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NOTE

PREPARATION OF CARBON-14 LABELED ORGANOPHOSPHATE PESTICIDES: DICHLOFENTHION

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Summary

Esterification of [U-^{14}C]-2,4-dichlorophenol with *O,O*-diethyl chlorothiophosphate afforded [U-^{14}C]-*O*-(2,4-dichlorophenyl)-*O,O*-diethyl thiophosphate (dichlofenthion) with specific activity 19.0 mCi/mmol in 87% radiochemical yield.

Key Words: Dichlofenthion, organothiophosphate, pesticide, carbon-14

Introduction

Organophosphate pesticide residues which have been found in lanolin (1,2) have been attributed to the chemical sheep dip, which is used as a preventive measure to repel pests. Since dichlofenthion (**1**), which is used for the control of pests in sheep (3), is highly fat soluble (4) and has been found to powerfully inhibit cholinesterase (4), it was important to determine its skin penetration. Therefore, the preparation of carbon-14 labeled dichlofenthion [^{14}C]-(**1**) was undertaken.

Results and Discussion

The preparation of carbon-14 labeled dichlofenthion (**1**) had not been reported. However, the general procedure for the synthesis of unlabeled *O,O*-dialkyl O-aryl thiophosphates (5) is suited to this purpose since carbon-14 labeled 2,4-dichlorophenol (**2**) is commercially available. Thus, treatment of carbon-14 labeled (**2**) with an equimolar amount of commercially available *O,O*-diethyl chlorothiophosphate (**3**) as shown in Chart 1 was expected to afford the desired product **1**.

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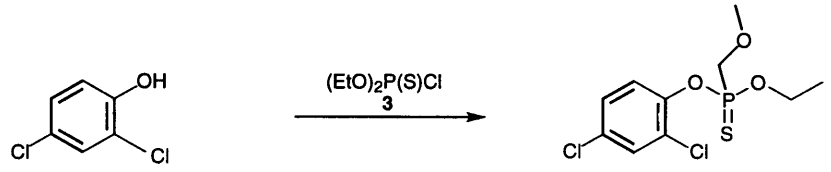
Chart 1



2 1

Before embarking on the radiosynthesis, the reaction sequence was explored using unlabeled materials. The reaction of commercially available 2,4-dichlorophenol (**2**) with commercially available *O,O*-diethyl chlorothiophosphate (**3**) in refluxing acetone was monitored by thin layer chromatography (TLC). Since both the starting materials were detected after 2 hours, reflux was continued overnight. At the end of 19 hours TLC indicated complete consumption of the starting materials. Evaporation of the volatiles after removal of the solids by filtration afforded a pale yellow oil. Gas chromatography showed 2.9% of **2** and 97% of **1**. Purification by flash chromatography afforded **1** in 98.5% purity (GC) and 61% isolated yield.

In view of these favorable results these reaction conditions were used with 5.5 mCi [^{14}C]-**2**. After purification 4.8 mCi (87% radiochemical yield) of the desired product [U-^{14}C]dichlofenthion ([^{14}C]-**1**) was obtained. The chemical purity was determined by GC to be 98.3%, and the radiochemical purity, which was determined by TLC-radioscan, was 99.4%. The chemical yield was 86%. The specific activity corresponded to that of the starting dichlorophenol [^{14}C]-**2**, which had been used without dilution.

Experimental

[U-^{14}C]Dichlofenthion ([^{14}C]-**1**)

A mixture of [U-^{14}C]-2,4-dichlorophenol ([^{14}C]-**2**) (5.5 mCi, 47 mg, 0.29 mmol) of specific activity 19 mCi/mmol, *O,O*-diethyl chlorothiophosphate (**3**) (45.5 µL, 0.29 mmol), and sodium carbonate (31 mg, 0.29 mmol) in acetone (2 mL) was brought to reflux under a N_2 atmosphere. After 19 h the reaction mixture was allowed to cool to room temperature and filtered through a cotton/celite plug. The filtrate was concentrated to give a pale yellow oil which was purified by flash chromatography on 5 mL flash SiO_2, eluting with 20% chloroform in hexane to afford 4.8 mCi of [^{14}C]-**1**. The radiochemical purity, determined by TLC-radioscan (SiO_2, 60% $CHCl_3$-hexane, R_f = 0.4), was 99.4% and the chemical purity, determined by GC (DB-17 megabore, 15 m, 95 °C for 4 min, to 200 °C @ 20

°C/min for 10 min; injector temp 150 °C; detector temp 225 °C; carrier gas: 15 mL/min; aux gas: 20 mL/min; H_2: 30 mL/min; air: 400 mL/min), was 98.3%. The radiochemical yield was 87%.

Conclusions

The esterification of carbon-14 labeled 2,4-dichlorophenol with *O,O*-diethyl chlorothiophosphate gave a 86% isolated yield of carbon-14 labeled dichlofenthion in 87% radiochemical yield providing an efficient route to the synthesis of this pesticide.

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