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Chaotic Parameters Extracted from Fluorescence Spectra to Quantify Sheep Cheese Whey in Natural Bodies of Water

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Abstract

Sheep cheese whey (SCW) is a by-product from the dairy industry, and due to its composition, it is very hazardous for natural bodies of water. However, illegal discharges of this product have been commonly reported in watercourses and reservoirs. To prevent this type of actions, a simple and affordable sensor has been designed and validated using diverse water samples from different sources containing SCW, such as water from two Spanish reservoirs and two Spanish rivers located in the province of Madrid. Using these waters, different SCW solutions (lower than 20 % in weight) have been prepared and measured. The equipment used to sense the samples is based on combining fluorescence measurements, obtained with light emitting diodes (LEDs), and algorithms which rely on chaotic parameters. Every sample was measured by six different types of LEDs possessing distinct emission wavelengths (blue, orange, green, pink, white, and UV), leading to 1,786 fluorescence spectra that were employed during the modeling phase. After the mathematical analysis, the dataset that generates the best statistical results was from the blue LED. This approach was validated by the leave-one-out cross-validation method and externally validated, and the results were very promising (error around 6.5 % and 8 % quantification error, respectively). Additionally, it is important to note that the sensor used has been designed and developed by a 3D printer and has the potential of being applied *in situ* for real-time and cost-effective analysis of natural bodies of water.

GRAPHICAL ABSTRACT

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