Synthesis and Characterization of 1-Aryl-5-hepta-*O*-acetyl- β -D-maltosyl-2-*S*-benzyl-2,4-isodithiobiurets

R. D. GHUGE and S. P. DESHMUKH*

P. G. Department of Chemistry, Shri Shivaji College
Akola-4444001 (M.S.) India
rdghuge.2011@rediffmail.com

Received 9 June 2011; Accepted 12 August 2011

Abstract: The facile synthesis of 1-aryl-5-hepta-*O*-acetyl- β -D-maltosyl-2-*S*-benzyl-2,4-isodithiobiurets (**IIIa-g**) has been achieved by the interaction of 1-hepta-*O*-acetyl- β -D-maltosyl isothiocyanate (**I**) with various 1-aryl-*S*-benzyl isothiocarbamides (**IIa-g**). All the newly synthesized *N*-maltosylated compounds characterized by elemental analysis, IR, NMR and Mass spectral studies.

Keywords: Synthesis, Maltosyl isothiocyanate, Aryl isothiocarbamides, isodithiobiurets

Introduction

Glycosylated isothiocyanates¹⁻³ is important class of organic compounds in the field of carbohydrate chemistry. In the last few years maltosyl isothiocyanate⁴⁻⁶ is used as the key intermediate in synthetic carbohydrate chemistry. Its derivatives shows various applications in medical chemistry as an antitumor agent⁷, antifungal agent⁸, bacteriostatic agent and also used against hepatic diseases⁹.

In view of these applications of *N*-maltosides we herein reports new route for the synthesis of 1-aryl-5-hepta-*O*-acetyl- β -D-maltosyl-2-*S*-benzyl-2,4-isodithiobiurets by the interaction of hepta-*O*-acetyl- β -D-maltosyl isothiocyanate with various 1-aryl-*S*-benzyl isothiocarbamides.

All the newly synthesized *N*-maltosylated compounds characterized by elemental analysis, IR, ¹H NMR and mass spectral studies.

Experimental

Melting points were taken in open capillary tubes and are found uncorrected. Specific rotations $[\alpha]_D$ were measured on a Equip Tronics digital polarimeter model no. EQ 800 in CHCl₃ at 30°. IR Spectra¹⁰⁻¹¹ were recorded on a Perkin-Elmer Spectra RXI (4000-450 cm⁻¹)

FTIR Spectrometer. ^1H NMR spectra¹²⁻¹³ were obtained on a Bruker DRX-300 (300 MHz FT NMR) Spectrometer for a sample in CDCl_3 solution with TMS as an internal reference. The mass spectra¹⁴⁻¹⁵ were recorded on a Jeol-SX 102 FAB mass spectrometer.

Scheme 1

1-Aryl-5-hepta-*O*-acetyl- β -*D*-maltosyl-2-*S*-benzyl-2,4-isodithiobiurets

Where, *R* = a) phenyl; b) *o*-Cl-phenyl; c) *m*-Cl-phenyl; d) *p*-Cl-phenyl; e) *o*-Tolyl; f) *m*-Tolyl; g) *p*-Tolyl, Ac = COCH_3

Scheme 2

General procedure

Hepta-*O*-acetyl- β -*D*-maltosyl isothiocyanate (I)

Hepta-*O*-acetyl- β -*D*-maltosyl isothiocyanate (I) has been prepared (Scheme 1) by condensation reaction of hepta-*O*-acetyl- α -*D*-maltosyl bromide (0.005 M) with lead thiocyanate (0.005 M) in boiling xylene for 3 h. After completion of reaction the xylene solution is filtered and the excess xylene has been removed by distillation. The sticky residue obtained was triturated several times with petroleum ether (bp 60-80 $^{\circ}\text{C}$) to afford a solid. It was then purified from

CHCl₃. The purity of product checked by TLC. The product (**I**) was found desulphurisable when boiled with plumbite solution and also show positive charring test when heated with conc. H₂SO₄.

1-Aryl-5-hepta-O-acetyl-β-D-maltosyl-2-S-benzyl-2,4-isodithiobiurets (IIIa-g)

1-Aryl-5-hepta-O-acetyl-β-D-maltosyl-2-S-benzyl-2,4-isodithiobiurets (**IIIa-g**) were prepared by the interaction of hepta-O-acetyl-β-D-maltosyl isothiocyanate (**I**), (0.005 M) with various 1-aryl-S-benzyl isothiocarbamides (0.005 M) in boiling benzene medium for 3 h (Table 1, Scheme 2). Afterwards, solvent was distilled off and a viscous semi-solid mass was isolated as residue. It was then triturated several times with petroleum ether (bp. 60-80 °C) to afford a solid. All products (**IIIa-g**) were purified from ethanol water, purity of products checked by TLC. The products were found desulphurisable when boiled with plumbite solution and also shows positive charring test when heated with conc. H₂SO₄. The % yield, M.P. Optical rotation, R_f values and elemental analysis are shown in Table 1.

Table 1. Characterisation data of the synthesized products (**III a-g**)

S. No.	Products (III a-g)	Yield, %	M.P. °C	[α] _D ³¹ (CHCl ₃)	Analysis*		R _f (CCl ₄ : EtOAc) (3:2)
					Required %	Found %	
1	III a	46	130-132	91.85 (c,0.3266)	N, 4.57 S, 6.96	N, 4.56 S, 6.95	0.84 (3 : 2)
2	III b	95	115-118	+ 206 (c, 5800)	N, 4.40 S, 6.71	N, 4.38 S, 6.74	0.73 (3 : 2)
3	III c	89	98-100	+150 (c,0.3333)	N, 4.40 S, 6.71	N, 4.41 S, 6.70	0.81 (3 : 2)
4	III d	60	106-107	-73.78 (c,0.4066)	N, 4.40 S, 6.71	N, 4.39 S, 6.73	0.83 (3 : 2)
5	III e	41	125	+ 257 (c,0.4667)	N, 4.50 S, 6.85	N, 4.52 S, 6.80	0.67 (3 : 2)
6	III f	47	132-134	+ 123 (c,0.4062)	N, 4.50 S, 6.85	N, 4.50 S, 6.87	0.65 (3 : 2)
7	III g	57	105-108	-24.63 (c,0.4071)	N, 4.50 S, 6.85	N, 4.7 S, 6.83	0.70 (3 : 2)

*Satisfactory C and H analysis is found in all cases

The required 1-aryl thiocarbamides were prepared by already known method¹⁶ *i.e.* by interaction of appropriate aryl amine hydrochloride and ammonium thiocyanate. The required 1-aryl-S-benzyl isothiocarbamides were prepared by already described procedure¹⁷ *i.e.* benzyl chloride (0.04 M.) was added in ethanolic suspension of aryl thiocarbamides (0.04 M) and the reaction mixture was refluxed for 90 min. Afterwards, it was cooled and rendered basic with dilute cold ammonium hydroxide as the sticky residue was obtained which solidify after 2 h. filtered and washed with petroleum ether (bp 60-80 °C).

Results and Discussion

The structures of the newly synthesized compounds were firmly established on the basis of elemental analysis, IR, ¹HNMR and Mass spectral studies.

Hepta-O-acetyl-β-D-maltosyl isothiocyanate (I)

Yield 72%, M.P. 118-120 °C, $[\alpha]_D^{31} + 30^0$ (c.0.3333 m, CHCl₃), R_f -0.75 (CCl₄;EtOAc,3:2), IR (KBr): ν 2962 (ali. C-H), 2032 (-N=C=S), 1753 (C=O), 1375 (C-N), 1231 (C-O), 1039.7 and 938,900 (characteristic of maltose), 770 cm⁻¹ (C-S) ; ¹HNMR (CDCl₃): δ 5.4-3.7 (m,14 H,maltosyl ring protons); 2.2-2.0 (m, 21H,acetyl); Mass (m/z) : 677 (M+), 619, 559, 457, 331, 169, 109. Anal. Calcd. for C₂₇ H₃₅ O₁₇ SN; C, 47.85; H,5.16; N, 3.63; S, 4.15 found C,47.80; H,5.20; N, 3.50, S, 4.02%.

1-Phenyl -5-hepta-O-acetyl-β-D-maltosyl-2-S-benzyl-2,4-isodithiobiuret-(IIIa)

IR (KBr): ν 3468 (N-H), 2960.9 (Ar-H), 1752.4 (C=O), 1567.2 (C=N), 1371.4 (C-N), 1231 (S-CH₂), 1136.2 (C=S), 1039.4, 938 and 901 (cha.of maltose ring), 770.2 cm⁻¹ (C-S); ¹HNMR (CDCl₃): δ 7.46-7.06 (m, 13H, Ar-NH and Ar-H); 6.25-6.23 (d, 1H, maltose NH), 5.4-3.8 (m, 14H, maltose ring), 2.2-2.0 (m, 21H, acetyl H); Mass (m/z): (M+)⁺ 920, 828,786,331,169,109. Anal. Cald. For C₄₁H₄₉O₁₇N₃S₂; C, 53.33; H,5.33; N,4.57; S, 6.96 found C, 53.35; H, 5.30; N, 4.56; S, 6.95%.

1-p-Cl-Phenyl-5-hepta-O-acetyl-β-D-maltosyl-2-S-benzyl-2,4- isodithiobiuret (III d)

IR (KBr) : ν 3468.5 (N-H), 2966.8 (Ar-H), 1754.6 (C=O), 1565 (C=N), 1371 (C-N), 1221 (S-CH₂), 1136.4 (C=S), 1040.1, 938 and 901 (cha.of maltose), 772.1 cm⁻¹(C-S); ¹HNMR (CDCl₃): δ 7.38-7.37 (d,1H,NH); 7.35 - 7.22 (m, 11H, Ar-H); 6.86-6.83 (d,1H, NH maltose); 5.44 – 3.60 (m, 14H, maltose ring); 2.21 – 2.00 (m, 21 H,acetyl); Mass (m/z) : (M⁺+1) 954, 862, 842, 619, 559, 457, 331, 169, 109. Anal. Calcd. for C₄₁H₄₈O₁₇ N₃S₂Cl; C, 51.57; H, 5.03; N, 4.40; S, 6.71 found C, 51.56; H, 5.00, N, 4.39; S, 6.73%

1-o-Tolyl-5-hepta-O-acetyl-β-D-maltosyl-2-S-benzyl-2,4-isodithiobiuret (IIIe)

IR (KBr) : ν 3471.2 (N-H), 2961 (Ar-H), 1752.9 (C=O), 1566 (C=N), 1371.5 (C-N), 1232 (S-CH₂), 1138.1 (C=S), 1039.4, 939.9 and 902 (cha. of maltose), 770.2 cm⁻¹ (C-S); ¹HNMR (CDCl₃) : δ 7.37 -7.19 (m, 12H, Ar-H); 6.25 – 6.23 (d, 1H, NH maltose); 5.44 – 3.9 (m, 14H maltose ring); 2.35 (S, 3H, methyl), 2.30-1.99 (m, 21 H, Acetyl); Mass (m/z): (M⁺+1) 934, 842, 619, 559, 331, 169, 109 (not located); Anal. Calcd. for C₄₂H₅₁O₁₇N₃S₂; C, 54.01 H, 5.46; N, 4.50 S, 6.85 found C, 53.87, H, 5.38, N, 4.52; S 6.80%.

Acknowledgment

Authors are thankful to SAIF, C.D.R.I. Lucknow for providing spectra and also Dr. S.G. Bhadange, Principal of Shri Shivaji College, Akola for providing necessary facilities.

References

1. Garcia Fernandez J M and Mellet C O, *Adv Carbohydr Chem Biochem.*, 2000, **55**, 35-135.
2. Fuentes J, Angulo M and Pradera M A, *J Org Chem.*, 2002, **67(8)**, 2577 -2887.
3. Fernandez J G, Zafra E, Lopez O, Robina I and Fuentes J, *Tetrahedron Assemetry*, 1999, **10(15)**, 3011-3023.
4. Witczak Z J, *Adv Carbohydr Chem Biochem.*, 1986, **44**, 9145.
5. Ortizmellet C, Balanco J, Jose L, Fernandez G and Fuentes J, *J Carbohydr Chem.*, 1993, **12**, 487-505.
6. Dustan D and Hough L, *Carbohydr Res.*, 1972, **23**, 17-21.

7. Tsujihara K, Ozeki M, Morikawa G, Kawamori M, Akaike Y and Arai Y, *J Med Chem.*, 1982, **25**, 441-446.
8. Mote S P and Deshmukh S P, *Rasayan J Chem.*, 2011, **4(1)**, 29-35.
9. Mizutani, Kito A (Nagoya J A) and Kyoji (Seto J A), U.S. Patent 1978, 4080442.
10. Segal L, O'conner R T and Eggerton F V, *J Chem Soc.*, 1960, **82**, 2807-2810.
11. Varma R, Kulkarni S Y, Jose C I and Pansare V S, *Carbohydr Res.*, 1984, **25**, 133.
12. Lemeiux R U and Driguez H, *J Am Chem Soc.*, 1975, **97**, 4069.
13. Ong G T, Chang K Y, Wu S H and Wang K T, *Carbohydr Res.*, 1994, **265**, 311-318.
14. Pearson M S M, Robin A, Bourgougnon N, Jean Claude Meslin J C and Denial D, *J Org Chem.*, 2003, **68**, 8583.
15. Silverstein R M, Bassler G C and Morill T C, *Spectrometric Identification of Organic Compounds*; 5th Ed., John Willey and Sons: Inc. New York 1991.
16. Krall H and Gupta R D, *J Indian Chem Soc.*, 1935, **12**, 629.
17. Werner E W, *J Chem Soc.*, 1890, **57**, 295-305.