Breeding for Enhanced Antioxidant Content in Peanuts

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Peanuts contain polyphenol antioxidants which protect against diseases involving oxidative stresses produced by cellular respiration and commonly present in inflammation, cancers, neurodegenerative and cardiovascular disorders. Research by our groups over the past decade has demonstrated very large genetic variation exists in total antioxidant content in peanut kernels, with nearly 3 fold differences among contrasting breeding lines (e.g. from ~ 580 to 1700 Trolox equivalence (μmg^{-1})).. Significant potential exists to breed and select high antioxidant genotypes for ultimate development of commercial cultivars. A population (P27) of recombinant inbred lines (RILs) was developed from the hybridization of low (D147-p3-115) x high (Farnsfield) antioxidant expressing parental lines, and evaluated across a range of contrasting environments. The genotype (G), environment (E) and G x E influence on antioxidant expression in the RIL population (as measured using the Oxygen radical absorbance capacity assay (ORAC) assay) showed significant genotypic and environmental effects, but non-significant G x E effects suggesting strong genetic control, moderate heritability and good potential for selection for this trait in peanut breeding programs. Quantifications of known polyphenols in high antioxidant expressing RILs showed increased ferulic acid, *p*-coumaric acid, salicylic acid, resveratrol and daidzein, with levels of these compounds being closely related to genotypic ORAC assay values. A novel, rapid and low cost phenotypic screening technique was then developed for antioxidant expression utilizing silver nanoparticles (AgNP) technology via their reductive capacity during shape transformation. A linear dose-response between AgNP transformation and polyphenol content was observed for sinapic acid, *t*-cinnamic acid, caffeic acid, gallic acid, protocatechuic acid, vanillic acid and syringic acid, as well as rutin, polydatin and resveratrol at extremely low concentrations (detection range: 1×10^{-2} M – 1×10^{-6} M). A rapid colorimetric antioxidant capacity assay has subsequently been developed where methanolic extracts from defatted peanut kernels show a significant correlation (r=0.52) against the ferric-reducing antioxidant power (FRAP) chemical assay. Further research on optimizing the AgNP assay is underway, however it shows significant potential as a simple, rapid and low cost colorimetric nanoparticle-based antioxidant capacity assay for screening of high antioxidant phenotypes in peanut breeding programs.