

Detection of irradiated foods packed in plastics and glasses using Electron Paramagnetic Spectrometry (EPR)

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Research Question/ Motivation

Motivation: Irradiated foods are not labeled, although free radicals generated during this process cause cancer.

Research question: Can we detect foodstuff exposed to radiation using the recently-developed Sci-hub inexpensive and portable EPR?

Abstract

Food irradiation is used to improve the safety of foods by killing pathogenic microorganisms. Though an identifiable symbol exists, very few commercial vendors display it on consumer products. Electron paramagnetic resonance (EPR) spectrometers can detect the paramagnetic centers that are created in foodstuff and any packaging if present during irradiation. However, this technique is not commonly used because the current equipment is bulky and expensive. The research focused on the use of an open-air EPR spectrometer developed by the Sci-Hub team that is inexpensive and portable to detect irradiated foods.

Approach

- Subjecting sample to the simultaneous action of a magnetic field and an electromagnetic microwave (Figure 1)¹.
- The integrated EPR signal is proportional to the concentration of the paramagnetic center (Figure 2)

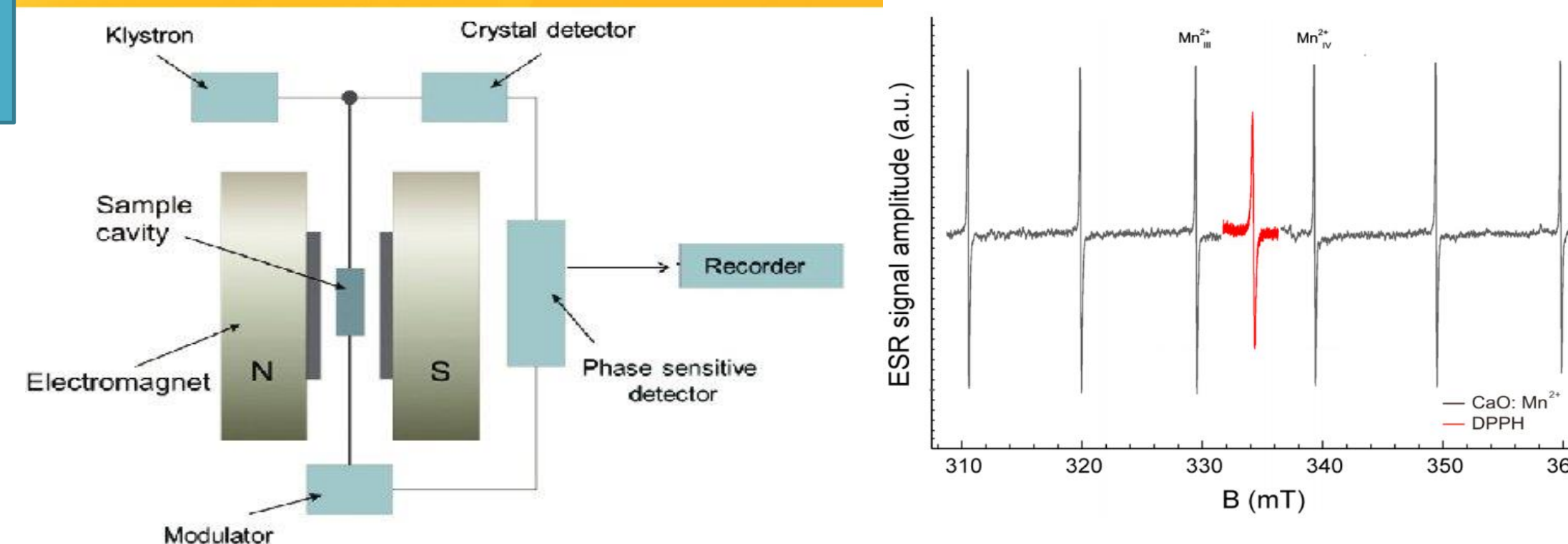


Figure 1: Block diagram of EPR

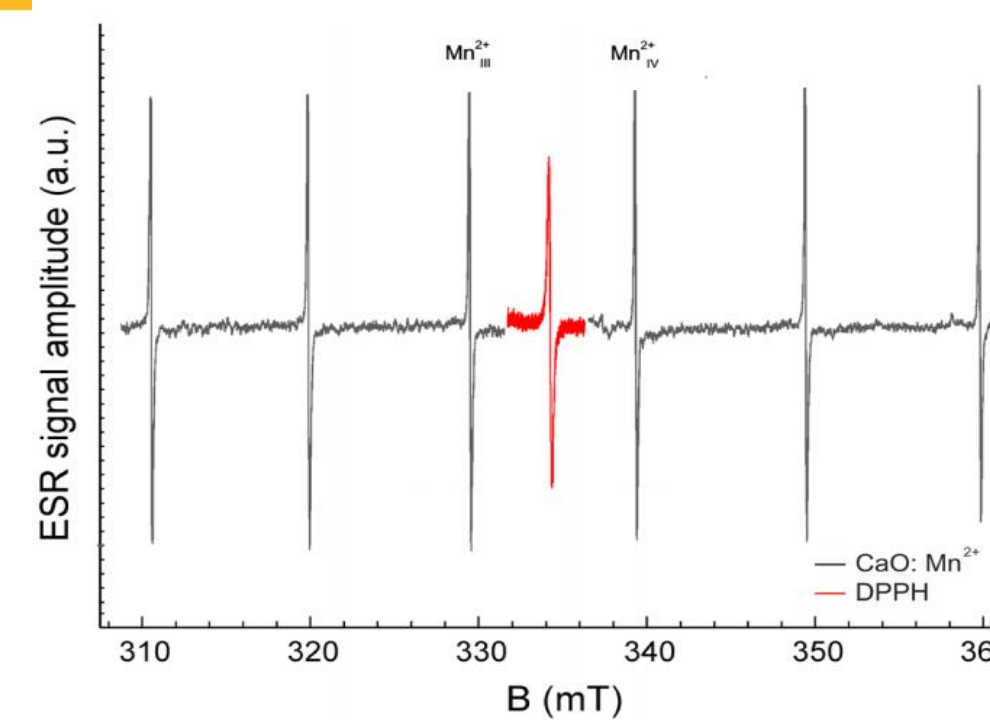


Figure 2: ESR spectra of Mn²⁺ in CaO and DPPH from Dului & Bercu, 2017

Findings

Foods containing cellulose (seeds, peels, herbs, and some spices), crystalline sugar from dried fruits and bone-containing foods are commonly irradiated. We designed a set of experiments to use our portable, inexpensive EPR spectrometer to determine the concentration of free radicals. (Figure 3,A,B,C).

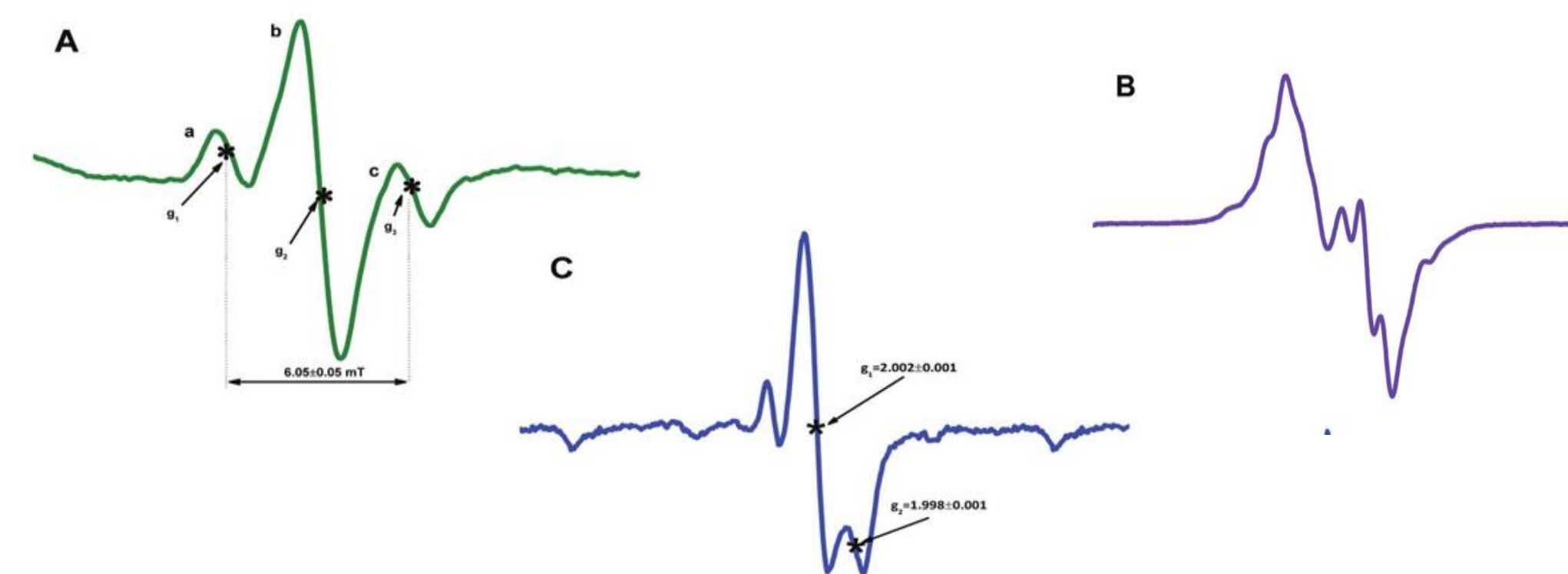


Figure 3: ESR spectra of A: cellulose radical, B: crystalline sugar radical and C: bone radical sourced from

<https://www.researchgate.net/publication/260599732>

Challenges

Due to COVID-19, the research work focused on literature searches rather than laboratory testing.

Conclusion

Sci-hub EPR spectrometer is very promising technique to determine the free radical concentration in foodstuff. We have identified the most commonly irradiated foods that would be tested.



Sourced from alamy stock

Future work

- Foodstuffs from various groceries would be obtained and tested for the presence of free radical.
- EPR laboratory experiments would be performed and the free radical concentration in irradiated and non-irradiated foodstuff would be compared in Fall 2021.

Acknowledgment

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References

1. Dului, O. G., & Bercu, V. (2017). ESR Investigation of the Free Radicals in Irradiated Foods. In *Electron Spin Resonance in Food Science*. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-805428-4.00002>
2. <https://www.researchgate.net/publication/260599732>