Abstract

Unique flavor characteristics and medicinal properties attributed to onion, Allium cepa, are due to a suite of organosulfur compounds that are generated through enzymatic hydrolysis of S-alk(en)yl-L-cysteine sulfoxides. One such medicinal property is inhibition of blood platelet aggregation by onion extracts. This dissertation emphasizes the role of varietal and environmental effects on onion-induced antiplatelet activity (OIAA) and related biochemical bioassay parameters.

Experiments were conducted with four long day onion selections at four locations in Wisconsin and Oregon during 1994 and 1995. Onion bulbs were sampled at harvest and every 40 days during postharvest cold storage. OIAA changed during storage and varied greatly with location, growing season and onion selection. Genotype x environmental interactions were measured, and attributed to changes in rank within mild or pungent onion selections. Mild types averaged 24.7% less OIAA than pungent types, however, OIAA was not correlated with pungency or soluble solids during postharvest storage. Fluctuations in OIAA were observed during storage, but across all environments, OIAA consistently increased from 0 to 90 days during postharvest storage.

Parental inbred lines, F_1, F_2, and F_2m generations derived from seven mild x pungent matings were assessed for OIAA, cysteine reacting compounds (CRC), and 5,5′-dithio-bis-(2-nitrobenzoic acid) reacting compounds (DTNB-RC) at two locations in 1995 and 1996. Environmental interactions and onion population strongly influenced OIAA and CRC. A significant correlation between OIAA and CRC was revealed, although complex environmental interactions might limit use of CRC bioassays to carefully controlled environments. Broad sense heritability (H^2) estimates for OIAA and CRC were 0.43 and 0.81, respectively, for the parental generation. DTNB-RC H^2 estimates ranged from 0.62 to 0.93 for the F_2 and F_2m generations, respectively. This study strongly suggests that OIAA, CRC, and DTNB-RC are quantitatively controlled traits. H^2 was of sufficient magnitude that using these bioassays in an improvement program may be feasible.

Biomedicinal attributes of onions are likely not caused by a few simply identifiable compounds, but instead several compounds which interact synergestically, controlled by complex biochemical pathways. Results from this dissertation highlight the complexities involved in characterizing medicinal traits controlled by a suite of secondary phytochemicals.