

# Scientists find gene that stops rice from breaking

**D.P. Kasbekar**

Rice is the staple food for over half of the world's population. Before a rice grain can be made edible, the outermost layer of husk covering it has to be removed. Mechanical rollers abrade the layers in a process called milling and some of the rice grains break as a result.

The breakage increases if the grains have a trait called chalkiness. Rice is said to be chalky if after milling a large fraction of grains have extensive parts that are opaque rather than translucent. (This difference disappears during cooking, however.)

Chalkiness is measured by the chalky grain rate, the proportion of chalky grains among all rice grains, and the degree of chalkiness.

The trait is influenced by many genes and by environmental factors, like high temperature. Thus

scientists have long struggled to find ways to reduce chalkiness. Recently, a breakthrough came in the work of a team from the Agricultural College of Yangzhou University in China. The researchers identified a gene they named *Chalk9*, which they found controls the chalkiness in many rice varieties. Their findings were reported in July.

## Encoding a protein

The researchers sequenced the genome of 175 rice varieties and identified a small stretch of DNA on chromosome 9 whose presence or absence correlated significantly with the variety's chalkiness. Less chalky varieties contained the segment and showed higher expression of *Chalk9* in endosperms compared to high-chalkiness varieties.

The endosperm is the part of paddy grain that makes up the bulk of the



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milled rice.

The DNA segment the team found contained sites that are recognised and bound by proteins called transcription factors. One of them, called OsB3, was highly expressed in the endosperm. When OsB3

bound to the DNA, it activated the expression of the *Chalk9* gene. The OsB3 protein failed to trigger this expression in varieties from which the segment was absent.

Based on the *Chalk9* gene's DNA sequence, the

researchers predicted it encoded a protein belonging to a class of enzymes called E3 ubiquitin ligases.

## Making, storing starch

The researchers wanted to find out what makes some rice grains chalky. First, they found that the *Chalk9* protein attached tags to another protein called OsEBP89. Tagging OsEBP89 caused it to become destroyed by the cell. This mattered because OsEBP89 was like a power switch. It turned on two kinds of important genes. One, called *Wx*, helped the rice grain make amylose, a starchy molecule built from sugar. The other kind, *SSP* genes, made proteins to store starch in the rice grain.

If OsEBP89 was missing, those genes didn't turn on much and the rice grains ended up being less chalky. But if there was too much OsEBP89, the genes switched on too much and

the rice became chalkier. When the scientists put the OsEBP89 protein in a lab mix with all the tagging machinery, the OsEBP89 got tagged and destroyed. But if the *Chalk9* gene was modified just a little, the OsEBP89 protein escaped tagging.

The researchers surveyed 127 rice varieties and found that the frequency of the *Chalk9* gene's low chalkiness version, *Chalk9-L*, was relatively low prior to 1990, but increased significantly thereafter. Before 1990, most rice varieties carried *Chalk9-H*, the high chalkiness version. Rice breeding programs had unwittingly selected for *Chalk9-L* to reduce chalkiness and improve grain quality.

Now, breeders can achieve this goal in a single step by introducing *Chalk9-L* into rice varieties from which it is absent. (D.P. Kasbekar is a retired scientist)