

SYNLETT Spotlight 100

Malononitrile

Compiled by Anil Saikia



This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

Anil Saikia was born in Golaghat, Assam, India in 1975. He completed his M.Sc. degree in Chemistry (1999) from Dibrugarh University, Assam, India. He is currently pursuing for his Ph.D. under the supervision of Dr. Romesh Chandra Boruah in Medicinal Chemistry Division, Regional Research Laboratory, Jorhat, Assam, India. His research involves the study of conjugated enones and synthesis of steroidal heterocycles.

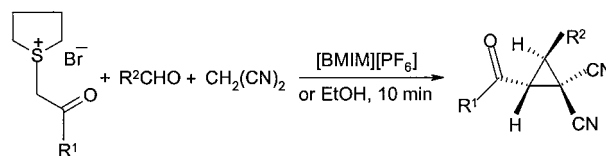
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The weak cyanocarbon malononitrile [$\text{CH}_2(\text{CN})_2$] is a colourless solid with a melting range of 32–34 °C and a boiling range of 218–219 °C. It is a versatile compound of exceptional reactivity. Malononitrile can be prepared in 80–96% yield by the reaction of cyanoacetamide and POCl_3 or PCl_5 in presence of inorganic salts.^{1–2} Due to the presence of active methylene protons, the reagent is found to be more useful in carbon–carbon bond formation reac-

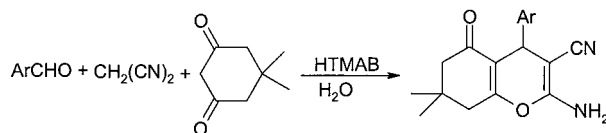
tions. It is used extensively³ as a reactant or reaction intermediate, since the methylene group and one or both cyano groups can take part in condensation reactions to give a variety of addition products and heterocyclic compounds. This unique reactivity makes malononitrile an important chemical in research and in medical, industrial and agricultural chemistry applications.

Abstracts

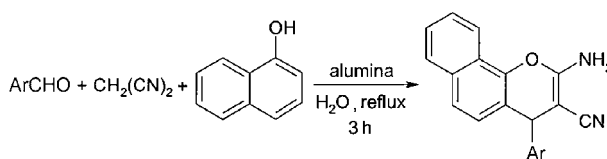
(A) A three-component reaction of sulfonium salt, malononitrile, and aldehyde in the ionic liquid 1-butyl-3-methylimidazolium hexafluorophosphate ($[\text{BMIM}][\text{PF}_6]$), or in ethanol in the presence of triethyl amine, is a convenient one-pot method for the synthesis of substituted 1,1-dicyanocyclopropanes. This reaction involves stereoselectivity to form substituted trans cyclopropanes.⁴



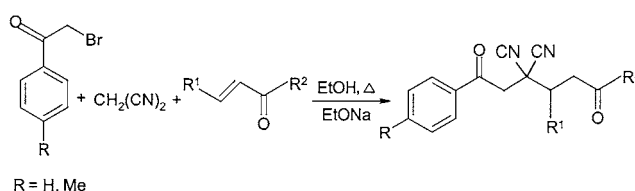
(B) A clean one-pot synthesis⁵ of tetrabenzo[b]pyran derivatives can be achieved from aromatic aldehyde, malononitrile and 5,5-dimethyl-1,3-cyclohexadione. The reaction uses hexadecyltrimethyl ammonium bromide (HTMAB) as a catalyst in aqueous media.



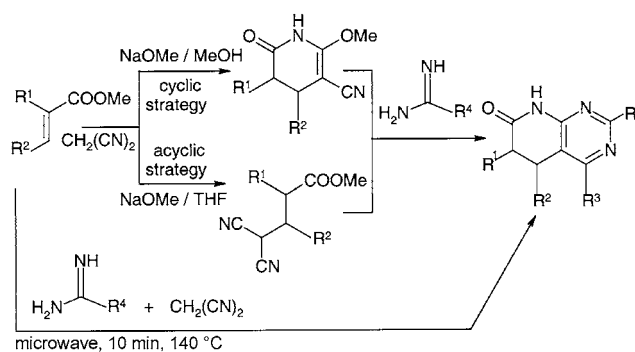
(C) Maggi et al.⁶ have reported an efficient and selective synthesis of substituted 2-amino-2-chromones by reaction of malononitrile, α -naphthol and aromatic aldehydes in water using basic alumina as heterogeneous and reusable catalyst.



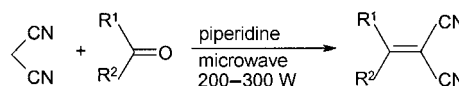
(D) Malononitrile is an efficient reagent for the synthesis of 1,6-diketo compounds⁷ via a three-component Michael addition reaction. This reaction proceeds via initial condensation of an α -bromoketone with malononitrile to afford a β,β -dicyanoketone which undergoes in situ Michael addition reaction with α,β -unsaturated ketones.



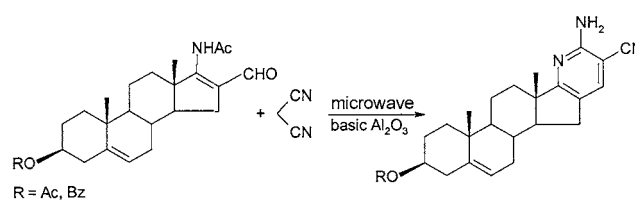
(E) A new high-yielding multicomponent reaction⁸ providing multifunctionalized pyrido[2,3,d]pyrimidines has been accomplished in a microwave-assisted one-pot cyclocondensation of α,β -unsaturated esters, amidine systems and malononitrile.



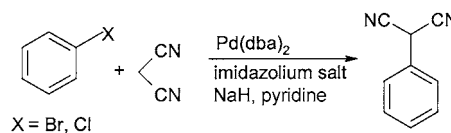
(F) Condensation of carbonyl derivatives with active methylene compounds, such as malononitrile, is achieved within 3–15 minutes by a solvent-free reaction. Under microwave irradiation in the presence of carefully adjusted amounts of piperidine, Knoevenagel products⁹ are obtained in good to excellent yield.



(G) D-ring annelated pyridines are synthesized¹⁰ by the condensation of β -formyl enamides with cyanomethylenes such as malononitrile under microwave irradiation. This reaction has been successfully extended to acyclic and aromatic β -formyl enamides.



(H) A highly efficient palladium carbene complex catalytic system has been developed and successfully employed for cross-coupling of arylhalides with malononitrile anion.¹¹



References

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