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Gamma radiation response of plant isolated *coumarin glycoside*

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ABSTRACT

A newly isolated compound: 7-hydroxy-8-*O*-β-glycosylbenzopyranone (*coumarin glycoside)* was obtained from *Rhododendron lepidotum* by column chromatography. This compound was subjected to gamma radiation of various doses. These radiated samples were characterized by Fourier transform infrared (FT-IR) spectroscopy, UV–vis spectroscopy and Photoluminescent (PL) spectroscopy. FT-IR confirms the presence of various functional groups, and a systematic variation in these bands can be observed after irradiation. From the UV–vis spectroscopy, the present compound shows an increase in absorbance with increasing radiation dose. This compound follows an indirect allowed transition with an optical band gap (E_g) of around 3.01 eV (pristine). However, with increase in radiation dose, an enhancement of observed E_g is observed. A variation in disordered energy was also observed with dose. An increase in PL emission can also be seen with radiation. The observed properties shown by this compound projects it as a potential dosimeter within the understudy dose range.

1. Introduction

For last few decades, a good quality research has been done to enhance quality of radiation sensors for detection of invisible ionizing γ and neutron radiations. Since, γ rays and neutrons are the highly penetrating source of ionization radiations, the best way of their sensing is due to indirect interaction with the detector material and produce light flash called scintillation [1]. The efficient way to detect γ radiations are by using Organic scintillators [2]. Organic scintillator materials comprise of crystals of organic molecules such as stilbene and anthracene, liquid scintillators and plastic scintillators (mostly aromatic cyclic in nature) [1–3].

The literature scan projects that aqueous coumarin solutions has been used for dose evaluation of different ionization radiations [4–6]. Quite recently, highly efficient fluorescent dosimeters with coumarin derivatives and other dyes have been reported [7–9]. In addition, radiolysis of coumarin based dyes are also active field of research [10–13]. Coumarins are vital group of naturally occurring compounds mostly distributed in the plants. They are also produced artificially for different applications [9]. Different derivatives of these compound show various important applications, such as in pharmaceuticals, cosmetics, agrochemicals, fragrances, additives to food, optical brightening agents, dispersed fluorescent, tunable dye lasers, biological activities like anthelmintic, hypnotic, insecticidal and anticoagulant properties [14]. To enhance their various

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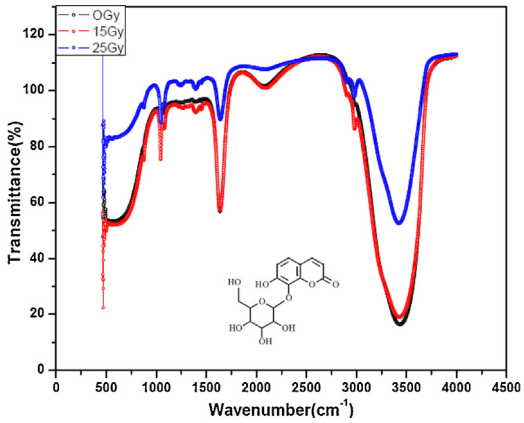

Fig. 1. FT-IR spectrum of compound after irradiated at different doses. Inset shows molecular structure of compound.

applicable properties, mostly coumarins and their derivatives are isolated and then modified by different ways as per their use.

In our previous investigation on some plant isolated coumarin, we had carried out their structural, morphological, vibrational, electrical and optical properties briefly [15]. Also, dosimeteric properties of some coumarins were explored by our group [16,17].

In the present study, 7-hydroxy-8-*O*-β-glycosylbenzopyranone (*coumarin glycoside)* was obtained from the plant *Rhododendron lepidotum* by column chromatography technique and its possible application as γ-radiation dosimeter is investigated.

2. Experimental

The 7-hydroxy-8-*O*-β-glycosylbenzopyranone (*coumarin glycoside)* molecule [now on words will be called *coumarin glycoside* or compound or molecule] were isolated from the plant *Rhododendron lepidotum* by column chromatography technique. Air-dried and coarsely powdered plant material (aerial part, 800 g) was defatted with hexane for 48 h. The defatted material was dried and extracted with methanol for 48 h. The methanolic extract thus obtained was concentrated under reduced pressure to give a crude extract, 112 g. This extract was dissolved in the minimum amount of methanol and adsorbed on silica gel to form slurry. The dried slurry was subjected to column chromatography over silica gel. The column was eluted with different percentages of petroleum ether and ethyl acetate and finally with methanol. Details about isolation and characterizations are described in literature [18]. Inset of Fig. 1 shows the molecular structure of *coumarin glycoside*. To investigate dosimeteric properties of this *coumarin glycoside*, certain amount in powdered form (3.5 mg; after optimization by using optical absorption) of this product was irradiated with ^{137}Cs γ-radiation source, the facility available at Sher-i-Kashmir Institute of Medical Sciences, Srinagar, J&K, India in dose range 0–25 Gy (with doses 15, 20 and 25 Gy). Ultraviolet–visible (Uv-Vis) spectroscopy of unirradiated and irradiated mixture was recorded on Shimadzu UV-1601 spectrometer. Photoluminescence (PL) was carried out by Shimadzu Spectroflourometer RF-5301. Fourier Transform Infrared (FT-IR) spectrum was recorded on Perkin-Elmer Paragon-1000 spectrophotometer Esquire 3000 spectrometer by KBr pallet technique. All the experiments were done at room temperature under normal conditions.

3. Results and discussion

The IR spectra of *coumarin glycoside* with different gamma doses are shown in Fig. 1. The observed spectrum shows a broad band at around 3430 cm^{-1} corresponding to the O—H stretching vibrations, (due to O—H stretching of carboxylic group). The band at 2974 cm^{-1} is attributed to the asymmetric stretching vibration of C—H. The band at 1395 cm^{-1} symmetric stretching of CH_2 bending. A band at 1049 cm^{-1} is due to the O—H bending vibration. The C—C and C—O—C stretching vibration was observed at 1245 cm^{-1} and 878 cm^{-1} respectively. The sharp band at 1638 cm^{-1} corresponds to the C=O stretching carbonyl group present in the molecule. The corresponding bending and wagging of C—H vibrations are at 1422 cm^{-1} and 1363 cm^{-1}, respectively [15,18,19]. In short, the under study molecule shows, stretching vibrations for C=C bonds in the aromatic ring, and the deformation vibrations for C—H bonds in CH_2 and CH_3 groups (and aromatic CH groups of compound) in the observed spectrum [15,18,19].

After gamma radiations, the spectrum shows changes in various observed bands of molecule. The changes in number, frequencies, intensity, and width of the FTIR bands in the particular region of ν(O—H) vibrations (3400 cm^{-1}), δ(C—H) vibrations (1500–1300 cm^{-1}) and ν(C—O) vibrations (1200–1000 cm^{-1}) (Fig. 1) were related to changes in the conformation and short range interactions. The changes in intensity of these bands are strongly associated with the alterations in the molecular order [15,18,19]. These bands in the spectra of the exposed molecule can be responsible for ordered or disordered micro-structure.