DETECTION OF ELEMENTS IN SLIMMING TEA PRODUCT BY USING LASER INDUCED BREAKDOWN SPECTROSCOPY

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DETECTION OF ELEMENTS IN SLIMMING TEA PRODUCT BY USING LASER INDUCED BREAKDOWN SPECTROSCOPY

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A thesis submitted in fulfillment of the requirements for the award of the degree of Master of Science (Physics)

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I declare that this thesis entitled “Detection of Elements in Slimming Tea Product by Using Laser Induced Breakdown Spectroscopy” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently in candidature of any other degree.

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To the people who loved me
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ABSTRACT

Laser induced breakdown spectroscopy (LIBS) has been applied to determine the element content in slimming tea product. A Q-switched Nd:YAG laser operating at 1064 nm and generating 93.7 mJ per pulses was employed to excite the pellet sample and the fluorescence emission was analyzed via spectrum analyzer. The induced spectral lines were compared with National Institute of Standards and Technology (NIST) database to identify the element. A commercial slimming tea was used as sample to be investigated whereas the natural tea leaves were used as control. The LIBS results showed that both slimming tea and natural tea leaves contain several elements including iron (Fe), sodium (Na), chromium (Cr), cobalt (Co), calcium (Ca), manganese (Mn), magnesium (Mg), silicon (Si), sulfur (S), titanium (Ti), nickel (Ni) and cesium (Cs). However, higher intensity of elements was found in slimming tea spectrum compared to natural tea leaves. The plasma temperatures calculated using Boltzmann plot were found to be 13588.95 K and 12319.50 K for slimming tea and tea leaves samples respectively whereas the electron density for slimming tea and tea leaves samples were \(7.46 \times 10^{16}\) cm\(^{-3}\) and \(15.91 \times 10^{16}\) cm\(^{-3}\), respectively. The plasma produced by this LIBS system was found to be in local thermodynamic equilibrium (LTE) condition after evaluating these plasma parameters. Quantitative analysis performed by using inductively coupled plasma mass spectroscopy (ICPMS) proved that the concentration of the elements is higher in slimming tea than in natural tea leaves.
ABSTRAK

Teknik spektroskopi leraian aruhan laser (LIBS) telah digunakan untuk menganalisis kandungan unsur di dalam produk teh pelangsingan. Sebuah laser suis-Q Nd:YAG beroperasi pada 1064 nm dan menjana 93.7 mJ per denyut telah digunakan untuk mengujakan sampel gentel dan pencucuran pendarfluor yang terhasil dianalisis melalui penganalisis spektrum. Garisan spektrum yang terhasil dibandingkan dengan data dari Institut Piawaian dan Teknologi Kebangsaan (NIST) untuk mengenal pasti unsur yang diwakilinya. Teh pelangsingan komersial digunakan sebagai sampel untuk dianalisis manakala daun teh semula jadi telah digunakan sebagai piawai. Hasil LIBS menunjukkan bahawa kedua-dua teh melangsingkan badan dan daun teh semula jadi mengandungi beberapa unsur logam berat termasuk ferum (Fe), natrium (Na), kromium (Cr), kobalt (Co), kalsium (Ca), silikon (Si), mangan (Mn), magnesium (Mg), sulfur (S), titanium (Ti), nikel (Ni) dan cesium (Cs). Walau bagaimanapun, kadar keamatan spektrum bagi teh pelangsingan badan adalah lebih tinggi berbanding daun teh semula jadi. Suhu plasma yang telah dihitung dengan menggunakan kaedah plot Boltzmann ialah 13588.95 K untuk teh pelangsingan badan dan 12319.50 K untuk daun teh semula jadi manakala ketumpatan elektron untuk teh pelangsingan badan dan daun teh semula jadi masing-masing ialah \(7.46 \times 10^{16} \text{ cm}^{-3}\) dan \(15.91 \times 10^{16} \text{ cm}^{-3}\). Plasma yang dihasilkan oleh sistem LIBS ini didapati berada dalam keadaan keseimbangan termodinamik setempat (LTE) selepas menilai parameter plasma. Analisis kuantitatif yang dilakukan menggunakan teknik plasma berganding aruhan spektrometri jisim (ICPMS) telah membuktikan bahawa kadar kepekatan unsur yang terkandung dalam teh pelangsingan badan adalah lebih tinggi berbanding daun teh semula jadi.