

## Near-Infrared Hyperspectral Imaging Spectroscopy to Detect Microplastics and Pieces of Plastic in Almond Flour

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**Abstract :** Plastic and microplastic pollution in human food chain is a big problem for human health that requires more elaborated techniques that can identify their presences in different kinds of food. Hyperspectral imaging technique is an optical technique than can detect the presence of different elements in an image and can be used to detect plastics and microplastics in a scene. To do this statistical techniques are required that need to be evaluated and compared in order to find the more efficient ones. In this work, two problems related to the presence of plastics are addressed, the first is to detect and identify pieces of plastic immersed in almond seeds, and the second problem is to detect and quantify microplastic in almond flour. To do this we make use of the analysis hyperspectral images taken in the range of 900 to 1700 nm using 4 unmixing techniques of hyperspectral imaging which are: least squares unmixing (LSU), non-negatively constrained least squares unmixing (NCLSU), fully constrained least squares unmixing (FCLSU), and scaled constrained least squares unmixing (SCLSU). NCLSU, FCLSU, SCLSU techniques manage to find the region where the plastic is found and also manage to quantify the amount of microplastic contained in the almond flour. The SCLSU technique estimated a 13.03% abundance of microplastics and 86.97% of almond flour compared to 16.66% of microplastics and 83.33% abundance of almond flour prepared for the experiment. Results show the feasibility of applying near-infrared hyperspectral image analysis for the detection of plastic contaminants in food.

**Keywords :** food, plastic, microplastic, NIR hyperspectral imaging, unmixing

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