A CYCLISATION REACTION OF 2-CYANOMETHYLBENZOTHIAZOLE WITH ACETYLENIC COMPOUNDS VIA MICHAEL ADDITION

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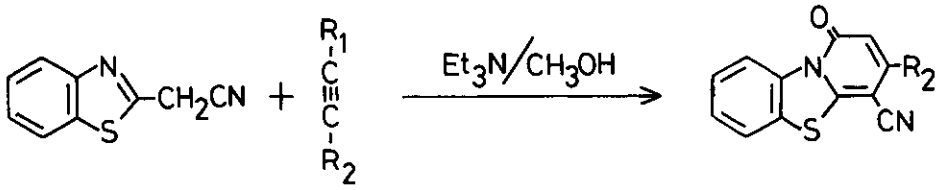
Abstract - 2-Cyanomethylbenzothiazole (1) reacts with acetylenic compounds (2) under the influence of base in Michael fashion followed by cyclisation to afford fused pyrido[2,1-b]benzothiazole (3&4) in excellent yields. The products were characterized through elemental and spectral analyses.

In 2-alkyl group of benzothiazoles the proton attached to the alkyl carbon atom are significantly activated and can be easily abstracted by bases[1]. The C-2 methylene group of benzothiazole undergoes Michael addition with α,β-unsaturated ketones to yield open-chain products[2]. 2-Cyanomethylbenzothiazole (1) conveniently condenses with arylaldehydes to give olefinic compounds[3]. There are sporadic reports to reaction of α,β-unsaturated nitriles with 1 affording a fused benzothiazole[4]. Acetylenic compounds are unique in their behaviour[5] as dienophile as well as Michael acceptors in organic synthesis. It is significant to note that benzothiazole reacts with dimethylacetylenedicarboxylate (DMAD) through zwitterionic intermediate triggered from basic-nitrogen[6]. In this study we report a base catalysed reaction of 2-cyanomethylbenzothiazole with differently substituted acetylenic compounds where the reaction is initiated from carbanion at 2-alkyl group instead of the basic nitrogen atom.

Equimolar quantities of 2-cyanomethylbenzothiazole (1) and dimethylacetylenedicarboxylate (DMAD, 2a) were stirred in methanol at room temperature in presence of a catalytic amount of triethylamine for 1 h ; subsequent work-up afforded 3-carbmethoxy-4-cyanopyrido[2,1-b]benzothiazol-1-one (3a) as yellow crystals, mp 224-226°C (from DMF) as the sole product. The

compound was identified through spectral and elemental analyses. The IR spectrum of 3a in KBr showed absorption bands at 2200, 1725 and 1670 cm^{-1}, which were assigned to cyano, ester carbonyl and conjugated cyclic keto groups. The ^1H NMR of 3a showed signal for ester methyl protons at δ 3.95 and a one proton singlet signal at δ 7.15 assignable to C-2 proton at the fused pyridone ring. The multiplet appeared at δ 7.60-9.20 integrating for four protons were assigned to aromatic protons of 3a. The mass spectra showed molecular ion at m/z 284 (M^+) as the base peak followed by fragmentation ion peaks at m/z 256 (M^+-CO) and at m/z 225 (M^+-CO-OCH_3). The reaction of (1) with ethylphenylpropiolate (2b) and ethyl propiolate (2c) gave



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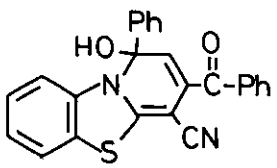
a, $R_1 = R_2 = COOCH_3$
b, $R_1 = Ph$; $R_2 = COOC_2H_5$
c, $R_1 = H$; $R_2 = COOC_2H_5$
d, $R_1 = R_2 = COPh$
e, $R_1 = R_2 = Ph$
f, $R_1 = H$; $R_2 = Ph$.



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a, $R_2 = COOCH_3$
b, $R_2 = Ph$
c, $R_2 = H$

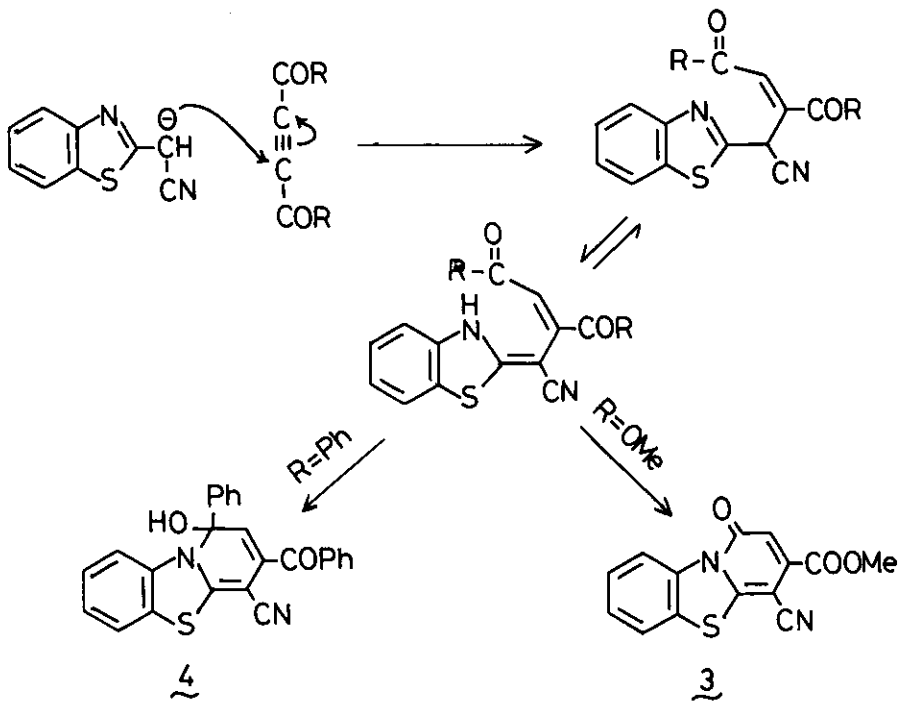
Table

Compd.	Mp °C	Yield (%)	IR ν_{max} cm^{-1}	MS m/z (%)	^1H NMR ($CDCl_3$/TMS) δ ppm
3a	225-228	85	2200,1725, 1670.	284(100) 256(23.2) 225(62.3)	3.95(s, 3H), 7.15(s, 1H), 7.60-9.20(m, 4H).
3b	270-272 (dec.)	80	2205,1680.	302(84.4) 274(54.5)	6.52(s, 1H), 7.50-9.25(m, 9H).
3c	205-207 (dec.)	55	2200,1675.	226(100) 198(40.5)	7.05-9.10(m, 6H).
4	213-215	90	3450,2150, 1670.	408(3.3) 381(51.3)	7.16(s, 1H), 7.40(s, 1H), 7.45-8.30(m, 14H).

All compounds gave satisfactory microanalytical data.

4-cyano-3-phenylpyrido[2,1-b]benzothiazol-1-one (3b) and 4-cyano-pyrido[2,1-b]benzothiazol-1-one (3c) in good yields. But the reaction of (1) with dibenzoylacetylene (2d) gave hydroxy derivative, i.e. 3-benzoyl-4-cyano-1,1-(hydroxyphenyl)pyrido[2,1-b]benzothiazole (4) in excellent yield (Table).

Regarding the mechanism of this reaction it is proposed that the base induced carbanion at the 2-alkyl position adds to the acetylene compounds in Michael fashion followed by rearrangement and cyclisation to form 3 or 4.



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Diphenylacetylene (2e) and phenylacetylene (2f) which are devoid of α-carbonyl group, did not react with (1) under the identical conditions, thus imparting further support for Michael type of reaction mechanism.

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