

Natural gene selection can produce orange corn rich in provitamin A for Africa, US

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Orange corn, which is naturally high in provitamin A carotenoids, could help combat vitamin A deficiency in developing countries, a condition that causes blindness in 250,000 to 500,000 children every year, half of whom die within a year of losing their sight. Credit: Purdue University / Natalie van Hoose

Purdue researchers have identified a set of genes that can be used to naturally boost the provitamin A content of corn kernels, a finding that

could help combat vitamin A deficiency in developing countries and macular degeneration in the elderly.

Professor of agronomy Torbert Rocheford and fellow researchers found gene variations that can be selected to change nutritionally poor white [corn](#) into biofortified orange corn with high levels of provitamin A carotenoids - substances that the human body can convert into vitamin A. Vitamin A plays key roles in eye health and the immune system, as well as in the synthesis of certain hormones.

"This study gives us the genetic blueprint to quickly and cost-effectively convert white or yellow corn to orange corn that is rich in carotenoids - and we can do so using natural plant breeding methods, not transgenics," said Rocheford, the Patterson Endowed Chair of Translational Genomics for Crop Improvement.

Vitamin A deficiency causes blindness in 250,000 to 500,000 children every year, half of whom die within a year of losing their eyesight, according to the World Health Organization. The problem most severely affects children in Sub-Saharan Africa, an area in which white corn, which has minimal amounts of provitamin A carotenoids, is a dietary mainstay.

Insufficient carotenoids may also contribute to macular degeneration in the elderly, a leading cause of blindness in older populations in Europe and the U.S.

Identifying the [genes](#) that determine carotenoid levels in [corn kernels](#) will help plant breeders develop novel biofortified corn varieties for Africa and the U.S. The dark orange color of these corn varieties also makes them more culturally acceptable to consumers in African countries where yellow corn is generally fed only to animals, Rocheford said.

Previous research by Rocheford and his colleagues identified two genes that contribute to provitamin A carotenoid levels in corn kernels, but "we wanted more cookies in the jar for breeders to pick from," he said.

The researchers used a combination of statistical analysis and prediction models to identify and assess the potential usefulness of genes associated with carotenoid levels in corn. They evaluated data sets from about 200 genetically diverse lines of corn at varying scopes of investigation - from the entire corn genome to stretches of DNA surrounding small sets of genes. They uncovered four genes that had not previously been linked to carotenoid levels in corn kernels.

Though many genes likely contribute to carotenoid levels in corn, "we're pretty confident that our previous and current research has now identified several genes that are the major players," Rocheford said.

Their study found that a combination of visually selecting corn with darker orange kernels and using a number of these favorable genes could be an effective way to rapidly convert white and yellow corn varieties to orange corn with higher levels of provitamin A and total carotenoids.

"We now have the genetic information needed to begin developing a major public-private sector collaboration with the goal of providing orange corn with high levels of provitamin A to farmers throughout Sub-Saharan Africa," he said.

The study also showed that using a more targeted approach to predicting the usefulness of a small set of genes was as effective as evaluating the whole [corn genome](#), said Brenda Owens, doctoral candidate and first author of the study.

"Having this smaller list of genes to select for means that we can make the improvement of carotenoid levels in corn a simpler, faster process

for plant breeders," she said.

Their research - in collaboration with HarvestPlus and the International Maize and Wheat Improvement Center, also known as CIMMYT - has yielded varieties of orange corn with markedly higher amounts of provitamin A carotenoids. But further efforts to produce even higher levels will be necessary to offset degradation of nutrients after harvest and reduce the amount of corn African consumers would need to eat to attain enough provitamin A, Rocheford said.

Varieties of orange corn are currently being grown in Zambia, Zimbabwe, Nigeria and Ghana. An open-pollinated variety of orange corn could be available for organic and local grower operations in the U.S. by 2016, he said.

More information: *Genetics*, [www.genetics.org/content/early ... 169979.full.pdf+html](http://www.genetics.org/content/early/2014/10/06/genetics.169979.full.pdf+html)

Provided by Purdue University

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