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A Brief Note on Polyphenols

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Opinion Article

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DESCRIPTION

Polyphenols include flavonoids, tannic acid and ellagitannin all of which have historically been used as dyes and tanning agents for clothing. Polyphenols are frequently larger molecules (macromolecules). Their maximum molecular weight is around 800 daltons allowing them to rapidly diffuse across cell membranes and reach intracellular sites of action or remain as pigments once the cell senesces. As a result, many larger polyphenols are biosynthesized *in-situ* from smaller polyphenols to non-hydrolyzable tannins and thus go unnoticed in the plant matrix. Most polyphenols contain pyrocatechol, resorcinol, pyrogallol and phloroglucinol phenolic moieties that are linked by esters (hydrolyzable tannins) or more stable C-C bonds (nonhydrolyzable condensed tannins). Proanthocyanidins are mostly polymeric catechin and epicatechin units.

Polyphenols can be extracted using a solvent such as water, hot water, methanol, methanol/formic acid, methanol/water/acetic acid or formic acid. Countercurrent chromatography or liquid–liquid extraction can also be used. C_{18} sorbent cartridges can also be used for solid phase extraction. Other techniques include ultrasonic extraction, heat reflux extraction, microwave-assisted extraction, critical carbon dioxide extraction, pressurised liquid extraction and immersion extraction with ethanol. The extraction conditions (temperature, extraction time,

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solvent-to-raw-material ratio, solvent and concentrations) must be optimised. High levels of polyphenols, which are primarily found in fruit skins and seeds, may reflect only the measured Extractable Polyphenol (EPP) content of a fruit which may also contain non-extractable polyphenols. Black tea contains a high concentration of polyphenols, accounting for 20 percent of the total. Volumetric titration can be used to quantify polyphenolic content after separation/isolation. Permanganate, an oxidising agent is used to oxidise known concentrations of a standard tannin solution yielding a standard curve. The unknown tannin content is then expressed as equivalents of the appropriate hydrolyzable or condensed tannin.

Colorimetric measurements are used in some methods for determining total polyphenol content. Some tests such as the Porter's assay are relatively specific to polyphenols. The Folin-Ciocalteu reaction can be used to determine total phenols (or the antioxidant effect). Gallic acid equivalents are commonly used to express the results. Antibody technologies are rarely used to evaluate polyphenols. Other tests assess a fraction's antioxidant capacity. Some employ the ABTS radical cation which is reactive with the majority of antioxidants including phenolics, thiols and vitamin C. The blue ABTS radical cation is converted back to its colourless neutral form during this reaction. The reaction can be spectrophotometrically monitored. This test is also known as the Trolox Equivalent Antioxidant Capacity (TEAC) assay. The reactivity of the different antioxidants tested is compared to that of Trolox, a vitamin E analogue.

Other antioxidant capacity assays that use Trolox as a standard include Di Phenyl Picryl Hydrazyl (DPPH) Oxygen Radical Absorbance Capacity (ORAC) Ferric Reducing Ability of Plasma (FRAP) and inhibition of copper-catalyzed *in vitro* human low-density lipoprotein oxidation. Condensed tannins which are found in almost all plant families are the most abundant polyphenols. Larger polyphenols are frequently concentrated in leaf tissue, the epidermis, bark layers, flowers and fruits but they also play important roles in forest litter decomposition and nutrient cycles. Absolute concentrations of total phenols in plant tissues range from 1–25 percent total natural phenols and polyphenols calculated with reference to dry green leaf mass depending on the literature source type of polyphenols and assay. Polyphenol levels in some woods are high which may explain their natural resistance to root.