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Bulk Hydrogen Analysis of Cyanogenic Food Plants Using Neutrons for Routine Quality Control

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The challenges of food safety affect over 600 million people globally. In the rural parts of Africa, about 70% of the staple foods are toxic, containing cyanogenic glycosides, which can cause long-term health issues if improperly processed. Some of these foods include cocoyam and sorghum. To enhance sustainable food safety, routine quality control of these food plants is needed.

Previously, scientists used the wet chemical method for quality control, but it is destructive and time-consuming. This study employed neutron reflection- a rapid, environmentally sustainable, and non-destructive technique to determine the hydrogen content of various food samples. The experimental setup comprised a source holder, an Americium-Beryllium neutron source, a Helium-3 neutron detector, and a neutron counter. To establish a reliable calibration, liquid hydrocarbons served as reference standards, and the reflection parameter in these standards was measured using the neutron attenuation principle. This was used to determine the hydrogen content in four different varieties of cocoyam and sorghum. The data obtained showed a range of 6.1 ± 1.1 to 8.29 ± 0.10 hydrogen wt% of the respective food samples. Furthermore, we employed the alkaline picrate method to measure the cyanide content in the food samples. This method revealed a cyanide content range of 3.02 ± 0.07 to 6.8 ± 1.0 $mg \cdot L^{-1}$.

Overall, the results showed an inverse relationship between the hydrogen content and cyanide concentrations, indicating a trend that can be used to assess cyanogenic food plants. This implies that neutron reflection can be used as a quality control tool for routine hydrogen assessment in cyanogenic food plants, underscoring the application of nuclear particle radiation in promoting food safety and sustainable development of the food industry.

Technical Track

Nuclear Applications and Radiation Processing

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