

If you stare at the word “nixtamalized” long enough, you can almost see the word “tamale.” That’s so apropos because many Mexican and Central American corn products—tamales, masa flour, and tortillas—are made by a high-temperature, alkaline cooking procedure called nixtamalization.

In some developing countries, corn is of a lower quality than in the United States, and that presents an emerging health concern for residents of Central America and Mexico, where corn is a major dietary staple.

Low-quality corn may contain high levels of fumonisins, pronounced *few-MON-i-sins*. These toxins are produced by the fungus *Fusarium verticillioides* (synonym *F. moniliforme*). Although no definite harm to human health from fumonisins has been determined, they cause sickness in horses and pigs and cancer in laboratory rats.

Before assessing the risk of fumonisins in corn products made in Guatemala, pharmacologist Ronald T. Riley, who is in the ARS Toxicology and Mycotoxin Research Unit, Athens, Georgia, surveyed the dietary habits of residents in two rural villages in that country’s Central Highlands: Patzicia and Santa Maria de Jesus. He discovered that men ate, on average, more than a pound of corn tortillas daily, and women consumed about 14 ounces. By comparison, a survey of North American adults revealed daily tortilla consumption of 0.12 ounces per day.

In 1995, Riley and ARS chemist Filmore I. Meredith began investigating corn-processing methods in Guatemala. The study was a collaborative effort of ARS, Emory University, and the Instituto de Nutrición de Centro América y Panamá (INCAP). Current studies are supported by USDA’s Foreign Agricultural Service, the Agricultural Research Service, and the International



## Cooking Process Reduces Toxin in Corn

RONALD RILEY (K9554-17)

**A Guatemalan woman shells corn for tortillas. Corn products in her country are sometimes made from low-quality corn that is high in fumonisins, compounds known to cause sickness and cancer in animals.**

Life Sciences Institute of North America. When Riley’s study was begun, INCAP researchers didn’t have the ability to analyze corn for fumonisins. Now, with USDA assistance, INCAP researchers will develop those skills.

In Guatemala, corn is harvested, dried, and graded as being clean, spoiled, or rotten based on the amount of fungal and insect damage. Then it’s bagged for storage. Kernels are removed from the cob and mixed in a ratio of one-third clean, one-third spoiled, and one-third rotten. This mix is added to near-boiling water treated with lime. When the corn is soft enough, the liquid is poured off and the remaining material is a hominy-like slurry that is called nixtamal. The nixtamal is then rinsed with water—if it is available.

“How much they rinse is critical because water washes out some of the toxins,” says Riley. At the time of the study, water supply in Santa Maria de Jesus was erratic, making the washing process difficult.

“We found that nixtamal from Santa Maria de Jesus had higher levels of fumo-

nisin B<sub>1</sub> than nixtamal in Patzicia,” he says.

Nixtamal from Santa Maria de Jesus contained an average of 14 parts per million of hydrolyzed fumonisin B<sub>1</sub>, a chemically converted product of fumonisin B. There was a much higher level of hydrolyzed fumonisin B<sub>1</sub> in the cooked tortillas from Santa Maria de Jesus (26 parts per million) than in tortillas made in Patzicia (6 parts per million).

“These high levels of fumonisins in the tortillas indicate that the quality of the corn used was very low,” says Riley. More rinsing may have further reduced the toxin content of the tortillas. “It’s also possible that the more affluent community

of Patzicia used higher quality corn for preparing tortillas,” he says.

### In the United States

In related research, ARS chemist Mary Ann Dombrink-Kurtzman in Peoria, Illinois, and ARS pharmacologist Kenneth A. Voss in Athens, Georgia, are also studying nixtamalization. Dombrink-Kurtzman conducted one of the first analytical studies of fumonisins during all phases of nixtamalization. This analysis is important because the population of immigrant citizens of Central and South America is growing in the United States and so is interest in their foods, she says.

“Though U.S. corn destined for human consumption normally contains low levels of fumonisins, drought stress in some years can raise the levels,” says Dombrink-Kurtzman. She works at the National Center for Agricultural Utilization Research, where she investigated the fate of fumonisins during the production of masa and tortillas. She first searched the United States for normal-appearing contaminated corn—a search that took almost a year. The processing was performed

in collaboration with Lloyd W. Rooney, a professor at Texas A&M University in College Station, Texas.

After examining samples from laboratory-made tortillas, Dombrink-Kurtzman found that “nixtamalizing corn to make tortillas reduces the level of fumonisins in raw corn by nearly 80 percent.”

Over the last 3 years, the corn milling industry has voluntarily screened about 2,000 cornmeal samples. “Based on their data of low fumonisin levels and combined with the fact that nixtamalizing further reduces

KEITH WELLER (K9555-10)



Many corn products such as tortillas and tortilla chips are made using a cooking process called nixtamalization, which can reduce fumonisin levels in raw corn by nearly 80 percent.

fumonisins, U.S. corn tortillas might be expected to contain between 0.02 and 0.2 parts per million,” Dombrink-Kurtzman says.

According to Voss, who works at the Russell Research Center in Athens, Georgia, “We found similar reductions in fumonisins in fried tortilla chips prepared on a pilot production line.” The work was part of a research agreement between ARS and Frito Lay, Inc.—By **Sharon Durham** and **Linda McGraw**, ARS.

*This research is part of Food Safety, an ARS National Program (#108) described on the World Wide Web at <http://www.nps.ars.usda.gov>.*

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Chemist Mary Ann Dombrink-Kurtzman examines corn that has been cooked in a solution of water and lime, the first step in nixtamalization.



RONALD RILEY (K9554-18)

**In the Central Highlands of Guatemala, corn is graded as clean, spoiled, or rotten, then combined before it is made into tortillas. This ear was rated rotten.**