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The single-aliquot additive dose method for retrospective EPR dosimetry in irradiated dried fruit

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Summary

The identification of irradiated dried fruit can be achieved by means of the EPR spectroscopy, as recommended by the European Community (1), since ionizing radiation induces free radicals in cellulose, a constituent of the fruit shell. The EPR signal is due to a group –CH2OH of the glucose molecule, produced after a homolitical cleavage of the carbon–oxygen bond and consequent loose of the OH radical. Unirradiated samples give only one singlet EPR signal, whereas in irradiated samples a pair of satellite lines appear, spaced 60 mT each other. Positive identification of the EPR lines ascribable to the cellulose radicals is evidence of irradiation, but their absence does not constitute evidence that the sample is unirradiated. The aim of this work was to use the EPR spectroscopy also as a quantitative procedure to evaluate the original dose in irradiated dried fruit, using the single-aliquot additive dose method, previously successfully applied to bone samples (2). Samples of nuts, chestnuts, peanuts and pistachios were irradiated at "original"dose values in the range 1 ⊠ 8 kGy. Little shell pieces were taken from these irradiated dried fruits, their EPR spectrum was recorded, and the peak-to-peak intensity of the satellite lines was measured. Each aliquot was then irradiated with additive doses of 1 kGy each, and the cumulated EPR signal intensity was measured after each re-irradiation. The following mathematical relationship between the EPR signal intensity and the additive dose D was used:

Back extrapolation to the dose axis gives an estimation of the original dose (3).
Our results show that the single-aliquot additive dose method gives an estimation of the original dose within ±30% in all the studied aliquots. An investigation on the time stability of the EPR signal was also carried out: the signal intensity decreases during the first days after irradiation, and remains almost steady afterwards. A procedure was therefore developed to take into account this signal fading when dose reconstruction is performed with the additive dose method. The method set up in this work allows, besides the identification of irradiated dried fruits, to check if the given dose is within the recommended limits.

References:
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