1,3-Diiodo-5,5-dimethylhydantoin

Compiled by Christophe Ricco

Christophe Ricco was born in Saint-Germain-en-Laye, France, in 1981. He started his undergraduate studies at the University of Maine, France, in 2003. In December 2007, he joined Alain Guy’s group at the Laboratoire de Transformations Chimiques et Pharmaceutiques at the Conservatoire National des Arts et Métiers (CNAM) of Paris where he conducts research on the synthesis of derivatives of 7β-hydroxy epiandrosterone under the supervision of Professor Clotilde Ferroud. Currently, he prepares for his engineering degree.

Conservatoire National des Arts et Métiers (CNAM), Laboratoire de Transformations Chimiques et Pharmaceutiques, ERL 3193, CNRS, 2 rue Conté, 75003 Paris, France.
E-mail: christophe.ricco@cnam.fr

Introduction

1,3-Diiodo-5,5-dimethylhydantoin (DIH, C₅H₆I₂N₂O₂, mp 192–196 °C, CAS: 2232-12-4) is a light brown powder. It has a light iodine odor and is stable when kept dry and at low temperature.

In 1965, Orazi et al. introduced DIH as an efficient reagent for iodination.¹ DIH is a stable compound with a high iodine content. Mechanistic studies suggest that this reagent acts as an I⁺ donor. Homolytic cleavage could not be detected and no HI is formed! Therefore, additional bases or oxidants are not required!²

DIH has a reactivity comparable to that of molecular iodine, but it is more convenient to handle, because this solid reagent does not sublime. It possesses the same selectivity as N-iodosuccinimide (NIS) and equal or better halogenating ability. With two N–I bonds, DIH can be more economical in direct comparison to NIS. It has been used as an iodizing agent or an oxidizing agent in production processes in the pharmaceutical, food, and agricultural industries.

DIH has been used for chemoselective iododesilylations² to obtain nitriles,³,⁴ for the iodination of aromatic compounds,⁵ for the preparation of chroman derivatives,⁶ to convert aromatic aldehydes into the corresponding amides,⁷ for the sulfonylamidation of alkylbenzenes at the benzylic position,⁸ and to obtain oxazolonederivatives,⁹ benzothiazine, and tetrahydroquinolinederivatives.¹⁰

Preparation

DIH was firstly prepared by Orazi et al. in 1965 by reacting iodine monochloride under basic conditions¹ with 5,5-dimethylhydantoin.

Recently, Mima¹¹ prepared DIH from an iodide source (like molecular iodine and sodium iodide) and 5,5-dimethylhydantoin with hypochlorite salts.

Abstracts

(A) Sidera et al.² reported the chemoselective iododesilylation of TIPS-, TBDPS-, and TBS-substituted alkenes with DIH. Such (Z- and E-) substituted alkenes could be transformed into vinyl iodides with retention of configuration in the presence of alkenes, alkynes, and silylated alkenes. Under these conditions, DIH is also efficient and does not affect O–Si bonds, epoxides, etc. The desired iodoalkenes are obtained stereospecifically without a byproduct.

(B) Iida and co-workers³ reported a direct, efficient, practical and less toxic oxidative conversion of alcohols, amines, aldehydes and alkyl halides into nitriles with DIH in aqueous ammonia. Unlike the traditional method with toxic cyanide, which induces one-carbon homologation, the use of DIH allows to maintain the same number of carbon atoms.

SYNLETT 2013, 24, 2173–2174
Advanced online publication: 30.08.2013
© Georg Thieme Verlag Stuttgart · New York
C. Ricco

(D) Chaikowskii and co-workers\(^3\) used DIH as an efficient reagent for iodination of aromatic compounds. The reactivity of the electrophilic iodine is controlled by the acidity of the medium. Good yields were obtained with electron-deficient arenes. With electron-rich arenes, polyiodination was observed at 20 °C.

(E) Furuyama and Togo\(^6\) have reported an efficient preparation of arenes, polyiodination was observed at 20 °C. were obtained with electron-deficient arenes. With electron-rich arenes, polyiodination was observed at 20 °C. for iodination of aromatic compounds. The reactivity of the electrophilic iodine is controlled by the acidity of the medium. Good yields for iodination of aromatic compounds. The reactivity of the electrophilic iodine is controlled by the acidity of the medium. Good yields were obtained with electron-deficient arenes. With electron-rich arenes, polyiodination was observed at 20 °C.

(F) Various N,N-dimethyl aromatic amides and N-arylmorpholines bearing electron-withdrawing and electron-donating groups on the aromatic rings were synthetized in moderate to good yields by Baba and co-workers.\(^7\) The reaction is simple, metal-free, and generates little waste. Heteroaromatic aldehydes give the corresponding amides in moderate to good yields.

(G) Baba and Togo\(^4\) reported a simple method for the sulfonylamidation of alkylbenzenes at the benzylic position with p-toluene-sulfonylamine and DIH in moderate to good yields. As DIH is not an hypervalent iodine compound, it can be used alone for the present radical reactions, instead of the combination of (diacetoxyiodo)-benzene and molecular iodine.

(H) Takahashi and Togo\(^9\) reported an efficient oxidative conversion of aldehydes into 2-substituted 2-oxazolines using DIH in good to high yields. The reactivity of DIH is higher than that of molecular iodine, NIS and tert-butyliodochloride. This method is a useful alternative for the preparation of 2-substituted 2-oxazolines and chiral derivatives from aldehydes and amino alcohols.

(I) 1,2,3,4-Tetrahydroquinoline derivatives were synthesized in good yields with DIH under irradiation with tungsten lamp by Moroda et co-workers.\(^7\) Initially, an N–I bond is formed in the sulfonamide and DIH in moderate to good yields. As DIH is not an hypervalent iodine compound, it can be used alone for the present radical reactions, instead of the combination of (diacetoxyiodo)-benzene and molecular iodine.

References