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Radiation dosimetry applications based on silicate minerals extracted from dried oregano

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Introduction

The European Standard EN1788 (2001) [1] defines the procedure of silicate minerals' extraction from food products and their use to distinguish irradiated from non-irradiated food products, based on Thermoluminescence (TL). The extraction of the minerals is important since most of the food products, such as dried oregano, are not heat-resistant, thus TL cannot be applied to them directly. Additionally, the isolation of the minerals leads to samples with higher ratio of luminescent materials in the overall mass, making the detection of lower doses more efficient.

Calculation of the applied sterilization dose for the irradiated products is important, since there are certain pre-defined dose limits. Exceeding these limits during food sterilization may compromise of the public health [2].

Moreover, researchers seek for materials that could be used in retrospective/accidental dosimetry, in the cases that there is no available data from personal dosimeters. Everyday objects can be used, including commonly used pharmaceuticals [3] or even biological materials, such as chicken bones [4].

Materials and Methods

Considering that dried oregano is a common herb in variant cuisines, it is chosen as the material under-study. The goal of the present study is twofold; to examine if the extracted minerals can be used for the estimation of the sterilization dose and to calculate the dose released in case of an accident. Therefore, the TL properties of the material are investigated, for two dose regimes, namely between 50 Gy to 4 kGy and between 1 to 20 Gy.

Measurements were carried out using a Risø TL/OSL reader (model TL/OSL DA-15) and a 9635QA photomultiplier tube for light detection. Measurements were performed in nitrogen atmosphere with a low constant heating rate of 2°C/s, to avoid significant temperature lag.

Results

Results reveal that the glow curve of the silicate minerals has at least three overlapping peaks in the dosimetric spectrum. The material exhibits strong sensitization, which can be corrected by normalizing the measured signal with the signal for a fixed test dose after each TL measurement. All three peaks demonstrate linear dose response for doses up to 1000 Gy, while for higher doses, saturation seems imminent.

An "unknown" delivered dose can successfully be recovered. The stability of the signal with respect to the storage time differs for the three peaks. However, the remaining signal is appreciable for 1 month post irradiation, for most of them.

Conclusion and Future work

The findings of the present study support the potential use of the silicate minerals, for accidental/retrospective dosimetric applications and for the estimation of the irradiation dose for sterilization purposes. Further investigation will focus on studying the response of the sample with Optically Stimulated Luminescence (OSL).

References

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