Researchers genetically alter wheat to make it nearly free of gluten

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Credit: Wikipedia.

(Phys.org)—An international team of researchers has succeeded in genetically altering wheat seeds to prevent the production of gluten in subsequent plants. The effort focused, the team writes in their paper published in the *Proceedings of the National Academy of Sciences*, on disabling the enzyme responsible for activating genes responsible for the development of gluten protein.

The research team is part of an effort by many groups to solve the problem of celiac disease, which is an autoimmune disorder triggered by gluten. The current treatment for patients with the disorder is to instruct them to avoid foods with gluten in it. The problem with that approach of course is that it leads to a difficult to maintain, severely restricted diet.

Recent research has centered around trying to isolate certain types of grains that don't produce gluten and switching over to them. That effort has run into trouble however as thus far none have been found that are safe for celiac patients. Another approach has been to try to develop a substance that could be added to the diet to aid in the digestion of gluten. But such efforts on that front have failed as well. This latest research has taken a different approach: altering current grains to cause them to not produce gluten in the first place.

To alter samples of wheat seeds, the researchers focused on the enzyme DEMETER which is responsible for activating a group of genes that result in the production of gluten. Using several genetic engineering techniques they managed to suppress the DENMETER enzyme by 85.6 percent which resulted in a 76.4 percent reduction of gluten in the seeds that were produced.

The researchers acknowledge that more work lies ahead to reach the ultimate goal of removing gluten from the wheat seeds altogether, but they say their results so far have given them confidence that they will be able to soon meet their objective. They also note that flour made with the seeds they've altered thus far appears to still be suitable for making bread. They also add that even as their attempts move forward to remove gluten altogether from grains, other research will commence to determine if such grains will allow for use in foods by those that suffer from celiac disease, with tests being conducted on mice and gluten sensitive apes.

More information: Structural genes of wheat and barley 5-methylcytosine DNA glycosylases and their potential applications for human health, *PNAS*, Published online before print November 26, 2012, doi: 10.1073/pnas.1217927109

Abstract

Wheat supplies about 20% of the total food calories consumed worldwide and is a national staple in many countries. Besides being a key source of plant proteins, it is also a major cause of many diet-induced health issues, especially celiac disease. The only effective treatment for this disease is a total gluten-free diet. The present report describes an effort to develop a natural dietary therapy for this disorder by transcriptional suppression of wheat DEMETER (DME) homeologs using RNA interference. DME encodes a 5-methylcytosine DNA glycosylase responsible for transcriptional derepression of gliadins and low-molecular-weight glutenins (LMWgs) by active demethylation of their promoters in the wheat endosperm. Previous research has demonstrated these proteins to be the major source of immunogenic epitopes. In this research, barley and wheat DME genes were cloned and localized on the syntenous chromosomes. Nucleotide diversity among DME homeologs was studied and used for their virtual transcript profiling. Functional conservation of DME enzyme was confirmed by comparing the motif and domain structure within and across the plant kingdom. Presence and absence of CpG islands in prolamin gene sequences was studied as a hallmark of hypo- and hypermethylation, respectively. Finally the epigenetic influence of DME silencing on accumulation of LMWgs and gliadins was studied using 20 transformants expressing hairpin RNA in their endosperm. These transformants showed up to 85.6% suppression in DME transcript abundance and up to 76.4% reduction in the amount of immunogenic prolamins, demonstrating the possibility of developing wheat varieties compatible for the celiac patients.