Proanthocyanidins (PAs) are of great interest in nutrition and medicine because of their potent antioxidant capacity and possible protective effects on human health in reducing the risk of chronic diseases such as cancer and cardiovascular disease. In vitro studies have shown that procyanidins in chocolate inhibit human 5-lipoxygenase, decrease the LDL oxidative susceptibility, inhibit platelet function, and promote transforming growth factor-ß1 homeostasis in peripheral blood mononuclear cells. Procyanidins in grape seeds induce apoptotic death of human prostate carcinoma and exhibit cytotoxicity towards MCF-7 breast cancer, A-427 lung cancer and gastric adenocarcinoma cells, while enhancing the growth and viability of the normal cells. Polymeric PAs were more effective than monomers in lowering blood cholesterol by binding cholesterol in the intestine through hydrophobic association, particularly those with higher DP.

In vitro studies have shown that procyanidins with the A-type interflavan linkage isolated from cranberries inhibit the adherence of uropathogenic E. coli to the uroepithelial cell surfaces. Also, the A-type polymers from cinnamon have insulin-like biological activity, and cinnamon consumption (1-6 g) in type II diabetic subjects for 40 days lowered serum glucose, triglycerides and total cholesterol. Procyanidins possess insulinomimetic properties, decreasing hyperglycemia in streptozotocin-diabetic rats and stimulating glucose uptake in insulin-sensitive cell lines. However, additional research is needed relative to procyanidins structure and concentrations that are effective in modulating insulin action.

Oligomeric and polymeric flavan-3-ols are better known as proanthocyanidins (PAs) or condensed tannins. They are ubiquitous and present as the second most abundant natural phenolic after lignin. The flavan-3-ol units are linked mainly through C4→C8 bond, but the C4→C6 bond also exists (both called B-type). The flavan-3-ol units can also be doubly linked by an additional ether bond between C2→O7 (A-type). The size of PA molecules can be described by degree of polymerization (DP) (1). PAs consisting of exclusively of (epi)catechin are procyanidins.

Proanthocyanidin quantitation using BL-DMAC.

A number of analytical procedures including colorimetric, gravimetric, chromatographic and mass spectrometric are currently being employed for the measurement of cranberry PACs, however, due to the complexities of the PAC structures and A-type linkages, the results can often be erroneous and may not be reproducible. Accurate standardization of PA content is vital to establishing dosage guidelines for consumers, monitoring efficacy and shelf-life of dietary supplements and other products, and to formulate standardized test materials for use in research studies. Currently, there is no universally accepted method for quantitation of cranberry PACs.

The new BL-DMAC method has been validated in a multi-lab test and provides a simple and relatively specific spectrophotometric assay for total PAs in cranberry or other powders, utilizing a commercially available procyanidin A2 standard. DMAC is most useful within a given type of food such as cranberries. The DMAC method is not be appropriate for comparing concentrations across different food types or processed samples where there are large differences among the relative amounts of the different oligomers and polymers.
HPLC/MS Profile to Confirm Relative Distribution of Oligomers, Polymers.

In addition to BL-DMAC, other techniques such as HPLC coupled with mass spectrometry are needed to authenticate cranberry powders by guaranteeing the presence of A-type linkages in the proanthocyanidins. This would guard against adulteration of cranberry products with B-linked proanthocyanidins or flavan-3-ols (epicatechin or catechin) from other less expensive food sources.

HPLC chromatogram of cocoa sample illustrating the distribution of oligomers and polymers

For more information about this application, Brunswick Laboratories and its services, please visit our website: www.brunswicklabs.com. We are very interested in your opinions and are readily available to answer any of your questions. Technical support can be reached at 508.281.6600, or if you prefer email, send them to info@brunswicklabs.com.

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