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Short Research Article

An improved procedure for the preparation of radiochemically pure (carbonyl-^{14}C)diuron[†]

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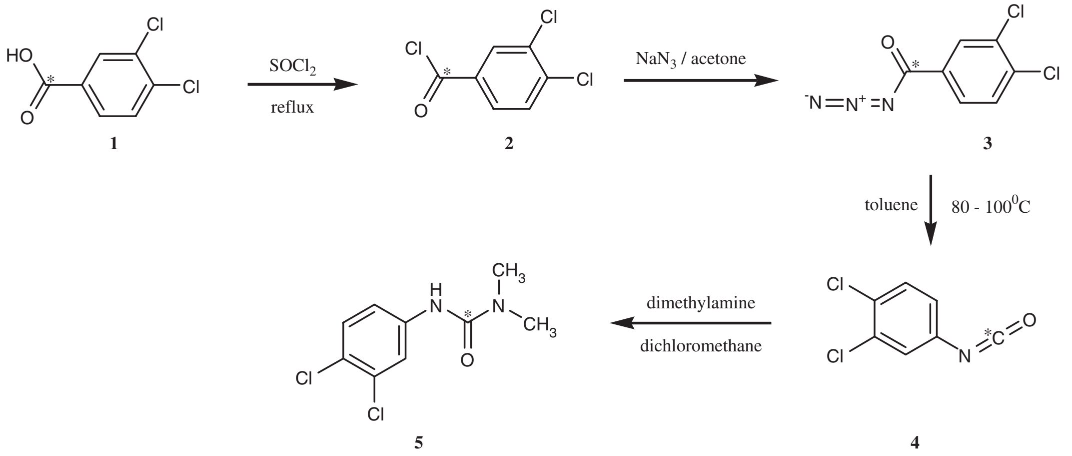
Introduction

Urea herbicides are widely used in modern agricultural practice. Diuron is a herbicide that inhibits photosynthesis and is used for the general weed control on non-crop areas. Till the year 2003, tributyltin (TBT) was used as a booster biocide in hull paints on ships but now it has been banned due to adverse effects on the aquatic environment.[1,2] Hence, alternative booster biocides are studied and diuron is one of them. [^{14}C]-Diuron, the radiolabelled analogue, is therefore required for carrying out studies on monitoring performance efficacy of diuron in paints and effect on aquatic environment.

An improved procedure for the preparation of radiochemically pure diuron labelled with carbon-14 in its urea carbon position is described.[3–5] [7-^{14}C]-Dichlorobenzoic acid **1** was transformed to its isocyanate via Curtius reaction which was finally reacted with dimethylamine to give [carbonyl-^{14}C] diuron **5** having specific activity of 1.09 mCi/mmol (40.33 MBq/mmol). The radiochemical yield was 77.3% based on [7-^{14}C]-dichlorobenzoic acid and the product had a radiochemical purity greater than 99% (Scheme 1).



Scheme 1

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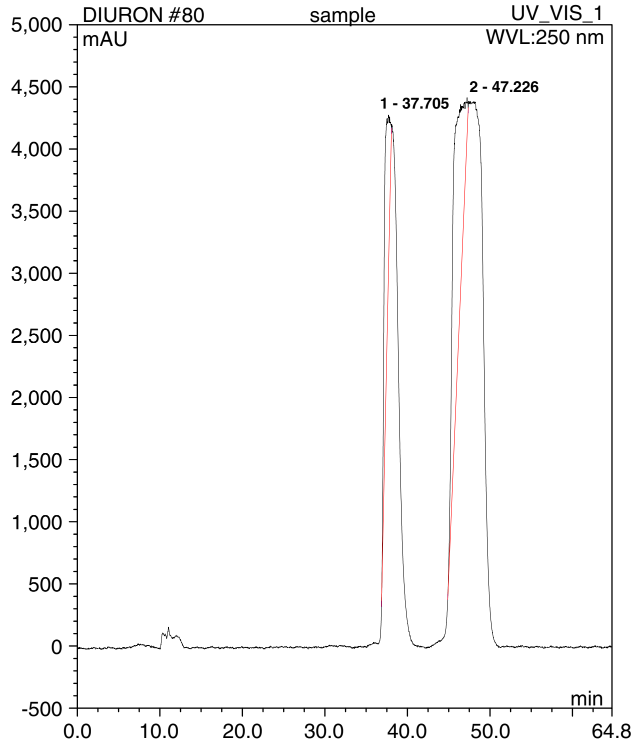

Figure 1 RP-HPLC of diuron obtained on carrying out the final reaction at room temperature. Figure available in colour online at www.interscience.wiley.com

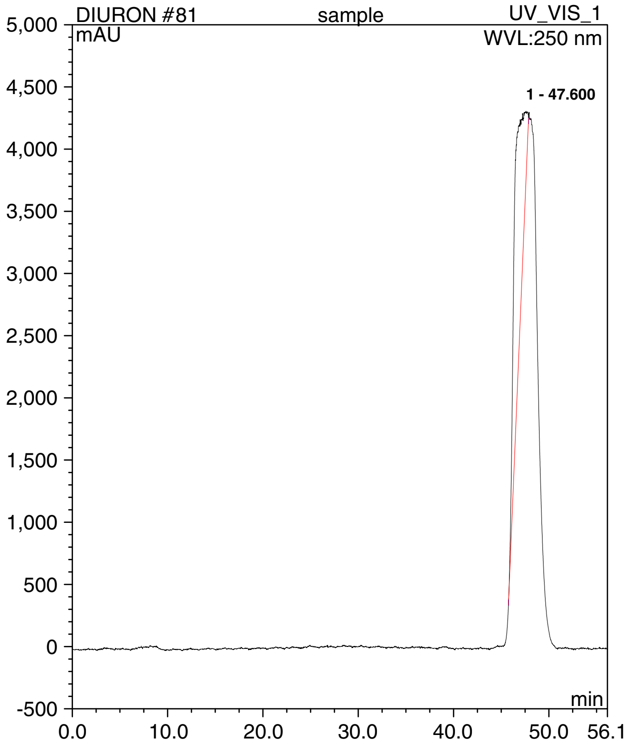

Figure 2 RP-HPLC of diuron obtained on carrying out the final reaction at ice-cold temperature. Figure available in colour online at www.interscience.wiley.com

Results and discussion

In all the previously reported methods for the preparation of ^{14}C-diuron labelled in its urea carbon position, [7-^{14}C]-dichlorobenzoic acid was transformed to its isocyanate via Curtius reaction and finally reacted with dimethylamine to give [carbonyl-^{14}C] diuron. Dimethylamine was used either as a chloroform solution or 33% ethanolic solution or it was generated *in situ* from dimethylamine hydrochloride. In our procedure, we used dimethylamine as a 33% absolute ethanolic solution and we were able to prepare the labelled analogue having radiochemical purity greater than 99% in a radiochemical yield of 77.3%, based on [7-^{14}C]-dichlorobenzoic acid.

The phenyl isocyanate reaction with dimethyl amine (33% in absolute ethanol) was carried out at room temperature for 2 h. Analytical RP-HPLC[3–5] was performed using methanol:water (80:20) and acetonitrile:-water (65:35) as the mobile phases at a flow rate of 1 ml/min and the UV-detector was set at 250 nm. The chromatogram showed one single peak of diuron in this solvent system in contrast to the two peaks shown during RP-HPLC analysis when performed using acetonitrile:water (40:60). Preparative RP-HPLC was carried out to separate the impurity from diuron and it was successfully achieved in the solvent system acetonitrile:water (40:60) at a flow rate of 6 ml/min. Retention time for the impurity was 37.7 min and retention time for diuron was 47.2 min (Figure 1).

When reaction of phenyl isocyanate with dimethyl amine (33% in absolute ethanol) was carried out at ice-cold temperature for 2 h, the product obtained on HPLC analysis showed a single peak of diuron at the retention time of 47.6 min (Figure 2). The above noted modified conditions were used during the preparation of carbon-14-labelled diuron. The crude pale brownish coloured final product was purified by preparative RP-HPLC to get chromatographically (HPLC and radio-TLC) pure [^{14}C]diuron as a white solid.

REFERENCES

1. Bryan GW, Gibbs PE, Burt GR, Hummerstone LG. *J Mar Biol Assoc* 1986; **66**: 611.
2. Evans SM, Evans PM, Leksono T. *Mar Pollut Bull* 1996; **22**: 263.
3. Volford J, Knausz D, Meszticky A, Horvath L, Csakvay B. *J Label Compd Radiopharm* 1981; **18**: 555.
4. Tanaka FS. *J Agri Food Chemistry* 1970; **18**: 213.
5. Volford J, Koltai E, Kling F, Volford A. *J Label Compd Radiopharm* 1996; **38**: 661.

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