Public Abstract
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Title:Soybean seed trait improvements and their effects on human and animal nutrition

Soybean (Glycine max) is the number one oil and protein crop in the United States, but the seed contains several anti-nutritional factors that are undesirable to both human and livestock nutrition. Soybean seed is comprised of about 40% protein, 20% oil, and 35% carbohydrate, and modifications in these components could significantly benefit human and livestock productivity. In this research, the undesirable soybean carbohydrate raffinose, an oligosaccharide that is indigestible for monogastric animals, was reduced using RNA interference. The resulting transgenic plants were analyzed for presence and copy number of the transgene using Southern blot, efficiency of mRNA silencing with qRT-PCR, and total raffinose content with HPLC. Transgenic plant lines were recovered that exhibited dramatically reduced levels of raffinose in mature seed, and these lines were further analyzed for other phenotypes such as development and yield. This research serves as further confirmation of the contribution of the RS2 gene to the low-raffinose phenotype, and validates both the effectiveness and specificity of RNA interference, thus the technology could be applied to many other important genes in crop plants.

Additionally, a study was conducted to measure the effects of soybean seed quality traits on the consumer acceptance of soymilk. In this study, several soybean traits – high oleic, low linolenic, lipoxygenase-null, and low raffinose/high sucrose – and combinations thereof were evaluated for their impact on soymilk consumer acceptance. Six soybean varieties representing a control food-grade tofu line and five improved lines were processed into plain soymilk, assayed for nutritional qualities, and subjected to a consumer acceptability panel. Results show that soybean genotype information can accurately predict some aspects of soymilk composition. Consumers preferred soymilks with increased sucrose and low lipoxygenase, and disliked the high oleic trait. This research evaluates key soybean seed traits and their impact on soymilk acceptability in the United States, and provides a framework for future soybean seed trait improvements.

Finally, a small-scale precision-fed rooster assay was conducted to measure the true metabolizable energy in wild-type and low-raffinose full-fat soybean meal. Although there was no significant measured difference in passage rate or dry matter digestibility for the two soybean sources, the fed low-raffinose soy meal had significantly higher gross energy than wild-type. Further, the excreta from birds fed low-raffinose soy meal had less gross energy. Therefore, there is more digestible energy in low-raffinose soybean than wild-type soybean. Low-raffinose soy had a measured TME of 2797 kcal/kg, compared with 2330 kcal/kg for wild-type. As low digestible energy is a major limiting factor in the percent of soybean meal that can be used in poultry diets, these results substantiate the use of higher concentrations of low-raffinose, full-fat soy in formulated diets.