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Rapid Elemental Analysis of Human Finger Nails Using Laser-Induced Breakdown Spectroscopy

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Zinc is a crucial element needed for many processes in the human body. It is essential for enzymatic activity and many cellular processes, such as cell division. A zinc deficiency can lead to problems with the immune system, birth defects, and blindness. This problem is especially important to address in developing countries where nutrition is limited. Supplements can be taken to increase the zinc intake, however it is difficult to determine who is zinc deficient and requires these supplements. The gold standard tests for determining the zinc concentration in the human body are both expensive and time-consuming. Zinc in human fingernails can be shown to represent the overall zinc concentration in the body. Laser-induced breakdown spectroscopy (LIBS) provides a quick analysis of the zinc concentration in a human fingernail with minimal sample preparation, thus LIBS could serve as a real-time biomedical assay for zinc deficiency.

LIBS was performed on a collection of healthy human finger nails in an argon environment. The intensities of the zinc ion lines observed in the plasma were proportional to the zinc concentrations of each nail as measured by SIDMS. The variance of the measured zinc intensities between fingers of a given hand and between left and right hands for a single person was studied. Normalization of the zinc lines to other emission lines in the spectrum to reduce shot to shot variation was investigated. Studies were also performed to determine the spatial distribution of zinc within the nail. The influence of nail preparation prior to LIBS testing is an ongoing area of study.

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