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EPR of some irradiated renal stones

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Abstract

Some renal stones were investigated by electron paramagnetic resonance of their untreated, UV-photolyzed and gamma-irradiated states. Powder X-ray diffraction technique indicated that the renal stones were made mainly from CaC_2O_4, MgC_2O_4, $MgCO_3$ and $NH_4MgPO_4 \cdot 6H_2O$. Before radiation treatment, the renal stones yielded a signal that could be attributed to a $\dot{C}_2O_4^-$ radical. UV-photolysis seems to slightly increase the intensity of this signal, but does not produce any new centres. Gamma-irradiation initially gives $–CH_2\dot{C}(CH_3)–R$ and $\dot{C}O_2^-$ radicals, and while the intensity of the $–CH_2\dot{C}(CH_3)–R$ signal decreases, the intensity of the $\dot{C}O_2^-$ signal increases as time elapses.

Keywords: EPR; Gamma irradiation; Renal stone; Radical

1. Introduction

It is well known that when materials are exposed to high-energy radiation, some paramagnetic centres are induced and these centres can be investigated by electron paramagnetic resonance (EPR). Various kinds of stones were gamma-irradiated and investigated with this technique (Ikeya et al., 1993). Some biocarbonates, aragonitic shells and corals indicated the presence of the isopropyl radical (Kai and Miki, 1989) and $\dot{C}O_3^-$ and $\dot{C}O_2^-$ radicals (Callens et al., 1987; Bacquet et al., 1981; Ishii and Ikeya, 1993) were also observed. These radicals were found either in the natural states of the samples as impurities or as a result of gamma-irradiation. An early study on gamma-irradiated aluminium, ammonium, calcium, cadmium, lithium and magnesium oxalate powders indicated the presence of $\dot{C}O_2^-$ radicals (Atkins et al., 1962). On the other hand, some gamma-irradiated oxalate containing materials exhibited the existence of $\dot{C}_2O_4^-$ and $\dot{C}O_2^-$ radicals (Horvath et al., 1988, 1991; Ravi Kumar and Lingam, 1990). Thermal decomposition of strontium oxalate indicated the presence of $\dot{C}O_2^-$ radicals in the decomposition process (Angelov et al., 1986). Since the oxalates are among the contents of renal stones, we thought it interesting to study some renal stones with EPR. We have not noticed any EPR study on these materials. Therefore, it is the purpose of this study to investigate some renal stones in their untreated, UV-photolyzed and gamma-irradiated states.

2. Experimental

The renal stones were obtained from the medicine faculties of Samsun and Erciyes Universities. The samples were powdered and exposed to UV-rays directly in the

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EPR cavity by a Conrad Hannovia 1 kW xenon lamp. The gamma-irradiations were made by a ^{60}Co gamma-ray source to a dosage around 5 kGy. The spectra were recorded with a Varian E-109 C model X-band EPR spectrometer using 2 mW microwave power and 100 kHz modulation frequency with an amplitude of 0.1 mT. The g factors were found by comparison with a diphenylpicrylhydrazyl sample of $g = 2.0036$. For the identification of the contents of renal stones, their powder X-ray diffraction spectrograms were obtained at the High Technology Institute at Gebze with a Rigaku dmask 2200 powder X-ray diffractometer. The simulation of the EPR spectra was made by using the Bruker Win EPR programme. The EPR spectra of renal stones of ten patients exhibited essentially the same behaviour in their clean, photolyzed and gamma-irradiated states.

3. Results and discussion

X-ray powder diffraction spectrograms of renal stones indicate that they contain mainly Ca, Mg oxalates, ammonium magnesium phosphates, magnesium carbonates, etc. as shown in the two examples in Fig. 1. The common component seems to be oxalate.

EPR powder spectra of the renal stones exhibit a line as in Fig. 2 with $g = 2.0038$ and a linewidth around 1 mT. The UV-photolysis for 2 h at ambient temperature seems to slightly increase the intensity of this line, which can be attributed to

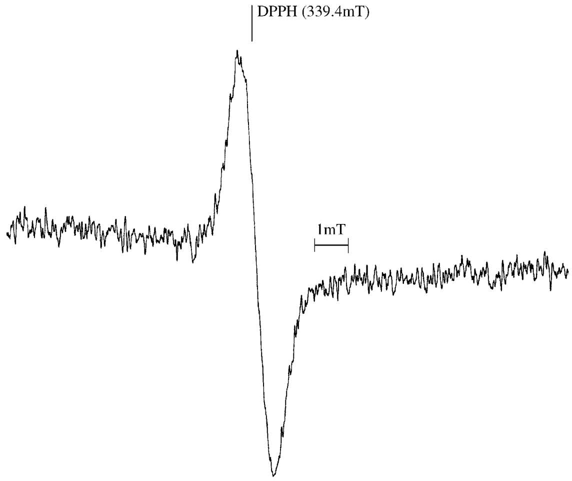

Fig. 2. EPR spectrum of clean renal stones.

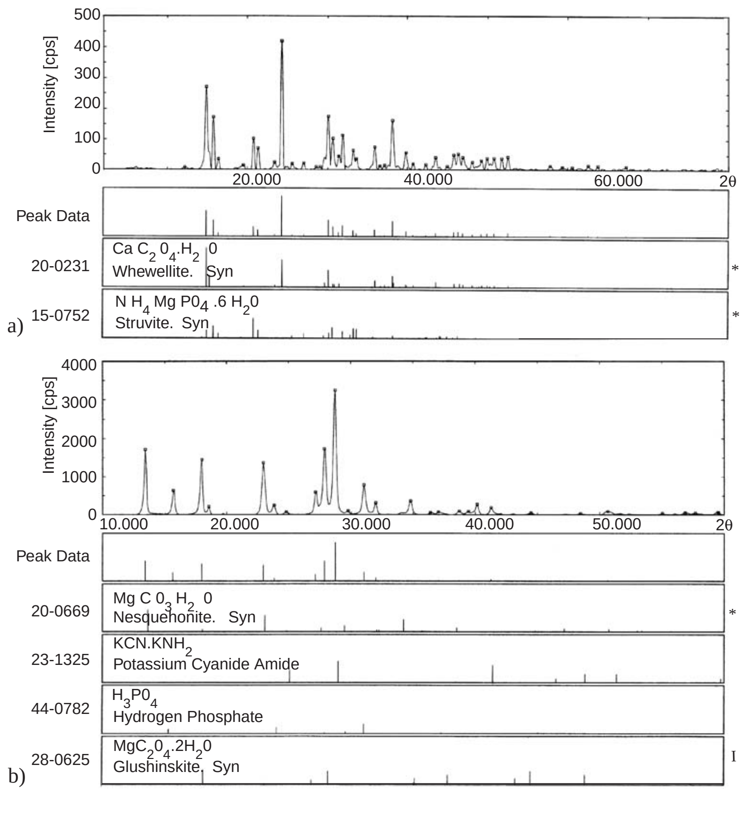

Fig. 1. X-ray powder diffraction spectrograms of renal stones of two patients (a) and (b).