Supplementary Information 3 - Analytical techniques for tissue analysis

Several methods are used by analytical labs to determine the concentration of essential elements. The most common technique is inductively coupled plasma (ICP) spectrophotometry [1]. Labs usually follow the EPA 6010D method for the determination of inorganic cations [2]. Solutions are nebulized into an argon plasma flame where they are ionized. ICP instruments can be coupled with either optical emission spectroscopy (OES) or mass spectrometry (MS). In OES, the intensity of the generated spectral emission peaks are proportional to the elemental concentrations in solution [3]. With MS, ions are separated and analyzed based on their mass to charge ratio [4]. Sampling speed and accuracy are higher, but MS is more sensitive to contaminants. A full ICP scan typically ranges from $30 – 100 (2022) per sample. Examples of laboratories can be found at: https://www.naptprogram.org/about/participants/all/ The Utah State University laboratory is here: http://www.usual.usu.edu/

Standard ICP methods cannot easily and accurately measure nitrogen (N). The large amount of N in air makes detection of N in the sample difficult to interpret [5], so it must be analyzed separately. The two most common techniques are the traditional Kjeldahl digestion or newer combustion methods [6]. The Kjeldahl digestion converts bound N to ammonium and requires nitrate to be converted to ammonium for accurate measurement of total N. The ammonium is then measured by titration. Combustion methods ignite samples at high temperatures and measure N content by thermal conductivity. Combustion analysis has largely replaced Kjeldahl digestion methods. Labs may also use ion chromatography to determine nitrate levels using the EPA 300.0 method [7]. Nitrogen analysis often costs $25 – 35 (2022) per sample.

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