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Detecting, identifying, and quantifying adulterations in foods through computational artificial intelligence

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In the past, many food sectors have suffered the impact of fraudulent activities which involve the adulteration of foods, which not only endanger the economy and prestige of the producers or the quality of the goods, but in occasions the health of the consumers. One of the main fields our research group focuses is on the design of different mathematical tools based on algorithms such as artificial neural networks (ANNs), which are a relevant part of the computational artificial intelligence field, to aid in this particular sense. They allow the detection of adulterated foods, the identification of particular adulterants, and even their quantification. In this work, an array of applications will be covered, as they are designed with the intention to help protect the integrity of the food sector. Specifically, regarding extra virgin olive oil (EVOO), various tools based on supervised ANNs to model spectroscopic data have been created and optimized to quantify and identify lower grade olive oils (pomace and refined) or oils with different botanical origins (corn and sunflower). On the other hand, non-supervised ANNs combined with calculations based on chaotic parameters have also been employed to detect edible oils that are used to adulterate EVOO. Finally, an assortment of linear and non-linear mathematical models have been employed to characterize binary mixtures of 6 vinegars with different origins (red wine, white wine, molasses, apple, apple cider, and rice). All of these models have been validated accordingly, resulting in reliable and accurate tools that can be useful for many phases during the distribution chain of foods, ranging from producers all the way to the final consumers.

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Quality control of olive oil by computer vision and artificial intelligence

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Olive oil in Mediterranean countries is the cornerstone of their popular and healthy diet. Spain is one of the main olive oil producing and exporting countries and it also represents an important pillar of its economy. For these reasons, quality control and protection of these products are relevant aspects of the sector, and new approaches that improve this are always well received. When controlling the quality of olive oil, special attention must be paid during the selection of the olives which will be used, because their quality will directly determine the final product. The use of low quality olives can ruin the outcome of the oil, even if adequate systems are employed. This fruit selection process is the first step carried out in the mill. Based on photographic studies which cataloged different types of olives by quality, a model based on image processing and artificial intelligence, in order to identify the quality of olives directly from the image, has been designed, reaching a high correct classification rate. This rate was 100% when trying to distinguish high quality olives from the rest, because its appearance is substantially different from those of average quality and lower grades. An olive selection process assisted by this system could be useful to predict oil quality. The collection and processing phases of the images could be done *in situ*, which would pave the road for a possible real-time application of the system.

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