithiocarbamic acid-3-(naphthalen-2-yloxy)propyl ester (47):** Yield: 0.84 g (90.2 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1114 (C=S), 1462 (Ar), 1514 (Ar), 1600 (Ar), 2862 (CH), 2925 (CH), 3388 (NH); $^1$H NMR ($CDCl_3$): δ = 1.08-1.10 (d, $CH_3$), 2.75-2.79 (m, 8H, $CH_3CH_2CH_3$), 1.38-1.41 (M, 6H, $CH_3CHCH_3$), 0.94-0.96 (t, 2H,$CH_3CHCH_2$), 3.28-3.30 (t, 2H, $CH_2$-S-C=S), 2.35-2.39(m, 2H, $CH_2CH_2CH_2$), 4.72-4.74 (t, 2H, $CH_2$-O-naphthyl), 6.96-7.62 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 389.62; Analysis: $C_{22}H_{31}NOS_2$, Calcd. (%): C, 67.80, H 8.01, N, 3.60, O, 4. 10, S, 16.42. Obsd. (%): C, 67.82, H, 8.02, N, 3.59, O, 4.11, S, 16.46.

**Di-*sec*-butyl-dithiocarbamic acid-4-(naphthalen-2-yloxy)butyl ester (48):** Yield: 0.84 g (90.2 %); m.p.: 119 °C; IR (KBr, $\nu_{max}$, $cm^{-1}$): 668 (C-S), 1114 (C=S), 1465 (Ar), 1514 (Ar), 1600 (Ar), 2865 (CH), 2927 (CH), 3388 (NH); $^1$H NMR ($CDCl_3$): δ = 1.08-1.10 (d, $CH_3$), 2.75-2.79 (m, 8H, $CH_3CH_2CH_3$), 1.38-1.41 (M, 6H, $CH_3CHCH_3$), 0.94-0.96 (t, 2H,$CH_3CHCH_2$), 3.27-3.31 (t, 2H, $CH_2$-S-C=S), 1.92-1.96 (m, 2H, $CH_2CH_2CH_2$), 1.68-1.71 (m, 2H, $CH_2CH_2CH_2$), 4.71-4.73 (t, 2H, $CH_2$-O-naphthyl), 6.97-7.64 (m, 12H, Ar-H of naphthyloxy and phenyl ring); Mass: *m/e* 403.64; Analysis: $C_{23}H_{33}NOS_2$, Calcd. (%): C, 68.41, H 8.20, N, 3.44, O, 3.92, S, 15.87. Obsd. (%): C, 68.44, H, 8.24, N, 3.47, O, 3.96, S, 15.89.

## RESULTS AND DISCUSSION

The synthetic route of ω-substituted 2-naphthyloxy haloalkanes and desired products (**4-48**) as shown in **Scheme-I** is prepared by direct condensation of β-naphthol and alkyl dihalide. Intermediate ω-substituted 2-naphthyloxy haloalkanes (**3**) was prepared by reacting alkyl dihalide (**2**) with β-naphthol (**1**) in the presence of anhydrous $K_2CO_3$ which was subsequently converted to corresponding dithiocarbamates of **4** to **48** by reaction of various types of primary and secondary amines involving Triton B/$CS_2$ system at room temperature. Hence, dithiocarbamates of desired (**4-48**) series is synthesized employing various kinds of aliphatic, aromatic, alicyclic, heterocyclic primary and secondary amines. The protocol proved to be successful and the desired product was isolated and further confirmed by spectroscopic and analytical methods.

The structural characterization of title compounds have been done by melting point, $^1$H NMR, $^{13}$C NMR and high-resolution mass spectrometry (HRMS). All spectral data were consistent with the assigned structures. The comparative study of the yield of **3a**, **3b** and **3c** increases with number of carbon due to +I effect. However, final yield of dithiocarbamates of Prototype **I** (**4-48**) is dependent upon the electron releasing effect of the amines like pyrrolidine, piperidine, *N*-methyl piperazine, cyclohexane, phenyl ethyl amine and phenyl propyl amine show higher yield compared to primary amines (Table-1).

**Antimicrobial screening:** The series of compounds were screened for antimicrobial activity through microdilution method using various bacterial and fungal strains. The antifungal and antibacteriaal values were estimated as MIC values. Fluconazole and ciprofloxacin were used as the standard antifungal and antibacterial drug. As shown in Table-2, the SAR of these compounds can be studied by variying the alkyl chain and amines attached to these range of compounds. Compounds having three-carbon chain attached to them are found to be more active as compared to two-carbon or four-carbon chain. Among **28**, **29**, **30** and **31**, **32**, **33**, **29** and **33** were found to possess higher potency as compared to others because of the three-carbon chain attached to them. The higher potency of three-carbon chain is due to hydrophilicity. Upon studying the effect of various types of amines, we found that compounds like **28**, **29**, **30**, **31**, **32** and **33** having aromatic amine like anisidine and toludine possessed comparable values to control drugs. Substitution of heterocyclic amines in compounds **16**,

TABLE-1
SYNTHESIS OF VARIOUS TYPES OF DITHIOCARBAMATES OF ω-SUBSTITUTED 2-NAPHTHYLOXY ALKANES

| Comp. No. | n | $R_1$ | $R_2$ | Time (min) | Yield (%) |
|---|---|---|---|---|---|
| **4** | 1 | $C_4H_9$ | H | 35 | 93 |
| **5** | 2 | $C_4H_9$ | H | 30 | 95 |
| **6** | 3 | $C_4H_9$ | H | 38 | 93 |
| **7** | 1 | $C_6H_{11}$ | H | 30 | 94 |
| **8** | 2 | $C_6H_{11}$ | H | 30 | 95 |
| **9** | 3 | $C_6H_{11}$ | H | 35 | 94 |
| **10** | 1 | $C_8H_{15}$ | H | 40 | 90 |
| **11** | 2 | $C_8H_{15}$ | H | 35 | 94 |
| **12** | 3 | $C_8H_{15}$ | H | 38 | 92 |
| **13** | 1 | $C_{10}H_{19}$ | H | 40 | 93 |
| **14** | 2 | $C_{10}H_{19}$ | H | 38 | 95 |
| **15** | 3 | $C_{10}H_{19}$ | H | 40 | 92 |
| **16** | 1 | $R_1 = R_2$ = Pyrrolidine | – | 25 | 96 |
| **17** | 2 | $R_1 = R_2$ = Pyrrolidine | – | 20 | 98 |
| **18** | 3 | $R_1 = R_2$ = Pyrrolidine | – | 25 | 95 |
| **19** | 1 | $R_1 = R_2$ = Piperidine | – | 30 | 98 |
| **20** | 2 | $R_1 = R_2$ = Piperidine | – | 28 | 95 |
| **21** | 3 | $R_1 = R_2$ = Piperidine | – | 30 | 98 |
| **22** | 1 | $R_1 = R_2$ = *N*-methyl piperazine | – | 20 | 98 |
| **23** | 2 | $R_1 = R_2$ = *N*-methyl piperazine | – | 20 | 98 |
| **24** | 3 | $R_1 = R_2$ = *N*-methyl piperazine | – | 20 | 96 |
| **25** | 1 | $R_1 = R_2$ = Morpholine | – | 25 | 90 |
| **26** | 2 | $R_1 = R_2$ = Morpholine | – | 20 | 92 |
| **27** | 3 | $R_1 = R_2$ = Morpholine | – | 25 | 90 |
| **28** | 1 | $R_1 = R_2$ = Toludine | – | 25 | 92 |
| **29** | 2 | $R_1 = R_2$ = Toludine | – | 20 | 94 |
| **30** | 3 | $R_1 = R_2$ = Toludine | – | 25 | 90 |
| **31** | 1 | $R_1 = R_2$ = Anisidine | – | 30 | 92 |
| **32** | 2 | $R_1 = R_2$ = Anisidine | – | 20 | 90 |
| **33** | 3 | $R_1 = R_2$ = Anisidine | – | 25 | 92 |
| **34** | 1 | $R_1 = R_2$ = Cyclohexane | – | 25 | 95 |
| **35** | 2 | $R_1 = R_2$ = Cyclohexane | – | 25 | 92 |
| **36** | 3 | $R_1 = R_2$ = Cyclohexane | – | 30 | 94 |
| **37** | 1 | $Ph(CH_2)$ | H | 40 | 93 |
| **38** | 2 | $Ph(CH_2)$ | H | 25 | 96 |
| **39** | 3 | $Ph(CH_2)$ | H | 30 | 98 |
| **40** | 1 | $Ph(CH_2CH_2)$ | H | 20 | 98 |
| **41** | 2 | $Ph(CH_2CH_2)$ | H | 20 | 98 |
| **42** | 3 | $Ph(CH_2CH_2)$ | H | 25 | 90 |
| **43** | 1 | $Ph(CH_2CH_2CH_2)$ | H | 25 | 92 |
| **44** | 2 | $Ph(CH_2CH_2CH_2)$ | H | 30 | 92 |
| **45** | 3 | $Ph(CH_2CH_2CH_2)$ | H | 25 | 95 |
| **46** | 1 | $R_1 = R_2$ = Dibutyl | – | 30 | 97 |
| **47** | 2 | $R_1 = R_2$ = Dibutyl | – | 25 | 95 |
| **48** | 3 | $R_1 = R_2$ = Dibutyl | – | 35 | 80 |

**17**, **18**, **19**, **20**, **21**, **22**, **23**, **24**, **25**, **26** and **27** gave promising result. Among substituted aromatic amines benzyl amine (**37**, **38** and **39**) gave better result than phenyl ethyl (**40**, **41** and **42**) and phenyl propyl amine (**43**, **44** and **45**).

## Conclusion

In conclusion, a convenient and efficient protocol for one-pot synthesis has been developed, employing three components coupling of various amines with variety of *via* $CS_2$ Bridge using Triton-B. This method produces the corresponding dithiocarbamates in good to excellent yields. Furthermore, the compounds produces by this method exhibited maximum potency for antifungal and antibacterial activity which is comparable to standard drug.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

TABLE-2
ANTIMICROBIAL DATA OF DITHIOCARBAMATES OF ω-SUBSTITUTED 2-NAPHTHYLOXY ALKANES

| Compounds | Antifungal activity | | | | Antibacterial activity | | | |
|---|---|---|---|---|---|---|---|---|
| | *C. albicans* | *S. schenckii* | *A. fumigatus* | *A. niger* | *S. aureus* | MRSA* | *E. coli* | *P. aeruginosa* |
| **4** | 1.56 | 1.52 | 6.25 | 8 | 6.25 | >50 | 3.12 | 6.25 |
| **5** | 1.58 | 1.56 | 6.27 | 8.5 | 6.27 | >50 | 3.14 | 6.26 |
| **6** | 1.60 | 1.58 | 6.28 | 9 | 6.28 | >50 | 3.18 | 6.28 |
| **7** | 3.12 | 1.56 | >50 | 8 | 8 | >50 | 6.25 | >50 |
| **8** | 3.14 | 1.58 | >50 | 8.5 | 8.8 | >50 | 6.27 | >50 |
| **9** | 3.18 | 1.62 | >50 | 8.8 | 9 | >50 | 6.28 | >50 |
| **10** | 6.25 | 6.25 | >50 | 16 | 16 | >50 | >50 | >50 |
| **11** | 6.27 | 6.27 | >50 | 15 | 17 | >50 | >50 | >50 |
| **12** | 6.30 | 6.28 | >50 | 18 | 18 | >50 | >50 | >50 |
| **13** | 12.5 | 6.25 | >50 | >50 | >50 | >50 | >50 | >50 |
| **14** | 12.8 | 6.28 | >50 | >50 | >50 | >50 | >50 | >50 |
| **15** | 13.0 | 6.28 | >50 | >50 | >50 | >50 | >50 | >50 |
| **16** | 0.92 | 0.32 | 0.80 | 1.30 | 3.12 | >50 | 0.62 | 3.12 |
| **17** | 0.75 | 0.28 | 0.71 | 1.20 | 3.14 | >50 | 0.48 | 3.14 |
| **18** | 0.82 | 0.32 | 0.78 | 1.25 | 3.18 | >50 | 0.54 | 3.16 |
| **19** | 0.95 | 0.35 | 0.89 | 25 | 6.25 | >50 | 0.84 | 6.25 |
| **20** | 0.80 | 0.30 | 0.78 | 24 | 6.27 | >50 | 0.55 | 6.26 |
| **21** | 0.88 | 0.33 | 0.85 | 28 | 6.28 | >50 | 0.72 | 6.28 |
| **22** | 0.88 | 0.30 | 0.75 | 0.82 | 0.78 | 50 | 0.42 | 1.38 |
| **23** | 0.70 | 0.26 | 0.66 | 0.64 | 0.64 | 50 | 0.24 | 1.33 |
| **24** | 0.80 | 0.28 | 0.70 | 0.74 | 0.70 | 50 | 0.36 | 1.35 |
| **25** | 0.81 | 0.29 | 0.68 | 0.66 | 0.76 | 30 | 0.32 | 1.25 |
| **26** | 0.65 | 0.20 | 0.59 | 0.52 | 0.60 | 24 | 0.20 | 1.27 |
| **27** | 0.74 | 0.25 | 0.62 | 0.58 | 0.68 | 28 | 0.25 | 1.29 |
| **28** | 0.80 | 0.25 | 0.62 | 0.58 | 0.68 | 27 | 0.30 | 0.72 |
| **29** | 0.64 | 0.17 | 0.55 | 0.45 | 0.57 | 20 | 0.15 | 0.52 |
| **30** | 0.72 | 0.20 | 0.58 | 0.50 | 0.61 | 25 | 0.19 | 0.65 |
| **31** | 0.78 | 0.20 | 0.52 | 0.50 | 0.59 | 22 | 0.20 | 0.68 |
| **32** | 0.50 | 0.15 | 0.45 | 0.40 | 0.45 | 18 | 0.10 | 0.48 |
| **33** | 0.65 | 0.18 | 0.50 | 0.45 | 0.55 | 20 | 0.15 | 0.55 |
| **34** | 2.89 | 3.12 | >50 | >50 | 8 | >50 | 8 | 12.5 |
| **35** | 2.90 | 3.14 | >50 | >50 | 8.5 | >50 | 8.5 | 12.7 |
| **36** | 3.28 | 3.20 | >50 | >50 | 9 | >50 | 9 | 13.0 |
| **37** | 1.05 | >50 | 50 | >50 | >50 | >50 | 50 | 8 |
| **38** | 0.95 | >50 | 50 | >50 | >50 | >50 | 50 | 8.8 |
| **39** | 1.10 | >50 | 50 | >50 | >50 | >50 | 50 | 9 |
| **40** | 1.16 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **41** | 1.05 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **42** | 1.22 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **43** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **44** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **45** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **46** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **47** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| **48** | >50 | >50 | >50 | >50 | >50 | >50 | >50 | >50 |
| Fluconazone | 0.25 | 0.09 | 0.35 | 0.25 | – | – | – | – |
| Ciprofloxacin | – | – | – | – | 0.25 | 16 | 0.03 | 0.25 |

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