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Protein Fibers from Sorghum Distillers Grains for Value-Additions to Sorghum-Based Biofuel Industry

Abstract:

Sorghum is an ideal biomass crop in arid regions. However, low values of sorghum distillers grains (DG) substantial decreases the profitability of sorghum-based biofuel industry, leading to a 43% decline in sorghum production from 2015 to 2019. Sorghum DG are mainly used as livestock feed for less than $100/ton because of its poor digestibility and potential health risk to animals brought by dense sulfur crosslinkages in sorghum proteins. We propose to develop proteins fibers from sorghum DG. Sorghum proteins are better than other plant proteins for biobased products because their high molecular weights, dense crosslinkages and rich hydrophobic amino acids ensure the toughness and water stability of the final products. Sorghum protein fibers developed from our technology will have lower processing costs, about $0.7/kg of materials cost, and higher values, at least $7/kg, than most biobased products. Converting 70% of proteins in 1 ton of sorghum DG into fibers could create a market value of $1,470, more than 10 times of sorghum DG price. Therefore, the success of our project will substantially add values to sorghum and its DG, promote sorghum conversion to biofuel, expand cultivation of sorghum in arid regions and reduce the dependence on petro-based products. Since fiber production requires ultimate manipulation and reconstruction of macromolecules, the technology developed from this research can easily be viable for the development of other products such as films, foams and composites. The P.I. has focused on utilizing densely crosslinked proteins for decades and is the first to achieve pilot-scale production of regenerated protein fibers from highly crosslinked feather keratins. Successful development of fibers from sorghum DG promotes production of biofuel with low energy consumption, development of sustainable agriculture with less dependence on water and fertilizers, establishment of renewable energy and materials industry and expansion of economic opportunities in Nebraska.