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Commentary

Role of X-ray Fluorescence in Agriculture Science

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DESCRIPTION

In recent years, agriculture and food science fields have made extensive use of X-ray fluorescence methods. Its benefits include minimal sample preparation, non-destructive analysis, high spatial resolution, and measurements of numerous components inside a single sample. In this study, X-ray fluorescence literature from the food and agricultural science fields is thoroughly reviewed and summarized with an emphasis on food safety inspection, food nutrition, plant science, soil science, and Ca related issues in horticultural crops. The benefits and drawbacks of X-ray fluorescence in comparison to conventional analytical methods for elements are also explored. Future applications of X-ray fluorescence methods would considerably rise with the development of more advanced technology, including detector, scanning, and beam line capabilities, among other things. The performance of XRF's prediction would be substantially enhanced by its combination with other methods, such as chemo-metrics or data analytics. Exciting new possibilities for X-ray fluorescence use in the fields of food and agricultural research are provided by these further advancements.

In plant science, trace element detection is critical. Both in plants and soil, the concentration of trace mineral elements can vary, and this fluctuation can cause shortages or an excessive accumulation of these mineral metals. It's critical to understand the amounts of trace elements in plants while diagnosing various crop diseases. A non-destructive, quick, simultaneous multi-element imaging approach for plant materials is X-Ray Fluorescence (XRF) spectroscopy. Its uses are extensive and encompass the majority of the elements with different concentrations below Parts Per Million (PPM). The well-known atomic spectrometric method known as XRF is also utilised as a field-portable equipment. Due to its quick and multi-element analytical imaging response straight from a solid sample, XRF has recently been seen as a particularly useful technique for diagnosing plant nutrition. However, certain recent advancements, such the development of spectrometers based on digital processing and better detector designs for XRF apparatus, have raised instrumental sensitivity and enhanced XRF's productivity and accuracy. The adoption of XRF spectroscopy in environmental research for the analysis of diverse plant materials has grown in popularity as a result of these advancements.

Safe and nutritious food from farm to table is important to everyone. The increased incidence of pollutants and contaminated food has concerned the public and government regulations. Simple, routine and sophisticated science-based methods enable a reliable, precise and transparent decision making process for safe and nutritious food all over the world. As food survey is becoming more demanding, providing rapid, multi-element and accurate results to obtain information on production process, toxicity, or nutrition/health is challenging the traditional analytical methods. Portable XRF which offers multi-element analysis provides actionable results at all stages of the food production process from the presence of required elemental nutrients to threats from elemental and metal contaminants. Compared to the high-energy X-rays (hard X-rays) used in medical diagnostics, low-energy X-rays (soft X-rays), which are less harmful, are often employed for food inspection. Energy-dispersive XRF was used to determine the elements concentration of olive oil and it has proven to be an effective.

Everyone values healthy food that has been produced from farm to table. The public and governmental agencies have expressed worry over the rising prevalence of toxins and fake food. Basic, routine, and sophisticated science-based methods can help the world reach a trustworthy, accurate, and transparent decision-making process for safe and nutrient-dense food. The old analytical methods are being put to the test as food surveys become more demanding and require the provision of quick, precise data with several elements to learn about the production process, toxicity, or nutrition/health. At all phases of the food production process, from the presence of necessary elemental nutrients to risks from elemental and metal pollutants, portable XRF that delivers multi-element analysis gives actionable results. Low-energy X-rays (soft X-rays), which are less damaging than the high-energy X-rays (hard X-rays) used in medical diagnostics, are frequently utilized for food inspection. Food and its packaging did not become radioactive when exposed to X-rays at the energy levels utilised for food goods.

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The ED-XRF approach is a quick and inexpensive way to identify the components in milk-based powders. The technique for quickly determining a number of elements (P, S, Cl, K, Ca, Fe, and Zn) in milk-based products was developed and verified by the authors. It ensures that mineral premixes are appropriately added during the manufacture of infant formula in order to achieve the desired concentration. The use of XRF can help us better understand the mechanisms underlying phytotoxicity, which occurs when certain components have a negative influence on plant development or crop output.

Reducing the concentration of harmful substances in the edible section is a concern for both humans and animals as it relates to food safety. Pb, Cu, As, and other heavy metals can move from the soil into vegetables and cereals, providing a risk to consumers. Consumption of lead-rich vegetables might significantly increase overall lead exposure, compared to direct exposure to the lead-contaminated soil in urban agriculture. It is crucial to have a quick and reliable way to assess the exposure to lead and other heavy metals since lead exposure causes a variety of health issues, particularly in children.