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Non-Conventional and Conventional Synthesis of 2-Substituted-Thiocarbamidophenols

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ABSTRACT

Synthesis of 2-substitutedthiocarbamidophenols **(III)** was carried out by an interactions of 2-aminophenol **(I)** with various isothiocynates **(II)** by solvent free green synthetic non-conventional method as well as usual conventional method. Determination and justification of structure of products was established by usual chemical characteristics, elemental analysis and spectral studies.

Keywords: Non-conventional, conventional methods, various isothiocynates 2-substituted thiocarbamido phenols.

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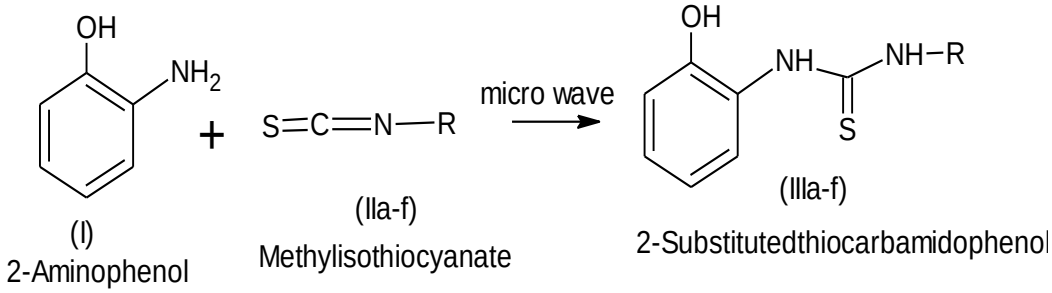
INTRODUCTION

Chemical research in recent years completely focused on eco friendly and green synthesis for reduction of environmental pollution and termed as green chemistry[1-4]. It is recent and up growing branch of science which consist of designing, developing and implementation of performance criterion. Hence it became prime duty of chemist to carry out selectivity in modern synthesis[5]. Microwave and sono-chemical methods of synthesis are green synthetic method in which product yield increases by avoiding undesired side products[6-7], this technique is time saving and endorse variety of solvent-free and eco-friendly chemical reactions[8-12] of low cost, facile, safe and reproducible experimental procedures[13]. So microwave irradiation technique[14-15] became influential synthetic method for rapid, economic and efficient synthesis of variety of compounds[16-19]. Literature survey reveals that synthesis of 1-phenylamidinothiocarbamides was successfully carried out[20-21]. Thiocarbamido nucleus containing molecules have strong antimicrobial activity [22-25]. While some derivatives showed anti-tuberculosis, anti-tumor, anti-cancer and anti-pyretic importance[26-27]. Considering these facts we carried out synthesis of 2-substitutedthiocarbamidophenols by making use of microwave irradiation technique i.e. solvent free non-conventional green synthetic method as well as conventional chemical method **(Scheme-I).**



Where R= -phenyl, p-chlorophenyl, p-tolyl.

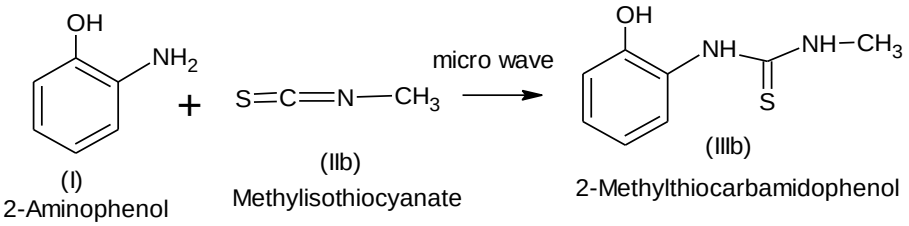
(Scheme-I)

RESULTS AND DISCUSSION

1) Synthesis of 2-methylthiocarbamidophenol (IIIb)

a) Solvent free synthesis by microwave irradiation technique

Interaction of 2-aminophenol **(I)** and methylisothiocynate **(IIb)** was carried out in microwave oven for two minutes. Faint yellow crystals of 2-methylthiocarbamidophenol **(IIIb)** were obtained; these were washed several times with ether, recrystalised from ethanol.

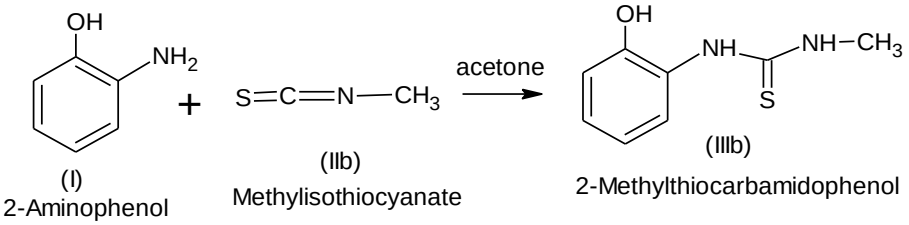


Conventional synthesis

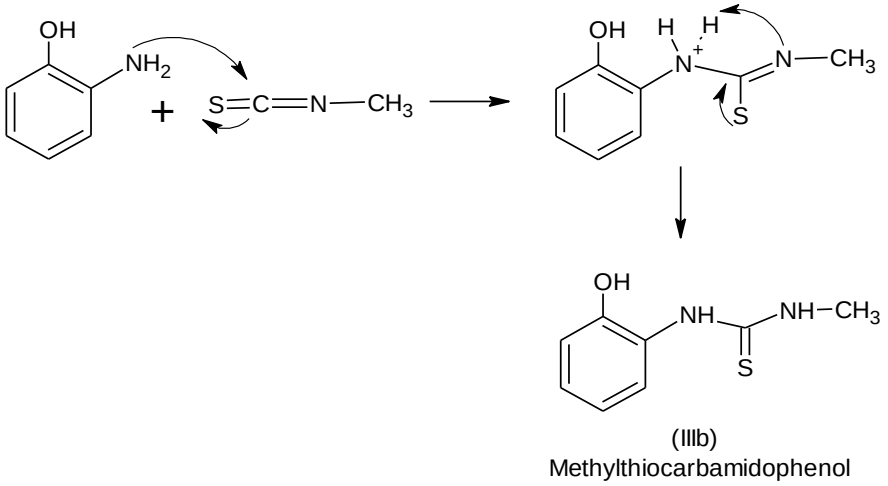
A reaction mixture of 2-aminophenol **(Ia)** and methylisothiocynate **(IIa)** was refluxed in acetone medium for 2 hours after distillation off excess solvent faint yellow crystals of 2-methylthiocarbamidophenol **(IIIb)** were obtained; these were washed several times with ether, recrystalised from ethanol.

In both reactions identical products were isolated. Probable reaction and mechanism of this reaction is as given as below,

Reaction



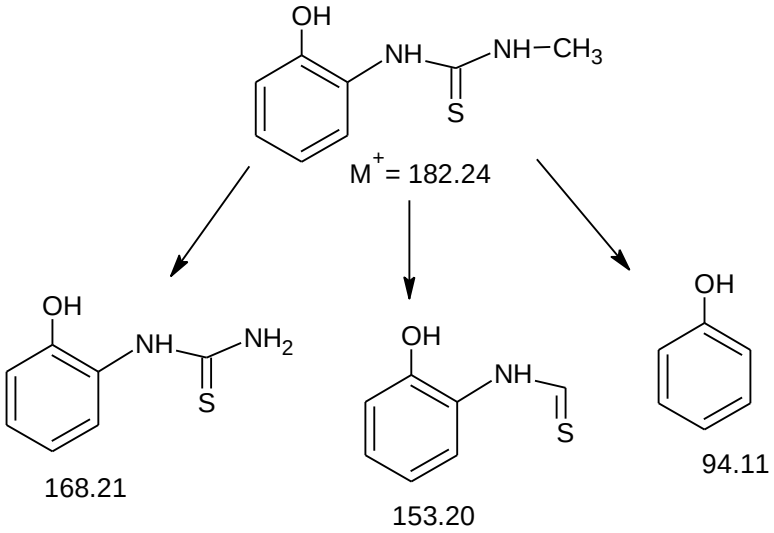
Mechanism



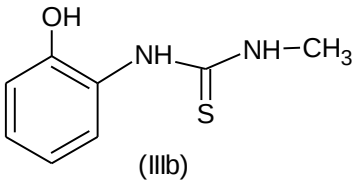
Properties of (IIIb):

Faint yellow crystalline solid, $C_8H_{10}N_2$ O S, Yield-94% by M W technique and by conventional method it is 87%, M.P.154^{0}C. Gave positive test for nitrogen and sulphur elements and phenolic group. Desulphurised by alkaline lead acetate solution indicating presence of C=S group. Formed picrate, M.P.137^{0}C. % Composition-Found(Calculated) C-51.60 (52.74), H-04.50 (05.49), N-

15.38 (15.38), S-16.35 (17.28). **FTIR (KBr) ν cm^{-1}**-: 3376.00 (OH stretching), 3166.01(NH stretching), 2752.13(Ar-H stretching), 1635.00(N-C-N stretching), 1504.20(-N-C=S stretching), 1254.30(C=S stretching), 1090.50 (C-N stretching). **^{1}H NMR (400 MHz CDCl$_3$ δ ppm)**, phenolic -OH proton at δ 8.2035-8.1035 ppm, Ar-H protons at δ 7.6123-6.6618 ppm and -NH protons at δ 4.2576-2.6138 ppm and CH_3 protons at δ 1.4456-1.2922 ppm. **^{13}C Spectrum**: C=S carbon at δ 183.69-181.14 ppm, Ar-C carbon at δ 140.46-120.91 ppm, -CH_3 carbon at δ 40.06-38.80 ppm. **Mass analysis:** Fragmentation occurs during the analysis is given



From above chemical characteristics, elemental and spectral studies compound **(IIIb)** was assigned structure as 2-methylthiocarbamidophenol.



(IIIb)

2-Methylthiocarbamidophenol

Similarly 2-phenylthiocarbamidophenol **(IIIa)** 2-(p-chloro)phenylthio- carbamidophenol **(IIIc)** and 2-(p-tolyl)thiocarbamidophenol **(IIId)** were synthesized by interacting of 2-aminophenol with phenylisothiocyanate **(IIa)**, p-chlorophenylisothiocyanate **(IIc)** and p-tolylisothiocyanate **(IId)** by both non- conventional as well as conventional methods and enlisted in **Table 1.**

Table 1

Sr. No.	2-*Substituted* thiocarbamidophenol	Yield (%) by non-conventional method	Yield(%) by conventional method	m.p.
1.	2-*Phenyl*----------	93	78	189
2.	2-*(p-Chlorophenyl)*------	96	72	191
3.	2-*(p-Tolyl)*----------	95	74	203

Synthesis of 2-phenylthiocarbamidophenol (IIIa)

Dark yellow crystalline solid, $C_{13}H_{12}N_2OS$, Yield-93 % by M W technique and by conventional method it is 78%, M.P. 189^{0}C, % Composition-found(calculated) C-61.67 (63.93), H-3.42(4.91), N-10.40 (11.47), S-12.45(13.11), **FTIR (KBr) ν cm^{-1}**- 3324.89 (O-H stretching), 3185.89 (N-H stretching), 2985.89 (Ar C-H stretching), 1587.31 (N-C-N stretching), 1485.67 (N-C=S Stretching), 1174.62 (C=S stretching), 1027.99 (C-N streching); **^{1}H NMR (400 MHz $CDCl_3$ δ ppm)**, O-H proton at δ 9.1236 ppm, Ar-H 4 protons at δ 7.9436-6.1241 ppm, Ar-H 5 protons at δ 6.7636-6.0341ppm, -NH proton at δ 5.0221 ppm, respectively; **^{13}C NMR (400 MHz $CDCl_3$ δ ppm)** C=S carbon at δ 182.21 ppm, Ar-C carbon at δ 156.16-128.02 ppm, respectively; LC-MS (m/z) Mol. Wt.: 244, (M^+) 243.50, 170.20, 100.22 .

Synthesis of 2-(p-chloro)phenylthiocarbamidophenol (IIIc)

Ivory crystalline solid, $C_{13}H_{11}N_2O$ S Cl , Yield-96 % by M W technique and by conventional method it is 72%, M.P. 191^{0}C, % Composition-found(calculated) C-55.24 (56.11), H-3.42(3.95), N-10.07 (10.07), S-10.45(11.51), **FTIR (KBr) ν cm^{-1}**- 3457.89 (O-H stretching), 3243.89 (N-H stretching), 2895.89 (Ar C-H stretching), 1602.31 (N-C-N stretching), 1508.67 (N-C=S Streching), 1204.62 (C=S stretching), 1020.46 (C-N streching); **^{1}H NMR (400 MHz $CDCl_3$ δ ppm)**, O-H proton at δ 9.1453 ppm, Ar-H 4 protons at δ 7.8564-6.3241 ppm, Ar-H 5 protons at δ 6.4236 ppm, -NH proton at δ 5.4521 ppm, respectively; **^{13}C NMR (400 MHz $CDCl_3$ δ ppm)** C=S carbon at δ 186.21 ppm, Ar-C carbon at δ 161.16-132.02 ppm respectively; LC-MS (m/z) Mol. Wt.: 278, (M^+) 278.50, 170.20, 245.2, 144.22 .

Synthesis of 2-p-(tolyl)thiocarbamidophenol (IIId)

Pale yellow crystalline solid, $C_{14}H_{14}N_2O$ S , Yield-95% by M W technique and by conventional method it is 74%, M.P. 203^{0}C, % Composition-found(calculated) C-64.40 (65.11), H-4.23 (5.42), N-10.40 (10.85), S-07.24 (08.56), **FTIR (KBr) ν cm^{-1}**- 3425.89 (O-H stretching), 3234.89 (N-H stretching), 2878.89 (Ar C-H stretching), 1580.31 (N-C-N stretching), 1562.67 (N-C=S Streching), 1146.62 (C=S stretching), 1102.99 (C-N streching); **^{1}H NMR (400 MHz $CDCl_3$ δ ppm)**, O-H proton at δ 9.2316 ppm, Ar-H 4 protons at δ 7.8320-6.0121 ppm, Ar-H 5 protons at δ 6.6541-6.0541ppm, -NH proton at δ 5.2431 ppm, respectively; **^{13}C NMR (400 MHz $CDCl_3$ δ ppm)** C=S carbon at δ 174.11 ppm, Ar-C carbon at δ 149.16-124.02 ppm, CH_3 carbon at δ 32.40 ppm, respectively; LC-MS (m/z) Mol. Wt.: 258, (M^+) 258.44, 170.20, 112.25.

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