

# SYNTHESIS OF S-HEPTA-O-BENZOYL MALTOSYL-1-ARYL DITHIOCARBAMATES AND THEIR *IN VITRO* ANTIMICROBIAL ACTIVITIES

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## ABSTRACT

A Series of novel S-hepta-O-benzoyl maltosyl-1-aryl dithiocarbamates have been synthesized by the interaction of hepta-O-benzoyl maltosyl bromide and various ammonium aryl dithiocarbamates. The newly synthesized compounds have been characterized by analytical and IR, <sup>1</sup>H NMR and Mass spectral analysis. The polarimetric study of the compounds has been carried out. In the present investigation compounds have been tested for their antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, *Proteus vulgaris* and *Pseudomonas auriginosa* and antifungal activity against *Candida albicans* and *Aspergillus niger*.

**Keywords:** Maltosyl bromide, ammonium aryl dithiocarbamates, maltosyl aryl dithiocarbamates, antimicrobial activities.

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## INTRODUCTION

Per-O-acetyl and per-O-benzoyl derivatives of sugar are important intermediates in carbohydrate transformation and synthesis. There are many reports on thio sugar in our laboratory<sup>1-2</sup>. Thio sugars are biologically and pharmacologically important. These compounds have several applications such as carbohydrate base detergents, antiviral, antidiabetic, anticancer agents<sup>3-5</sup>.

Synthesis of S-hepta-O-benzoyl maltosyl-1-aryl dithiocarbamates is based on the interaction of hepta-O-benzoyl maltosyl bromide<sup>6</sup> with the corresponding ammonium aryl dithiocarbamates<sup>7</sup> was described. The newly synthesized compounds have been characterized by analytical and IR, <sup>1</sup>H NMR and Mass spectral analysis<sup>8-12</sup>. The polarimetric study of the compounds has been carried out.

## EXPERIMENTAL

All the melting points recorded were found uncorrected. The structures of newly synthesized compounds were confirmed on the basis of elemental and spectral analysis. IR Spectra were recorded on Perkin-Elmer spectrum RXI FTIR Spectrometer and in KBr disks on SHIMADZU IR affinity-1 FTIR spectrometer. <sup>1</sup>H NMR was obtained on Bruker DRX-300 NMR Spectrometer. Samples were prepared in CDCl<sub>3</sub> with TMS as an internal reference. The mass spectra were obtained on Thermo Fennigan LCQ Advantage max ion trap mass spectrometer. Optical rotations [ $\alpha$ ]<sub>D</sub><sup>31</sup> were measured on the Equip-Tronics EQ-800 Digital Polarimeter at 31 °C in CHCl<sub>3</sub>.

### Material and Method

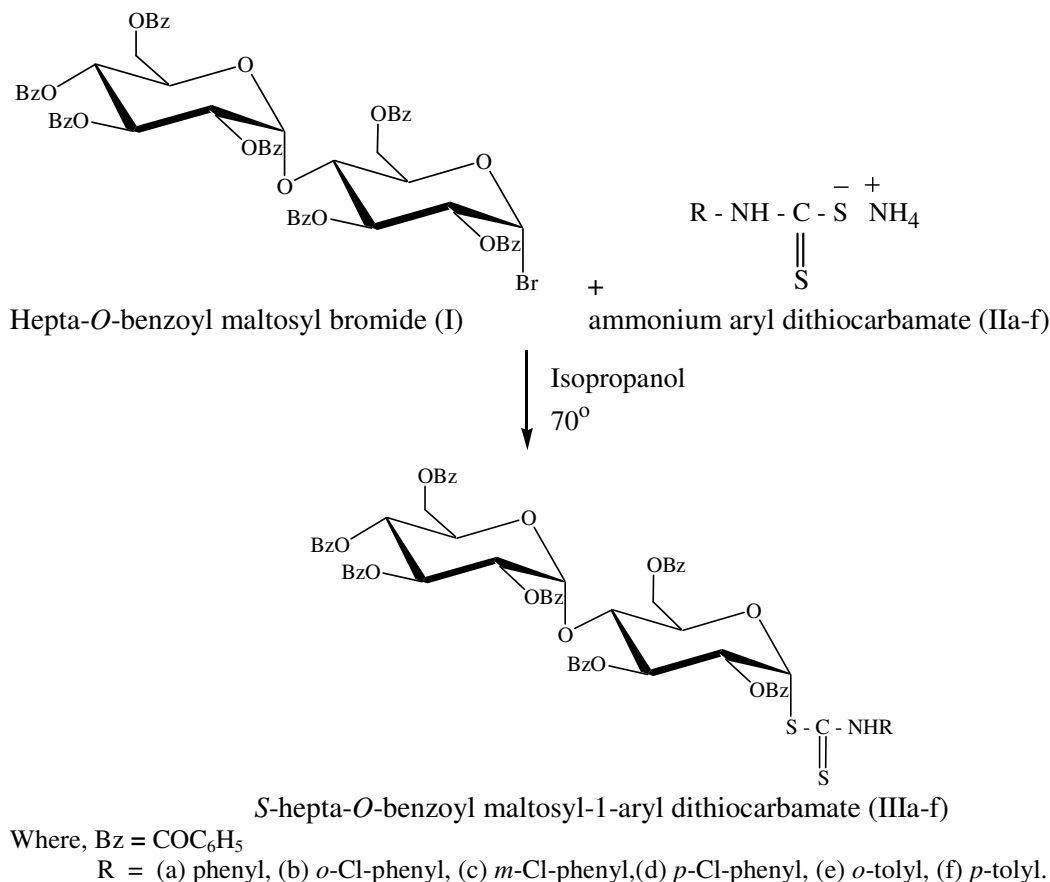
The reagents required for the given synthesis are obtained as-

#### 1. Hepta-O-benzoylmaltosyl bromide (I)

Hepta-O-benzoyl maltosyl bromide was prepared by the interaction of maltose octaacetate with brominating reagent.

#### 2. Ammonium aryl dithiocarbamates (IIa-f)

Ammonium aryl dithiocarbamates were prepared by the interaction of ammonia, carbon disulphide and aryl amines.



Scheme-1

### 3. S-hepta-O-benzoyl maltosyl-1-aryldithiocarbamates (IIIb-f)

Isopropanolic suspension of hepta-*O*-benzoyl maltosyl bromide (0.005 M) and ammonium aryl dithiocarbamates (0.005 M) was heated on water bath at about 70°C until the suspension gets cleared. The clear solution was kept at room temperature for 20 h. The reaction was monitored by TLC, after completion of reaction; the aqueous solution was basified with ammonium hydroxide which afforded a sticky mass which was not solidified on standing for several h. This sticky mass was purified by ethanol-water, the solid was obtained. The structures of all products synthesized were established on the basis of usual Chemical transformation and IR, NMR and Mass spectral analysis.

## RESULTS AND DISCUSSION

Isopropanolic suspensions of hepta-*O*-benzoyl maltosyl bromide (I) and ammonium aryl dithiocarbamate (IIa) were heated on water bath at about 70°C until the suspension gets cleared. The clear solution was kept at room temperature for 20 h. It was mixed with 100 ml distilled water. These aqueous solutions were acidic and non-desulphurisable when boiled with alkaline plumbite solution. The aqueous solutions were basified with ammonium hydroxide afforded a sticky mass which were not solidified on standing for several h. It was purified by ethanol-water. It gave charring test and non-desulphurisable.

The IR, <sup>1</sup>H NMR and mass spectral analysis (Experimental) and elemental analysis (Table-1) clearly indicated the product and assign the structure as *S*-hepta-*O*-benzoyl maltosyl-1-phenyl dithiocarbamide (IIIa). When the interaction of hepta-*O*-benzoyl maltosyl bromide (I) was extended to other ammonium aryl dithiocarbamates (IIb-f) the related *S*-hepta-*O*-benzoyl maltosyl-1-aryldithiocarbamates (IIIb-f) were obtained.

### Spectral data

**IIIa.** IR (KBr) :  $\nu$  3431  $\text{cm}^{-1}$  (N-H), 1725  $\text{cm}^{-1}$  (C=O), 1601  $\text{cm}^{-1}$  (C=N), 1449  $\text{cm}^{-1}$  (C-N), 1272  $\text{cm}^{-1}$  (C-O), 1099 and 1030 (characteristic of maltose) and 710  $\text{cm}^{-1}$  (C-S);  $^1\text{H NMR}$  ( $\text{CDCl}_3$ ):  $\delta$  8.09- 7.27 (40 H, m, Ar-H ),  $\delta$  5.88 -3.91 ( 14 H, m, maltosyl protons ),  $\delta$  6.16 (H, s, N-H ); MS ( $m/z$ ): 1221 ( $\text{M}^+$ ), 1053, 976, 948, 932, 918, 579.

**IIIb.** IR (KBr) :  $\nu$  3429  $\text{cm}^{-1}$  (N-H), 1730  $\text{cm}^{-1}$  (C=O), 1600  $\text{cm}^{-1}$  (C=N), 1450  $\text{cm}^{-1}$  (C-N), 1273  $\text{cm}^{-1}$  (C-O), 1107 and 1039 ( characteristic of maltose ) and 710  $\text{cm}^{-1}$  (C-S);  $^1\text{H NMR}$  ( $\text{CDCl}_3$ ):  $\delta$  8.065- 7.210 (39 H, m, Ar-H ),  $\delta$  5.934 -3.85 ( 14 H, m, maltosyl protons ),  $\delta$  6.163 ( 1H, s, N-H); MS ( $m/z$ ): 1256 ( $\text{M}^+$ ), 1140, 1.98, 1.31, 969, 907, 845, 579, 463, 323, 139.

**IIIc.** IR (KBr) :  $\nu$  3428  $\text{cm}^{-1}$  (N-H), 1730  $\text{cm}^{-1}$  (C=O), 1600  $\text{cm}^{-1}$  (C=N), 1452  $\text{cm}^{-1}$  (C-N), 1376  $\text{cm}^{-1}$  (C-O), 1095 and 1039 ( characteristic of maltose ) and 710  $\text{cm}^{-1}$  (C-S);  $^1\text{H NMR}$  ( $\text{CDCl}_3$ ):  $\delta$  8.099- 7.170 (39 H, m, Ar-H ),  $\delta$  5.965 – 3.910(14 H, m, maltosyl protons ),  $\delta$  2.346 ( 3H, s, Ar- $\text{CH}_3$  ),  $\delta$  6.124 ( 1H, s, N-H ); MS ( $m/z$ ): 1235 ( $\text{M}^+$ ), 1120, 1031, 969, 907, 831, 758, 683, 609, 579, 429, 327, 298.

C and H analysis were found satisfactory in all cases.

Table-1: Characterization data of *S*-hepta-*O*-benzoyl maltosyl-1-aryldithiocarbamates (IIIa-f)  
Reactants: (1) Hepta-*O*-benzoyl maltosyl bromide (I) [0.005 M].  
(2) Ammonium aryl dithiocarbamates (IIa-f) [0.005 M].

| S. No. | Product | Yield (%) | Rf Value | m. p. ( $^{\circ}\text{C}$ ) | $[\alpha]_{\text{D}}^{31}$<br>( $c$ in $\text{CHCl}_3$ ) | Analysis (%):<br>Found(Required) |                |
|--------|---------|-----------|----------|------------------------------|----------------------------------------------------------|----------------------------------|----------------|
|        |         |           |          |                              |                                                          | N                                | S              |
| 1.     | IIIa    | 62        | 0.69     | 105                          | -148 $^{\circ}$<br>( $c$ , 0.966 )                       | 1.09<br>(1.15)                   | 5.04<br>(5.24) |
| 2.     | IIIb    | 71        | 0.72     | 110                          | -10 $^{\circ}$<br>( $c$ , 0.986)                         | 1.03<br>(1.12)                   | 4.98<br>(5.10) |
| 3.     | IIIc    | 69        | 0.79     | 126                          | -90 $^{\circ}$<br>( $c$ , 0.693)                         | 1.01<br>(1.15)                   | 5.02<br>(5.10) |
| 4.     | IIId    | 56        | 0.75     | 141                          | -55 $^{\circ}$<br>( $c$ , 0.856)                         | 1.07<br>(1.15)                   | 5.05<br>(5.10) |
| 5.     | IIIe    | 72        | 0.82     | 119                          | -70 $^{\circ}$<br>( $c$ , 0.980)                         | 1.08<br>(1.13)                   | 5.11<br>(5.18) |
| 6.     | IIIf    | 77        | 0.88     | 135                          | -130 $^{\circ}$<br>( $c$ , 1.006)                        | 1.07<br>(1.13)                   | 5.09<br>(1.13) |

### Antimicrobial studies

All the compounds have been screened for both antimicrobial and antifungal activity using cup plate agar diffusion method<sup>13-14</sup> by measuring the inhibition zone in mm. the compounds were taken at a concentration of 1 mg/ml using dimethyl sulphoxide (DMSO) as solvent. Amikasin (100  $\mu\text{g/ml}$ ) was used as standard for antibacterial activity. The compounds were screen for antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, *Proteus vulgaris* and *Pseudomonas aeruginosa* in nutrient agar medium. Amikasin (100  $\mu\text{g/ml}$ ) was used as standard for antibacterial activity. The compounds were screen for antifungal activity against *Aspergillus niger* and *Candida albicans* in potato dextrose agar medium. fluconazole (100  $\mu\text{g/ml}$ ) as standard for antifungal activity. The results are presented in Table-2.

It has been observed that some of these compounds exhibited interesting microbial activities. IIIb, IIIc exhibited most significant activity against *Staphylococcus aureus*, IIId exhibited most significant activity against *Proteus vulgaris* and IIIa and IIIb exhibited most significant activity against *Pseudomonas aeruginosa* respectively. All the other compounds exhibited low to moderate activity. (Table-2).

The results of antifungal activities are also tabulated in Table-2. IIIa and IIIb are effective towards *Candida albicans*. IIIc and IIIe inhibited *Aspergillus niger*. While other compounds inhibited moderate to low activity.

Table-2: Antimicrobial activities of *S*-hepta-*O*-benzoyl maltosyl-1-aryldithiocarbamates (IIIa-f).

| Compounds   | Antibacterial** |                  |                    |                      | Antifungal**       |                 |
|-------------|-----------------|------------------|--------------------|----------------------|--------------------|-----------------|
|             | <i>E. coli</i>  | <i>S. aureus</i> | <i>P. vulgaris</i> | <i>P. aeruginosa</i> | <i>C. albicans</i> | <i>A. niger</i> |
| IIIa        | 11              | 14               | 10                 | 25                   | 20                 | 18              |
| IIIb        | 12              | 22               | 12                 | 21                   | 24                 | 17              |
| IIIc        | 15              | 24               | 18                 | 18                   | 18                 | 21              |
| IIId        | 13              | 19               | 20                 | 20                   | 17                 | 22              |
| IIIe        | 12              | 18               | 17                 | 17                   | 12                 | 25              |
| IIIf        | 10              | 17               | 13                 | 15                   | 15                 | 19              |
| Amikacin    | 19              | 23               | 22                 | 24                   | -                  | -               |
| Fluconazole | -               | -                | -                  | -                    | 25                 | 26              |

\*\*zone of inhibition in mm (15 or less) resistance, (16-20mm) moderate and (more than 20mm) sensitive. *Escherichia coli* (*E. coli*), *Staphylococcus aureus* (*S. aureus*), *Proteus vulgaris* (*P. vulgaris*), *Pseudomonas aeruginosa* (*Ps. aeruginosa*), *Candida albicans* (*C. albicans*) and *Aspergillus niger* (*A. niger*).

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### REFERENCES

1. B. S. Gabhe and S. P. Deshmukh, Int. J. Chem. Sci., **8(4)**, 2083 (2010).
2. D.V Mangte and S. P. Deshmukh, Int. J. Chem. Sci., **2(2)**, 159 (2004).
3. S. K. Bhagat, S. P. Deshmukh and A. K. Fokmare, *Oriental J. Chem.*, **17(3)**, 437 (2001).
4. J. R. Clamp, L. Hough, J. L. Hickson and R. L. Whistler, "Advances in Carbohydrate Chemistry and Biochemistry", **16**, Academic Press, NY, 159 (1961).
5. Laboratories Albert Rolland, French Pat. 937, 1948, 719, Chem. Abst., **44**, 2924 (1950).
6. F. D. Tropper, F. O. Anderson, Grand-Maitre, Chantal, R. Roy, *Synthesis*, 734 (1991).
7. A. I. Vogel, A Text Book of Practical Organic Chemistry, **V**, Pearson, Longman, 967 (1989).
8. (a) R.M.Silverstain and G.C. Bassler, Spectrometric Identification of Organic Compounds, 5<sup>th</sup> ed., John Wiley & Sons, Inc, New York (1991); (b) D.H. Williams and Ian Fleming, Spectrometric Methods of Organic Chemistry, 4<sup>th</sup> ed., Tata-McGrawHill (1991); (c) J.R.Dyer, Applications of Absorption Spectroscopy of Organic Compounds, 8<sup>th</sup> ed., Prentice hall (1991).
9. R. Verma, S. Y. Kulkarni, C. I. Jose and V. S. Pansave, *Carbohydr. Res.*, **25**, 133 (1984).
10. H. H. A. M. Hassan, A. H. F. E. Huseiny, *Polish J. Chem.*, **75**, 803 (2001).
11. F. Sansone, E. Chierici, A. Casanti, R. Ungaro, *Org. Biomol. Chem.*, **1**, 1802 (2003).
12. Carla Prata, Nathalie Mora, J. Lacombe, Maurizis and B. Pucci, *Carbohydr. Res.*, **4**, 321 (1999).
13. Kawangh, F., Analytical Microbiology, Academic press, New York (1963).
14. British Pharmacopoeia- II, Biological assay and Tests, The Stationary Office Ltd., London, **A-205** (1998).

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