Journal of Thermal Analysis and Calorimetry, Vol. 55 (1999) 291–300

THERMAL STABILITY OF γ-IRRADIATED TOLBUTAMIDE

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Abstract

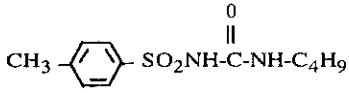
The thermal stability of tolbutamide before and after exposure to various γ-radiation doses was investigated. The data were followed by studying DTA, X-ray diffraction, IR, and UV absorption spectra before and after γ-irradiation. The results obtained were promising, and were explained, and discussed on the basis of γ-enhanced stabilization through recombination of free radicals.

Keywords: DTA, γ-radiation doses, IR, thermal stability, tolbutamide, UV

Introduction

Tolbutamide is 1-butyl-3-tosylurea [1], sulfonamide but not a sulfanilamide derivative.

Tolbutamide is a sulfonylurea drug in current use. It is an orally active hypoglycemic agent which reduces the blood sugar concentration. It probably acts by



stimulating insulin secretion, as it has no action on muscle-glucose metabolism when given alone [2].

The investigation of radiation damage in various materials has begun relatively recently; however, in the last few years, considerable progress has been made in this area. Radiation effects in solids are of great importance and are sometimes also an emotional issue [3–6].

The γ-ray spectrum of a radionuclide is a valuable tool for the qualitative identification of γ-ray emitting radionuclides. The full energy peak, or the photopeak, is identified as the γ-ray transition energy that is given in the decay scheme of the radionuclei.

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1418–2874/99/ $ 5.00

Akadémiai Kiadó, Budapest
Kluwer Academic Publishers, Dordrecht

In irradiation with ^{60}Co gamma rays, the Compton effect has the larges cross-section [7] except for materials of very high atomic number and, moreover, the number of atoms displaced (cm^{-3} S^{-1}) is maximum in the very light elements and diminishes [8] to zero around atomic masses of 125. Irradiation with these rays therefore involves atomic displacement by the Compton electrons. Photoelectric and pair production events appear.

An electron spin resonance study of radiosterilization of antibiotics has been carried out by measurement of γ-ray-irradiated ceftazidime and ampicillin [9, 10]. Several studies have been carried out on the applicability of thermal analysis to investigate drugs [11].

The present work was carried out in view of assessment of the effect of γ-radiation on the physicochemical properties and thermal stability of tolbutamide. This effect was examined by recording the DTA curve before and after each γ-dose supplemented by X-ray diffraction, IR, and UV absorption studies. While significant work has been done on the effect of irradiation on the thermal decomposition of simple inorganic compounds, the effect exerted on pharmaceuticals is still not clear.

Through studying γ-induced changes in thermal behaviour, the determination of some constants and characteristics by thermal analysis is also aimed at.

Experimental

Tolbutamide is a pure substance and satisfies British Pharmacopeia (B.P.) requirements. All chemicals used were of analytical grade.

The X-ray diffraction patterns were recorded with a Shimadzu-XI-3 diffractometer using a CuK_α radiation and Ni filter. DTA measurements were made with an XD-30 thermal analyzer in air up to 500°C. The IR absorption spectra were recorded for KBr pellets with a Shimadzu (Japan) spectrophotometer in the range (4000–200 cm^{-1}). A Beckman DU-8-spectrophotometer was used for the UV absorption measurements in the range (200–350 nm) in ethanolic solution.

A group of samples of tolbutamide (four samples) were irradiated with different doses ranging from 0.192 KGy up to 8.830 KGy from a Cs-137 source as in Table 1. The Cs-137 source was calibrated with a dosimeter 2507 under its optimum conditions. The dose rate was 0.2666 Gy/min at 0.3 m from the source in air.

Table 1 γ-doses given to the examined compound

Dose/No	Dose (KGy)
I_o	0.000
I_a	0.192
I_b	2.087
I_c	5.374
I_d	8.83