



# Nixtamalization as a Method to Reduce Aflatoxin and Increase Available Nutrients in Maize

Molly Carroll, Natalia Palacios Rojas, Aide Liliana Molina Macedo



## Aflatoxin

- The most common strains are *Aspergillus flavus* and *Aspergillus parasiticus* which produce four aflatoxin types, B<sub>1</sub>, B<sub>2</sub>, G<sub>1</sub>, and G<sub>2</sub> that are distinguished by the blue or green fluorescence under UV light. These strains of aflatoxin are the most potent natural carcinogen. B<sub>1</sub> produced by *A. flavus* will be referred to as "aflatoxin" as it is the only strain present in the data.



Corn glowing from presence of Aflatoxin



Corn contaminated by Aflatoxin

- Secondary metabolites, found in soil and organic matter, produced by microfungi that have very detrimental effects on human and animal health.
- Aflatoxin contamination is largely inevitable in crop production, especially in drought conditions and intermediate temperatures, and not easily eliminated during food processing. Aflatoxins are very resistant to heat, chemical and physical treatments, and other widely used food processing methods.

## Nixtamalization

A traditional processing method for maize to increase nutritional value, possibly decrease aflatoxin levels, and prepare maize for various food products.



### Nixtamalization:

- Decreases the risk of Pellagra disease by increasing niacin bioavailability
  - Increases calcium levels from absorption of calcium hydroxide solution
  - Increases resistant starch which supplies dietary fiber
  - Decreases aflatoxin levels
  - Lengthens the shelf life of food products
- This process yields a dough called masa which is used in over 300 food products in Mexico, the most recognized being tortillas.

## Methods

### Chemical Analysis

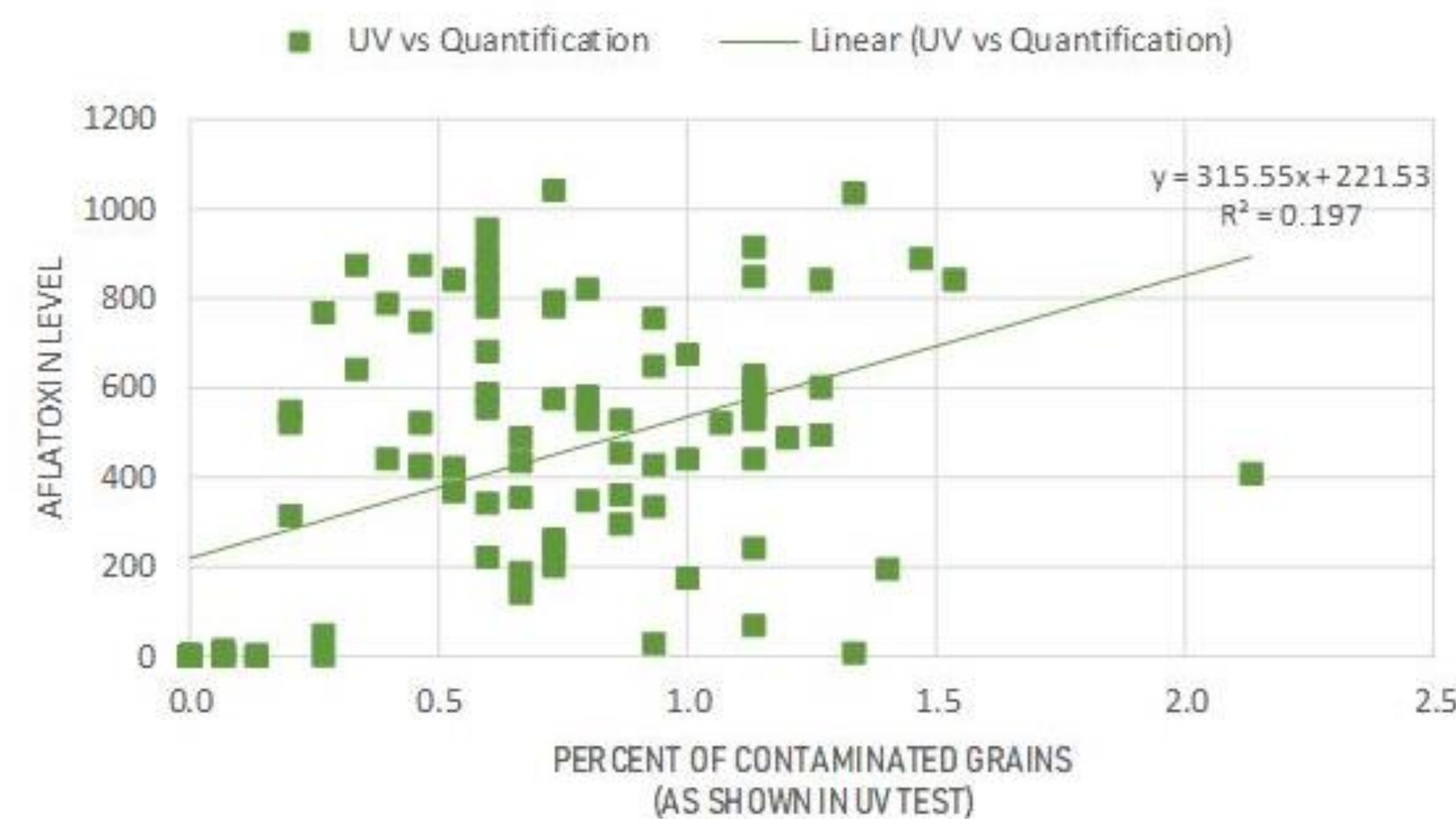
- A chemical analysis was performed to quantify aflatoxin levels in the maize grain samples after an initial UV light test.
- The analysis was performed using AccuScan™ equipment on initial grain samples and again after nixtamalization to test and identify how aflatoxin levels were affected in a sample.

### Nixtamalization

- After an initial chemical analysis of aflatoxin levels in the grain, the samples were nixtamalized at two different concentrations of lime (calcium hydroxide): 1% and 1.5%
- The traditional nixtamalization process was performed (cooking, steeping, washing, and wet-milling) to create masa dough
- Using the masa, tortillas were made using the traditional process
- Chemical analysis was performed on the nixtamal, nejayote, masa, and tortillas for each concentration of lime and compared to initial grain aflatoxin levels.

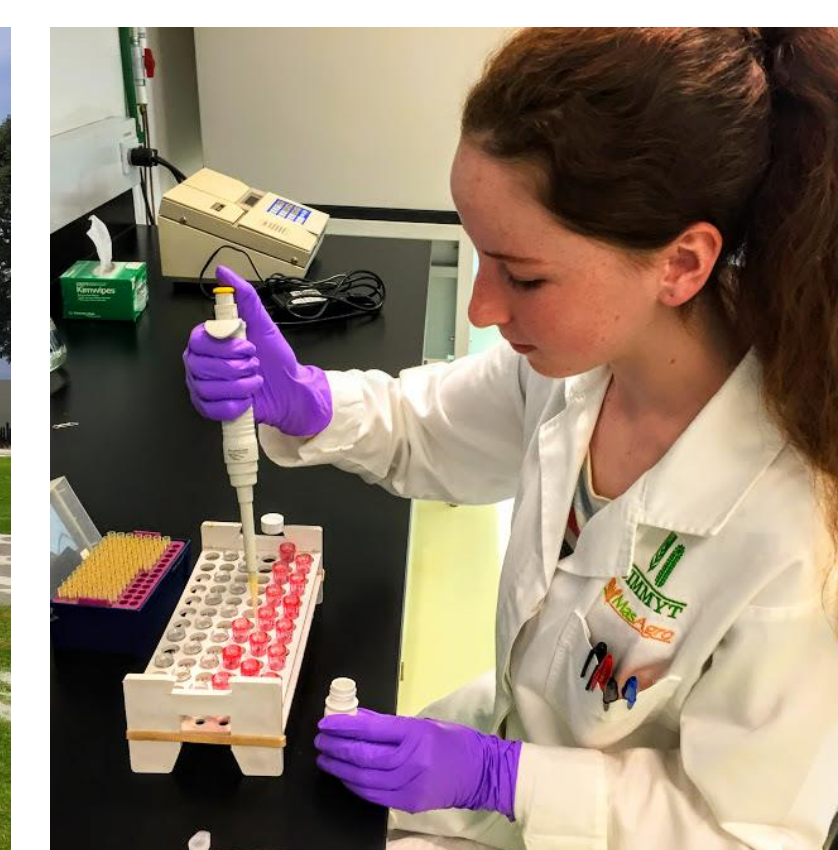
## Results

### UV VS AFLATOXIN QUANTIFICATION

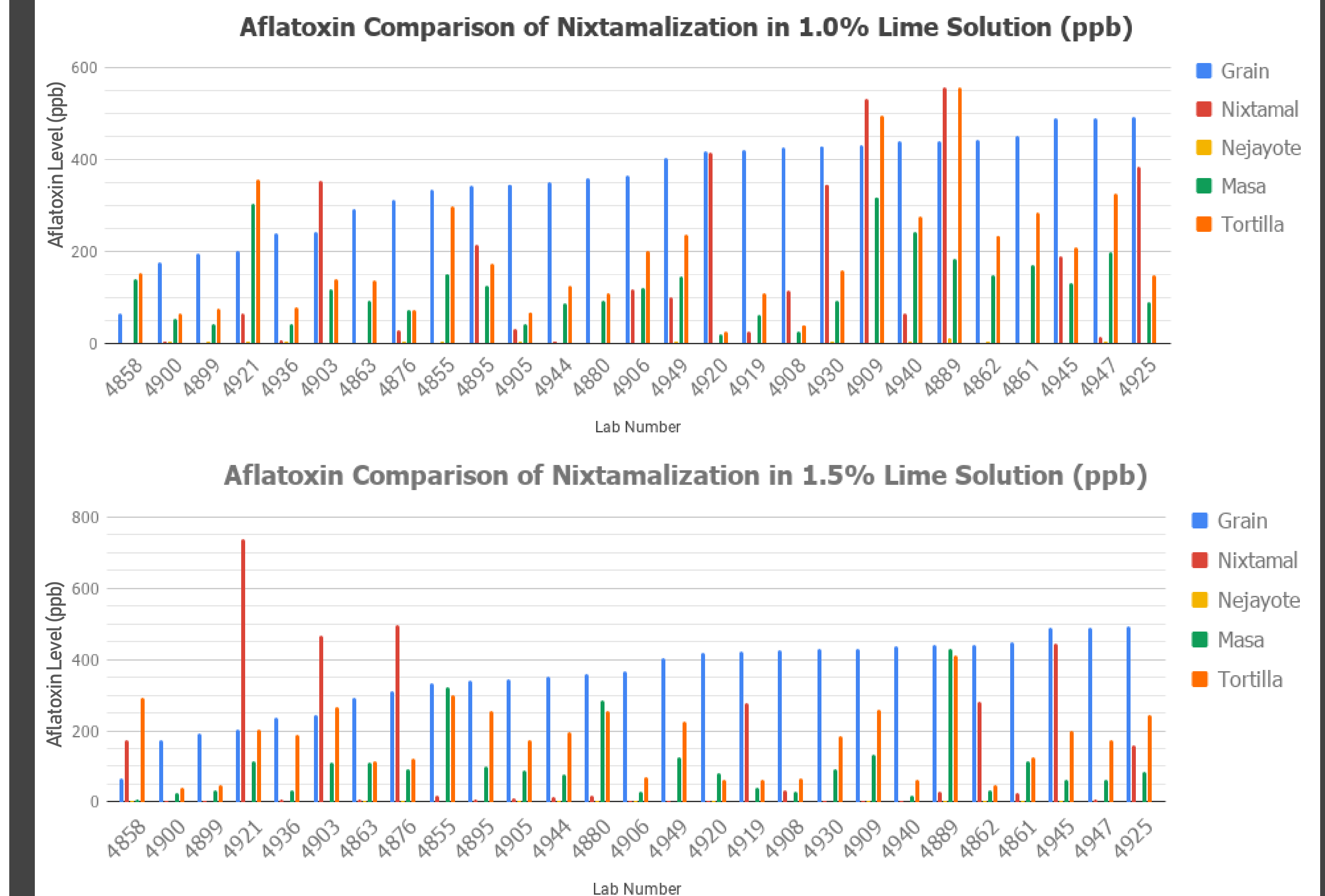


This figure compares percent of average grains contaminated in the initial UV light test to aflatoxin quantification values using chemical analysis.

While in Mexico I had the opportunity to travel to historic sites and Mexico City. I climbed the Pyramids of Teotihuacan, explored the historic center of Mexico City, experienced traditional culture and food, and expanded my world view. This experience taught me valuable lessons in and out of the lab.



## The Effect of Nixtamalization on Aflatoxin Levels in Maize



## Discussion and Conclusions

- The UV light test predicted an accurate trend in aflatoxin results when compared to the quantification of aflatoxin. The grains with similar % contaminated UV results had similar aflatoxin levels.
- Nixtamalization overall reduced the aflatoxin levels in maize grain samples
- 1.5% lime concentration had a higher rate of aflatoxin reduction in all stages of nixtamalization when compared to 1% lime concentration.
- Nixtamalization is a practical application to reduce aflatoxin in maize at both household and industry settings to provide a safer and more nutritionally rich staple food

## Importance

- Maize is an excellent source of proteins (10% of grain), starch (72%), lipids (4%), and other micro- and macronutrients, but the nutritional quality can be significantly reduced with the presence of aflatoxin
- Maize is the major food source for 1/3 of the world's population, including many undeveloped and developed nations.
- The versatility and ease of maize and its derived products makes it a go-to for many families in low-income areas, especially where food insecurity is present
- There are 600+ maize-based food products in Mexico, 300 from nixtamalization outputs
- Determining how to make maize an even more nutritious and sustainable food source could have many applications for creating solutions to global food insecurity.

## Acknowledgements

I would like to thank the World Food Prize Foundation and Ambassador Kenneth M. Quinn for funding and providing me this opportunity to expand my worldview and have a direct hand in creating solutions for the global hunger crisis. I would also like to thank CIMMYT for allowing me to participate in research at their facilities. Specifically, I would like to extend my greatest gratitude to Natalia Palacios Rojas for guiding me in my research and Aide Liliana Molina Macedo for assisting me in conducting the research. I am very appreciative to all those that helped me in this incredible experience.