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Screening the level of cyanogenic glucosides (dhurrin) in sorghum accessions using HPLC analysis

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Abstract

Sorghum (*Sorghum bicolor* (L.) Moench.) is one of the most important crops for human and animal nutrition. Nonetheless, sorghum has a cyanogenic glucoside compound which can be degraded into hydrogen cyanide, toxic to humans and animals even with tiny amount. In consequence, breeding materials with a low cyanide level has been a top priority in sorghum breeding programs. To fulfill our long-term goal, we are screening sorghum accessions with low cyanide level, which would be an important breeding material for food safety. We collected seeds of various sorghum accessions and analyzed relevant metabolites to find useful breeding materials of sorghum accessions containing low cyanide. Fourteen wild relatives were obtained from the University of Georgia in US, a reference accession BTx623, and three local varieties from National Agrobiodiversity Center of Rural Development Administration in Korea, and one wild species from the Wild Plant Resources Seed Bank of Korea University in Korea. Sorghum plants were grown in plastic greenhouse under natural conditions. After growing, leaf samples were harvested at different developmental stages: seedling phase, vegetative phase (right before flowering), and reproductive phase (ripening). Using collected samples, quantification analysis were performed by an HPLC system for three metabolites (dhurrin, 4-hydroxybenzaldehyde, and 4-hydroxyphenylacetic acid) in sorghum plants. Prior to metabolome analysis, specific experimental condition for HPLC system was set to be able to separate three metabolites simultaneously. Under this condition, these metabolites were quantified in each accession by HPLC system. We observed that the metabolite contents were changed differently by developmental stages and accessions. We clustered these results into five groups as patterns of their contents by developmental stages. Most of accessions showed that 4-hydroxybenzaldehyde content was very high at seedling stage and decreased rapidly at vegetative phase. Interestingly, the patterns of dhurrin content were very different among clusters. However, 4-hydroxyphenylacetic acid content was maintained at low levels by developmental stages in most accessions. The results would demonstrate how dhurrin and alternative degradation pathways are differentiated in each accession.

Keywords: Sorghum, Breeding, Cyanide, Metabolome, Transcriptome

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