

A National Effort to Lower Acrylamide in Fry Processing Potatoes

Yi Wang, Kimberly Research and Extension Center, University of Idaho

Acrylamide, a suspected human carcinogen, is found in French fries and potato chips after they are processed under high temperature. Consumption of fried potato products can contribute to dietary intake of acrylamide. According to USFDA and its counterpart in Europe, the European Food Safety Authority, one of the most promising ways to reduce acrylamide level in the potato products is to develop and commercialize new potato varieties.

The National Fry Processing Trial (NFPT) was conducted from 2011 to 2013 in five states: ID, ME, ND, WA, WI, which represent the major fry processing potato production in the northern tier of the US. The objective of this trial is to identify and develop new potato varieties that show low acrylamide-forming potential while maintaining or exceeding the agronomic and storage quality of current varieties. More than 140 advanced entries from breeding programs in the US, as well as the standard varieties Russet Burbank and Ranger Russet, were evaluated for tuber agronomic traits and biochemical properties from harvest through 8 months of storage. Thirty-eight and 29 entries had significantly less acrylamide in French fries than Russet Burbank and Ranger Russet, with reductions of more than 50%, after one and 8 months of storage, respectively. Similar to previous studies, the glucose content of raw tubers was highly related with acrylamide in finished French fries ($R^2 = 0.64-0.77$). However, despite its role as a precursor in acrylamide formation, tuber free asparagine was not related with acrylamide, potentially because it showed relatively little variation in the NFPT population. Even when glucose was included in the model, genotype was significantly ($p = 0.001$) related with acrylamide, indicating there may be some unknown genetic loci to target for future breeding. The NFPT has demonstrated that there exist many elite US breeding lines with low acrylamide-forming potential. Our ongoing challenge is to combine this trait with complex consumer attributes that are required by the fry processing industry.

A second national effort that specifically evaluated some promising elite NFPT entries for their agronomic traits and long-term storability was conducted in replicated trials from 2013 to 2015 in ID, ME, MN, OR, WA, WI. Those entries have exhibited consistently low acrylamide-forming potential during 8 months of storage. Results have indicated that throughout the six locations, some entries (Easton, AF4296-3) consistently out-yielded others, some (Payette Russet, Dakota Russet, W8152-1rus) had specific gravity that always fell within the commercially desired range (1.080-1.095). These advanced entries also showed desired length to width ratio, suggesting good shape for frying potatoes, and low incidence of internal defect such as internal brown spots, hollow hearts, heat necrosis, etc. Fry color, sugar profiles (sucrose and glucose), and sugar end defects are monitored at 0, 16, and 32 weeks subsequent to harvest to look for entries that persist well until early June of the next year. Long term storage capability is one of the most critical traits that newly adopted frying potato varieties should possess.

Additionally, data has been collected on individual tuber specific gravity variation within a variety, an important indicator of consistency of tuber solid content and fry texture.

The NFPT and its agronomic trials are collaborated by both academia and industry that aims at solving a practical problem. On the academic side, scientist and researchers from nine universities and four USDA labs are doing active research from molecular biology to crop production level. On the industry side, the direct involvement of potato processors (JR Simplot, McCain Foods, Lamb Weston) and end users (quick service restaurants or QSR) is unprecedented and includes industry funding of variety evaluation, use of their facilities for commercial scale production runs and participation in critical consumer attribute testing. This engagement greatly changes the dynamic of the variety development process and increases the likelihood that research findings about new potato varieties will directly benefit the processing industry.