Got cotton? Texas researchers' discovery could yield protein to feed millions

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A scientific method used to explore cancer and HIV cures now has been successfully used by agricultural researchers in the quest to develop food for the world's hungry.

"The exciting finding is that we have been able to reduce gossypol – which is a very toxic compound – from cottonseed to a level that is considered safe for consumption," said Dr. Keerti Rathore, Texas Agricultural Experiment Station plant biotechnologist. "In terms of human nutrition, it has a lot of potential." The cottonseed from these plants meet World Health Organization and U.S. Food and Drug Administration standards for food consumption, he said, potentially making the seed a new, high-protein food available to 500 million people a year.

The work, announced today (Nov. 20) in the *Proceedings of the National Academy of Sciences*, was done by Rathore and a team of scientists from the Experiment Station, Texas A&M University and the U.S. Department of Agriculture's Southern Plains Research Center in College Station.

Gossypol naturally occurs within the glands in all the above-ground parts of the cotton plant including the seed. Rathore said the "beauty of this project" is that the gossypol has been reduced only in the cottonseed -- where the high levels of protein are packed -- but not in the rest of the plant where the compound serves as a defense against insects and disease.

The team used RNAi, or technology that can "silence" a gene. This enabled them to target the gossypol gene only in the cottonseed but let the gene express itself in the rest of the plant. The discovery of RNAi is what landed the Nobel Prize for Medicine this year for U.S. scientists Andrew Z. Fire and Craig C. Mello.

"What we have done is use this technology to selectively inhibit a gene that codes for an enzyme that is involved in the gossypol biosynthetic pathway in the seed, " Rathore said.

Cotton fibers have been spun into fabric for more than 7,000 years. For most of that time, products from the fuzzy seed that is extracted in the fiber process have been edible only for cattle. They can tolerate gossypol only after digesting it through the four compartments of their stomachs.

"Very few people realize that for every pound of cotton fiber, the plant produces 1.6 pounds of seed," Rathore pointed out. "The world produces 44 million metric tons of cottonseed each year. Cottonseed typically contains about 22 percent protein, and it's a very high-quality protein."

In all, about 10 million metric tons of protein are contained in that amount of seed, he said.

Decades ago, California and Texas researchers were able to breed cotton varieties that contained no gossypol glands throughout the plant. But glandless varieties were a commercial failure, Rathore said, because the lack of any gossypol made the plants a delicious treat for insects and diseases.

Processes have been developed to extract gossypol, making the oil available for human consumption but at great expense, he said. Plus, the meal that is left after the oil is removed still contains the gossypol and thus is not edible for humans, or for pigs, chickens or turkeys.

Plants with the new trait developed by the team could make the plant more valuable both as a fiber and a food crop.

"One could utilize the cottonseed either directly as food if there is no gossypol or as feed for livestock," he said.

The food value of the cotton crop may be for countries "where there are small farmers who grow cotton, and if they could use the seed they could get much more value from it," Rathore noted.

He believes food products ultimately could be developed from the cottonseed of these new plants. Though the glandless cotton varieties bred by Experiment Station researchers in the late 1970s and 1980s suffered from insects and disease, one of the food products -- TAMUnuts -- made from the seed of these plants could be eaten by humans.

This discovery will yield not just one new variety, but rather "a new trait that can be bred into any good commercial variety, and the trait should be maintained generation after generation," Rathore said.

The researchers have been successful in maintaining the trait through three generations in lab work. The next step will be to screen for the best plants from the many lines they have produced, then grow plants with the trait in a greenhouse.Field demonstrations will follow that, he said.

He estimates at least another decade in the development of cotton varieties for widespread commercial production.

Source: Texas A&M University